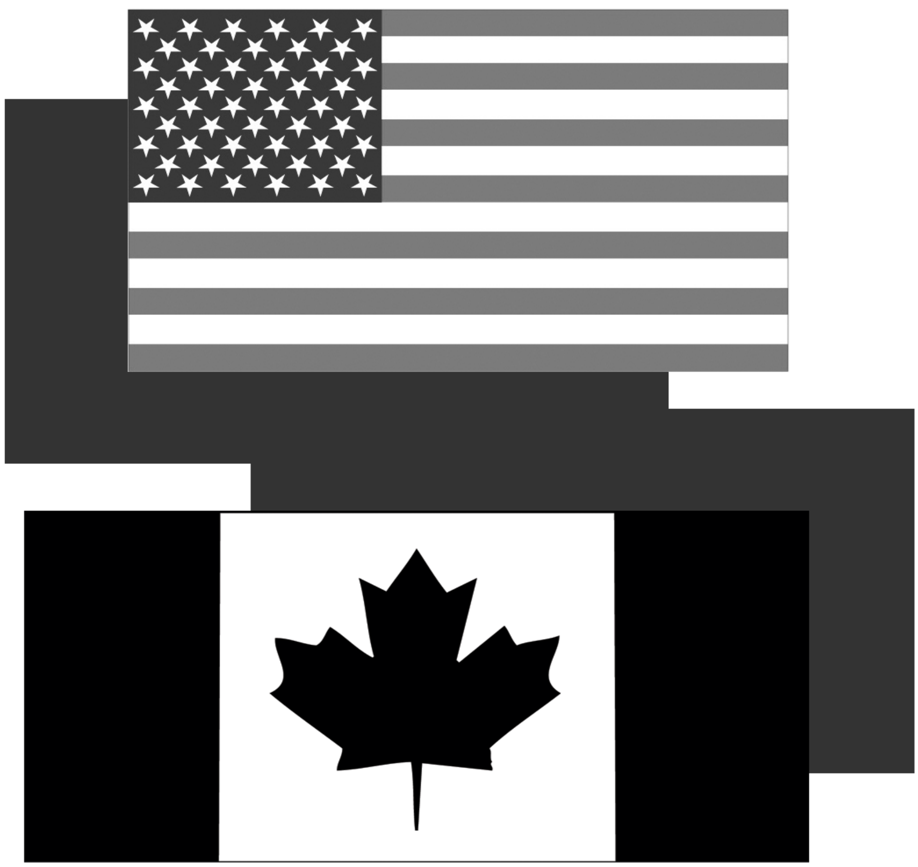
Report of the Technical Subcommittee of the Canada-United States Groundfish Committee

52nd Annual Meeting of the TSC
May 3-4, 2011
Astoria, Oregon



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

Compiled by the Pacific States Marine Fisheries Commission

History of TSC Meeting Locations, Hosts and Chairpersons

YEAR	DATES	LOCATION	HOST	CHAIR
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
2010	May 5-6	Nanaimo, BC	Stanley	Clausen
2011	May 3-4	Astoria, OR	Phillips	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 3-4, 2011 in Astoria, Oregon. This year's meeting was hosted by the Pacific States Marine Fish Commission (list of attendees is attached). The meeting was chaired by Dave Clausen, AFSC Auke Bay Lab. As is done each year at the meeting, participants review previous year (2010) research achievements and projected current year (2011) research for each agency. Each agency also submits a written report summarizing groundfish accomplishments for the previous year.

The TSC again noted the valuable ongoing work of the **Committee of Age Reading Experts** (**CARE**) (http://care.psmfc.org/), a long-standing TSC Working Group that was originally created by the TSC in 1982. The purpose of CARE is to facilitate among agencies the standardization of groundfish age determination criteria and techniques. Josie Thompson (Oregon Department of Fish and Wildlife, representing CARE) reported on CARE activities in 2010 and on the recent (April 2011) biennial CARE workshop in Seattle. Major topics at the workshop included 1) digital imaging tools and procedures as a important aid for ageing; 2) a mini-workshop of the Sablefish Age Readers Ad hoc Working Group in which a 2009-2010 exchange of known-age sablefish otoliths among agencies was discussed which indicated a general tendency to under-age sablefish; 3) whether CARE was straying from its original mandate by placing too much emphasis on new technology. The conclusion among workshop participants was that this was not the case; and 4) long-term storage of otoliths and other age structures for archival purposes, and what is the most appropriate way to store these, continued to be a topic of concern.

Mark Wilkins (NMFS Alaska Fisheries Science Center) reported on the TSC's Trawl Survey Working Group, which has been meeting on a mostly annual basis since 2002. Previously, this working group was very informal and only included representatives from Canada DFO and the NMFS Alaska Fisheries Science Center (AFSC) and NMFS Northwest Fisheries Science Center. In 2010, the TSC recommended that the working group hold an expanded meeting by inviting participants from Pacific coast state agencies as well as researchers using fixed gear methods to survey groundfish. The expanded workshop was entitled "**The Trawl and Setline Survey Workshop**" and was held at the AFSC in Seattle on March 22-24, 2011. Nearly 60 participants attended the workshop, and a few even came from agencies on the U.S. East coast. The workshop's purpose was to provide an opportunity for scientists from various agencies that conduct groundfish surveys to share their insights and to discuss methodologies and problems. From all reports, the workshop was a success, and it represents a major accomplishment of the TSC. Hopefully it will lead to further survey workshops in the future. For workshop presentations and other products, go to http://www.psmfc.org/tsc2/Trawl_and_Setline_Survey_Workshop_2011.html.

The TSC made one substantive new recommendation at the 2011 meeting: that a workshop be held among agencies to **determine the best methods for reconstructing historical commercial catches.** This is in response to a request from the Scientific and Statistical Committee of the Pacific Fishery Management Council that Washington, Oregon, and California should reconstruct groundfish catch histories as far back as possible. Canada has also recently undertaken catch reconstructions for some rockfish species and reconstructions are planned for all groundfish species in British Columbia, so a workshop under TSC auspices would be especially timely. The TSC noted that each agency is presently doing the reconstructions independently, and it recommended a workshop be convened to discuss, compare, and develop best practices of reconstructing species-specific catches from grouped-species landing data. The goal of the workshop would be to produce consistent methods among agencies.

Other important topics discussed at the meeting included: 1) problems several agencies face with declining budgets, which for some agencies has resulted in a reduction of staff; 2) marine protected areas have been a major topic at recent TSC meetings and they were discussed again this year, especially regarding the effects that marine reserves may have on existing groundfish surveys. For example, a couple of agencies have had to drop survey stations because they were located in no-take reserves; and 3) the increasing importance of ecosystem studies and how they can be used in groundfish stock assessments. It was suggested that "Ecosystem Studies" be added as an agenda item for next year's TSC meeting and that annual agency reports for the TSC should include a section on this topic.

Mark Wilkins, who will be retiring from NOAA in Summer 2011, was presented an award for 30 years of outstanding service to the TSC.

The **53nd Annual Meeting of TSC** is scheduled for May 1-2, 2012 in California, although the exact location has not been determine

C. Minutes of the Technical Subcommittee

Minutes of the 52nd Annual Meeting of the TSC
Cannery Pier Hotel, Astoria, Oregon
May 3-4, 2011

Tuesday, May 3

I. Call to Order – Chairman Dave Clausen called the meeting to order at 9:05 am, May 3, 2011.

II. Appointment of Secretary – Mark Wilkins (NMFS AFSC) volunteered to record and compile minutes of the meeting.

III. Introductions – Participants were greeted by Stephen Phillips, PSMFC Portland, on behalf of citizens of the great state of Oregon. Susan Hilber, representing ODFW, is attending the meeting for the first time and unaccustomed to the meeting protocols. Consequently, Stephen undertook the duty of hosting the meeting. Chairman Clausen also greeted the participants, explaining that he was continuing his extended chairmanship of the TSC, again because of the change in representation within ODFW.

Reports for the current meeting from the following agencies were available prior to the meeting on the TSC Working Draft page: NMFS AFSC, NMFS NWFSC, NMFS SWFSC, DFO Canada, WDFW, ODFW, ADFG, and IPHC. The CARE provided a report of their activities, including a summary of their recent biennial workshop in Seattle. Hard copies of reports from AFSC, DFO, WDFW, and CARE were provided at the meeting. Mark Wilkins also provided a report from the Trawl Survey Working Group on the Trawl and Setline Survey Workshop held March 22-24, 2011, in Seattle.

List of Participants

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ODFW		
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(also representing CARE)		

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IPHC		
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IV. Approval of the 2010 Report – The 2010 report was finalized and published through the diligent efforts of Rick Stanley, host of the 2010 meeting and compiler of the minutes of that meeting, and Stephen Phillips. The report was approved and the participants commended Rick & Stephen for getting this done expediently. A short discussion ensued regarding clarification of the appropriate reporting period for agency reports, the makeup and organization of the Parent Committee, and the relationship between the TSC and the Parent Committee. This helped to educate the newer agency representatives regarding the workings of this body.

V. Approval of the 2011 Agenda – Minor changes were made to the agenda and it was approved. The final Agenda is included as Appendix 1.

VI. Working Group Reports

A. Committee of Age Reading Experts (CARE)

Josie Thompson (ODFW representative to CARE) presented highlights from the CARE report (included as Appendix 2) covering the group's activities during the 2010 calendar year, as well as an executive summary of CARE's biennial workshop held recently (April 2011) at AFSC in Seattle. The report documents the activities and accomplishments of the Manual/Glossary, Website, and Charter subcommittees. Age structure exchanges and efforts to complete the summary information available from exchanges are described. The status of pending recommendations from CARE (either to itself or to TSC) and to CARE (from itself or TSC) are summarized.

The executive summary of the recent workshop contains activity summaries of the three aforementioned subcommittees, as well as a summary of activities and accomplishments of a Sablefish Age Readers Ad Hoc Working Group. Other highlights of the 2011 workshop included demonstrations of the group's web forum, digital imaging, micro-milling, and staining elasmobranch vertebrae. Six participants presented their recent research. Major topics of discussion included whether CARE was straying from their mandated activities by focusing on website design and other technology issues, the usefulness of the CARE Forum for facilitating communication among members, and digital imaging tools and procedures (software, hardware, and protocols).

Status of and progress on pending recommendations were reviewed and CARE made 5 new recommendations to itself. Notable among those was for each agency to review otolith storage methods they use and bring that information to the 2013 workshop for a discussion. The discussion would be aimed at answering whether long-term storage in glycerine is a problem or if dry storage should be recommended for all species. CARE provided an initial response to TSC's 2010 recommendation for examining the feasibility of preparing an online summary of the material that is archived by each of the west coast groundfish research agencies. This recommendation apparently prompted a lively discussion regarding the scale of work that publicizing holdings (and the potential for numerous requests) would entail. CARE requested clarification of TSC's concept of what data such an inventory should contain prior to consulting with their respective agencies.

Some brief discussion followed at this point. Theresa pointed out that PacFIN reports include age structures collected from commercial catches, but not ones collected from surveys or research. IPHC and CDFG provide request forms for using age structures. Josie explained that, while several CARE participants expressed reluctance, many acknowledged the benefits of making this information available. Several strategies were discussed about how to most efficiently compile the information requested, such as annual updates from agencies to the CARE website or linking existing tables to the website.

TSC made note to respond to CARE's request later in the meeting when considering *Progress on 2010 Recommendations*. An additional point was brought up regarding the difficulty of navigating to the CARE and TSC websites from the main PSMFC home page. Stephen explained that the PSMFC site was being redesigned and this problem would be addressed. He encouraged each agency to add links to CARE and TSC to their own home pages.

B. Trawl Survey Working Group

Mark Wilkins presented a report of the Trawl and Setline Survey Workshop held in March at the AFSC in Seattle (included as Appendix 3). Based on comments received since, the workshop was successful and appreciated.

Related to a discussion at the Workshop about how we can afford to keep conducting surveys, Traci suggested that less frequent surveys would sacrifice fewer animals, creating both financial and biological savings. Tom, who assesses Alaskan groundfish stocks, explained that less frequent surveys reduced the certainty of abundance estimates, necessitating more conservative management advice and the consequent loss of economic opportunity to the industry. Aimee also replied that less frequent surveys lead to complications analyzing the data.

Kristen suggested that the next time that a similar survey workshop is scheduled that more emphasis might be focused on longline/setline surveys. The consensus at the workshop in March was that the expanded workshop should be repeated periodically, but probably not annually.

The discussion tied into the Non-Lethal Sampling Symposium that Theresa is organizing for the upcoming AFS meeting in Seattle in September. Theresa reported that twelve presentations and two posters are scheduled for the Symposium with participation from the Atlantic coast as well as the Pacific coast. The main topics will include whether such surveys are a feasible and effective tool, methodologies in use or being developed, and how the surveys might be used for stock assessments. Many present were excited about the value of such a meeting.

C. Yelloweye Rockfish Working Group

Lynne reported that the working group had undertaken no activities nor made any major progress in the past year. However, this working group agenda item is a placeholder to assure continued attention upon and discussion about this resource. We reviewed the history of the working group, which was originally convened a few years ago to dredge up any available data for a stock assessment. Traci reported that CDFG has been trying to conduct an ROV survey for several years but has been unable to fund it. A few otoliths are received from recreational landings, despite the prohibition of keeping yelloweyes. Theresa reported that the additional sampling stations off Washington that have been done during IPHC surveys has been de-funded and discontinued. However, on IPHC surveys in WA and OR, all rockfish are retained and tagged, recording station and skate of capture, and state biologists meet the vessel during the offload to collect additional biological data from the tagged fish. John Wallace (NWFSC) will be revising the PFMC yelloweye rockfish assessment this year. Lynne mentioned that a revised assessment of yelloweye in inside waters is due and that the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is considering listing this species. Kristen reported that ADFG has not been conducting their surveys because the submersible has not been available; their most recent survey was in 2009. They are exploring options of using a different submersible (one is under construction) or using an ROV to conduct a survey next year. They would like to conduct simultaneous submersible and ROV surveys for comparison. Lynne asked how ADFG uses these surveys to assess stocks and Kristen explained that the most recent density estimates by area are combined with IPHC setline survey data in an age structured assessment model developed by Dave Carlile. Heather reported that during IPHC surveys in SE Alaska and Fairweather Grounds, all yelloweye rockfish caught are counted and those data are given to ADFG.

D. Pacific Whiting (Hake) Working Group

The treaty between the U.S. and Canada concerning whiting assessment and management (included as Appendix 4) has been signed. As TSC had hoped, assessments by both nations are being used for the stock and a joint assessment working group has been established. We recommended that the TSC working group be dissolved.

VII. Other Topics

A. Marine Reserves

ODFW: Susan gave a good overview of numerous activities and developments in Oregon in 2010. Candidate areas for reserves to protect rockfishes were identified, and some were embraced enthusiastically and others considerably less so. Some proposed areas were accepted but actions on closing these reserves have been postponed for six months in order to collect more baseline data. Diving transects to determine fish abundance will be done before reserves get established. Oregon's biennial budget is unsettled, creating uncertainty for the program.

There was some discussion regarding conflicts between reserves and survey activities. Aimee asked whether NWFSC trawl surveys would still be able to sample within Oregon's marine reserves. Susan and Josie replied that all reserves are within state waters, so they are relatively shallow. They reported doing some ROV work in some of the reserves. We discussed what is known about the role of reserves as refugia to support vulnerable stocks such as rockfish. This ties in with work that AFSC is doing on untrawlable areas in the Gulf of Alaska examining ways to compare fish density in trawlable vs untrawlable portions of the survey area to improve stock assessments.

ADFG: Kristen had talked about ADFG's reserves at the Trawl and Setline Survey Workshop. They do some hook and line surveys in addition to their submersible surveys.

IPHC and **DFO:** Both agencies reported closures of areas to protect sponge reefs in Canada and discussed the impact of those closures on their surveys. DFO does not sample in closed areas and the IPHC will need to seek permission to sample within those areas.

CDFG: Traci reviewed California's MPA activities. They have been working for 10-12 years on this and have established a series of MPAs in 2 regions. Two regions are coming on line soon. Options are currently being developed for the last region (San Francisco Bay). These areas represent an array of habitats and some allow limited fishing while others prohibit any fishing. These successes follow some unsuccessful attempts. She reported that California's funding for MPAs is drying up. The next step is to develop monitoring plans for the areas.

B. Genetics and Stock Structure

CDFO: Lynne reported that they have been collecting tissues from rougheye and blackspotted rockfish to assist in distinguishing the species. Rick Stanley is also resuming work on yellowtail rockfish genetics. They are supporting a student at UBC who is looking into yelloweye rockfish genetics. Jackie King is collecting sixgill shark tissues looking for evidence of polyandry.

IPHC: Heather reported that they are collecting tissue samples from the commercial halibut fleet to investigate a genetic means of determining gender.

NWFSC: They are collecting fin clips to facilitate distinguishing canary, vermilion, and sunset rockfishes. They are detecting some differences from the original work on these species. Tissues are being collected from other cryptic or unidentified rockfish, also. John Harms developed an assay hook that can be used to collect a tissue sample without bringing the fish to the surface, which is particularly helpful for avoiding barotrauma when sampling rockfish during their hook-and-line survey.

WDFW: Have expanded their nearshore tagging project and are now taking fin clips from nearshore rockfishes.

AFSC: The REFM Status of Stocks Program has hired geneticist Ingrid Spies to investigate genetic drift in Pacific cod stocks. Her work may extend to other species in the future, such as arrowtooth flounder.

C. Western Groundfish Conference Update

Mark reported that the organizing committee is just getting organized. Potential venues in Washington that are being considered include the Bellingham area, the Seattle area, Fort Warden State Park Conference Center at Port Townsend, and others.

Following a lunch break, Stephen presented a very nice plaque to Mark Wilkins and the group thanked him for his [as stated on the plaque] "... 30 years of exemplary service" to the TSC. Mark thanked everyone for the plaque [and for the apparent honorary doctorate degree that came with it, since it reads "Presented to Dr. Mark E. Wilkins"].

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

A. Agency Overviews

CDFG: Staff has been diminishing and is down to 120 in the marine region. Funding is tighter in all aspects and everyone is trying to do more with less. MLPA and MLMA funds are gone and recreational fishing staff is cut back. They are concentrating on high profile issues.

ODFW: Susan is relatively new to the agency, coming from Florida. Her general impression is that the Marine Region is trying to grow and bring in new blood. Things generally look positive.

WDFW: Expecting budget cuts because of the poor economic outlook of the state. Greg Bargman, Mel Stanley, and Greg Konkel recently retired and replacements are being recruited.

NWFSC: Michelle McClure has taken over leadership of the FRAM Division; Liz Clarke is now pursuing AUV research full time. Usha Varanasi retired; John Stein is acting Center Director. They expect to announce the new Center Director soon. FRAM is being encouraged to collaborate more with other Center divisions and they have joined with SWFSC to help conduct the spring juvenile rockfish survey. They are active participants on the FATE (**F**isheries **A**nd **T**he **E**nvironment) initiative. Their whiting stock assessment team has been collaborating with their counterparts in Canada to manage the largest quota ever seen for that species. Whiting was the only stock assessment that was updated in 2010. Jason Cope and others are continuing to collaborate with other stock assessment scientists to develop ways to assess data-poor stocks. They have Essential Fish Habitat projects funded but are challenged to actually field the research with short lead time. FRAM's economics group received a recent award for one of their journal articles. Observer coverage is expanding to 100% for some vessel categories but the necessary funding is slow to keep up with this mandate. Observers themselves are contractors and government, rather than industry, is paying for the observers. However, trainers and debriefers are mainly NOAA staff.

CDFO: Lynne reported that Greg Workman, previously the acting head, is now the Section Head of Groundfish. Plans for replacing the R/V W.E. Ricker have been postponed until 2014. Tamee Mawani (known to longtime TSC participants) has married and now known as Tamee Karim. Dr. Robyn Forrest is a new stock assessment scientist working on Pacific hake (whiting). Dr. Nathan Talor is a new stock assessment biologist who is being mentored by Rick Stanley. Kendra Holt (MSc) is filling Jeff Fargo's role. Funding challenges do not appear to be as bad as US agencies but are also going to affect DFO programs. Larocque Funding for survey work is sunsetting as of this year and there is no other funding mechanism identified for next fiscal year's survey work.

IPHC: Recently moved from UW campus to new Ballard offices. Consequently, the web address for IPHC and email addresses for staff have changed. Likely in 2011 they will be hiring for two positions – Assistant Director and Database Manager.

ADFG: Kristen assumed her new position last August and is able to benefit from her two predecessors, Tory O'Connell and Cleo Brylinsky, who still live in town. There are new commissioners and a new director of commercial fishing, Jeff Regnart. Funding will likely be level for this year.

AFSC: Well publicized delays in getting a budget in place have scuttled much of the early work anticipated for 2011.

RACE Division: Sea days for all NOAA ships have been cut back. All late winter and spring pollock hydroacoustic surveys and early FOCI recruitment surveys were cancelled. RACE is having problems chartering one of the boats for the Gulf of Alaska bottom trawl survey and may have to conduct that survey with only two vessels.

REFM Division: A geneticist, Ingrid Spies, has been hired to help answer some important Pacific cod stock delineation and genetic drift questions. Several staff will be investigators on various portions of the Gulf of Alaska Integrated Ecosystem Research Plan (GOA-IERP), as will many at ABL.

ABL: Jeff Fujioka retired last fall. Dave related that Jeff had been a great support for all of the staff there dealing with stock assessments over the years and his contributions will be sorely missed. They have hired two new stock assessment scientists through Stock Assessment Improvement Plan monies, Pete Hulson and James Murphy. Katy Echave has also been hired (2 year term) to manage the sablefish tagging program.

B. Multispecies Studies

Catch reconstruction - Representatives from CDFG, ODFW, and WDFW reported that their agencies have been expending considerable effort to reconstruct historical catch information dating back as far as they can. These projects are in response to a directive from the PFMC's Scientific and Statistical Committee to help generate information for assessments of data poor stocks. Oregon has produced a draft report on their project, with reconstructions extending back to 1892. They used an undocumented multispecies expansion model for the analyses, but are looking at developing a new model to replace that one. Since they are converting to a new computer system, they are taking this opportunity to make this switch.

WDFW: Is expanding ROV surveys of San Juan Islands this year to include all habitats. Previously only high-relief rocky areas were surveyed. The study includes 24-hour observations to determine the best time of day to sample with the ROV.

NWFSC: John Harms published the methods he uses for their hook-and-line survey, supporting the use of those survey results for stock assessments of bocaccio and other species.

CDFO: Lynne described a pilot project using the Ecological Risk Assessment for the Effects of Fishing (ERAEF) model developed for Australian fisheries. The DFO study focuses on a Hecate Strait bottom trawl fishery harvesting some 25 groundfish species. Staff continue to work on the Strait of Georgia Ecosystem Research Initiative Project designed to predict what that area might be like in 2030. In 2010, staff began working with other Canadian researchers from academia, industry, and government agencies on Canadian fisheries research through the National Sciences and Engineering Research Council (NSERC) of Canada's *Canadian Capture Fisheries Research Network*. Refer to the DFO report for further details on these projects. In response to a question from Heather, Lynne explained that there is some involvement by First Nations and recreational fishers with the NSERC project.

AFSC: Mark reported on the three Alaskan groundfish surveys conducted in 2010 in the Aleutian Islands, the continental slope of the eastern Bering Sea, and the shelf of the eastern Bering Sea. The Bering Sea shelf survey last year included a northern extension into Norton Sound, adding approximately 145 new stations further north from the standard survey area. This area was added to investigate further the effects of the loss of sea ice from global warming. In 2011, surveys will be conducted on the eastern Bering Sea shelf and on the shelf and slope in the Gulf of Alaska.

C. By Species

1. Pacific Cod

IPHC: Fork lengths from cod catches during the IPHC setline survey in the Bering Sea are being provided to NMFS to supplement assessment information for Pacific cod. They are also providing information on wounds from lamprey seen on Pacific cod.

ADFG: Information on tag returns from cod is detailed in their report.

CDFO: Staff are preparing to conduct an assessment of cod in 2012.

AFSC: Staff from the Behavioral Ecology Program and Kodiak Lab continue work to describe juvenile habitat and distribution. Cod populations in the Bering Sea and Gulf of Alaska have seen notable increases over the past 2 years, although no similar increase was seen in the Aleutian Islands.

2. Nearshore Rockfish

CDFG: California currently issues two categories of rockfish permits separated by depth. Traci reported that there is a push to combine these into a single rockfish permit. Californians have seen a 70% decrease in the number of permits issued over the last 12 years. Catches of cabezon and greenling species have been limiting this fishery. The very small volume live fish fishery continues to pose a challenging sampling situation.

ODFW: Black rockfish PIT tag program – 518 tags have been recovered in the Newport area since 2002. Data-poor assessment techniques are being applied to minor species. Susan is applying for a grant and hopes to contract with OSU for assistance in developing these assessment methods. When asked how quotas are set now, she replied that harvest caps are established using PSMFC allocations and these are adjusted as necessary. Josie reported that a maturity assessment of quillback and china rockfishes has been published.

WDFW: A report summarizing the 30-year history of their black rockfish tagging project has been published. Although black rockfish have been the focus of this program, it was expanded to include other species in 2009.

NWFSC: The Fish Ecology Division, led by Ric Brodeur, has been focusing on juvenile rockfishes. Their surveys in recent years have detected substantial increases in the abundance of juvenile rockfish species in their plankton and trawl samples. They are using genetic profiles to identify these samples to species.

CDFO: The surveys begun in 2003 have continued. They have developed a new abundance estimator that considers hook competition and saturation and they are using the new estimator for recent stock assessments. They find that it works well in some applications and not so well in others. Yelloweye rockfish have been designated a species of Special Concern through the COSEWIC process. Quillback rockfish will probably fall under the Threatened designation soon. Visual surveys have continued since 2009 and the results are being used to assess the effectiveness of rockfish conservation areas.

ADFG: Research and assessment work on black rockfish continues.

3. Shelf Rockfish

CDFG: The Department is interested in trying to open up some opportunities for fishing for some of the less demersal rockfish species in some of the MPAs.

CDFO: Five of the more minor shelf rockfish species are being assessed synchronously using methods suited for stocks with relatively little data.

ODFW: Department staff are collecting information on yelloweye rockfish caught during recreational fishing through a program encouraging photographic documentation of fish caught before they are returned to the sea. Photographers are encouraged to photograph the fish with an item of known size in the frame, then release them quickly.

ADFG: Staff involved with the recreational fishery are conducting a study to evaluate release methods that might reduce mortality on rockfish as they are being released. The use of ROV as a potential methodology to measure demersal shelf rockfish abundance is being explored.

4. Slope Rockfish

NWFSC: Full assessments will be done in 2011 for several species of slope rockfishes, including POP and blackgill and an assessment update for darkblotched rockfish. Vlada Gertseva published a paper on the age and growth of splitnose rockfish.

CDFO: Rougheye rockfish are listed as Special Concern and a management plan for this species is underway. This opened up a discussion of the current status of our ability to distinguish rougheye and blackspotted rockfishes in the field. Mark described the findings of a 2009 experiment where tissues were collected from all rougheye, blackspotted, and indeterminate rockfish sampled for otoliths during the 2009 Gulf of Alaska survey. These specimens were genetically identified to species and compared with the field identification. Misidentification rates were similar to what has been seen using the best and latest field guides. Hybrid individuals were also detected, complicating the matter further. There is a difference in depth range between the species but that characteristic has considerable overlap.

AFSC: Dave elaborated on the rougheye vs blackspotted identification problem and also described the barotrauma relief tanks that ABL has developed to repressurize rockfish that have been brought to the surface from depths. Animals that have been repressurized before release have shown good survival.

5. Thornyheads

NWFSC: FRAM Division began collecting shortspine thornyhead ovaries this year. They are examining fish smaller than 20 cm to look further at the practicality of determining sex of these small fish that have previously been considered too small to sex.

6. Sablefish

NWFSC: Sablefish maturity samples have been collected and they are being prepared for histological classification. They have not been classified yet as the stock assessment has a higher priority.

CDFO: Sablefish were assessed in 2010 and the next assessment will be in 2012. Aimee noted that NWFSC surveys detected a peak of small fish in 2008 and asked Lynne whether that had been detected in Canada. Lynne said that DFO surveys corroborated that observation.

ADFG: Kristen reported that a pulse of young fish around 470 mm was seen in their most recent survey in Chatham Strait. She also mentioned that the agency uses permit holders to conduct the Chatham Strait survey so that the fish landed during the survey are effectively returned to the fleet, rather than putting all the catch onto the state's share of the TAC. This year, the Department will reduce their testfish catch by >50% through accommodating permit holders on board the vessel. Fishers can sell the highest quality fish on their tickets. Regarding this provision, Heather expressed that IPHC does not allow survey vessels to benefit from the halibut catch, as survey fishers might be able to skew survey effort, thereby increasing their profits when selling the fish. She suggested that Kristen consult with Claude Dykstra at the Halibut Commission about this.

7. Halibut and IPHC Activities

IPHC: Two additional survey projects will take place in 2011. For the first time, stations will be fished inside Puget Sound and the depth range of stations will be expanded off Oregon and Washington. Instead of sampling from 20-275 fm, the stations will fall within a depth range of 10-400 fm. This pilot project will examine the practicality of wider expansion to the entire geographic range of the survey. It added 20 new stations in Washington and 16 new stations in Oregon. The second project is a bait study to determine the effect of switching from chum salmon to another bait. Pollock, chum salmon, pink salmon, and herring will be compared. This is being driven by uncertainty as to the continuing availability of the standard chum bait. Lynne asked whether sharks usually make it aboard during survey fishing or do they rip out the hooks because of their size and weight? IPHC practices careful release of all species on all of their surveys. Jackie King (CDFO) was requesting identification and sex determination of sharks.

8. Flatfish

NWFSC: Herding by sweeps and other components of the trawl were visually examined with video cameras. A manuscript has been prepared and is undergoing internal review.

CDFO: Jeff Fargo retired but is still writing up some technical reports. Jergen Westrheim still comes into the office occasionally, too, although less frequently.

AFSC: Tom reported that flatfishes in the Bering Sea are doing well. They are being lightly exploited and the model used to assess them fits well and is providing solid information on stock status.

9. Lingcod

CDFO: A stock assessment for lingcod in outside waters was done and showed that those stocks were all above the threshold for a precautionary approach. An assessment of inside stocks will be done next year. Tom asked whether the outside waters quota is being fully utilized. Lynne replied that it is not, especially in more northern areas.

ADFG: Lingcod are getting a lot of attention. In particular, the appropriateness of using submersible surveys to assess the stocks is being examined.

10. Pacific Whiting (Hake)

CDFG: California whiting fishers are expected to lease their TIQ quota shares as the individual shares are too low to make it economically feasible for them to fish.

WDFW: An acoustic survey is being used to assess whiting in Puget Sound.

NWFSC: A new data processing package is being used for the echo integrations during the acoustic surveys. Target strength research is being done to develop methods to distinguish hake from other species, even from Humboldt squid. Geostatistical methods are being used to enhance the analysis, also.

CDFO: As reported previously, the bilateral treaty on hake was signed and has been implemented. A working group has been established to conduct joint assessments. The size of the 2008 cohort is uncertain, but appears to be very large.

11. Walleye Pollock

AFSC: Following a few recent years of concern about dwindling stocks, fish are showing some abundance in the Bering Sea and Gulf of Alaska. The hydroacoustics program staff in the RACE Division are working on a codend with cameras which they hope to be able to use with an open codend trawl to identify and measure fish as they pass through the net without the need to actually catch them and bring them aboard. An acoustic survey of the Gulf of Alaska will be conducted this summer.

12. Dogfish and Other Sharks

ADFG and AFSC: Both agencies are tagging dogfish for Cindy Tribuzio at AFSC's ABL. Heather added that IPHC is also collecting dogfish pre-caudal length and sex from fish caught on their longline surveys for the cause. Dave reported that ABL is also tagging dogfish with pop-off satellite tags.

CDFO: Basking sharks were recently surveyed using an aerial survey and only two fish were sighted. They have been designated as an endangered species in BC waters. DFO had tried to eradicate this species in the 1950s and 1960s. Jackie King and Vince Gallucci conducted an assessment of dogfish in BC for MSC certification.

WDFW and NWFSC: Spiny dogfish are being assessed this year by Vlada Gertseva (NWFSC).

13. Skates

CDFG: "Winging" skates, which is illegal, has become a problem in California and skates are now required to be landed whole to facilitate species identification. They initiated an outreach effort to educate fishers and buyers about issues surrounding skates with good results. In 2009, 89% of skates landed were unspecified species; in 2010 only 9% were unspecified.

14. Grenadiers

AFSC: Dave has been preparing stock assessments of grenadiers for several years. These are unofficial assessments but ABL is trying to get them included in the NPFMC FMPs. They feel that grenadiers should at least be included as an "ecosystem component" species.

NWFSC: There is interest in conducting an assessment of Pacific grenadiers.

15. Other Species

D. Other Related Studies

NWFSC: Research and development of bycatch reduction devices and methods have been underway since 2008. Center staff are working on developing an ecological assessment of the interactions between research activities and protected species. Mark added that all NMFS Fisheries Science Centers are working on these. The effort is being pioneered by the Northeast Fisheries Science Center. Meanwhile all field activities require posting a marine mammal watch to avoid activity that has an increased likelihood of "taking" a protected species.

CDFO: Staff has been working toward a goal of reconstructing groundfish catches back to 1900 to use in stock assessments. They expect to achieve 90% of that goal by the end of 2013. When this topic was raised, representatives from all three Pacific states said that they were also working on this type of catch reconstruction. The idea behind the effort seems to be to establish a (more or less) "standard" data set that would help assessment modelers ascertain estimates of virgin biomass levels. Mark asked whether standard methods were being used by all agencies to develop this "standard" data set. He further noted, from an historical perspective, that one of the main original functions of the TSC annual report was to compile and present finalized groundfish catch statistics for the Pacific coast, a function that was taken over by PSMFC through PacFIN many years ago. Apparently the efforts of these agencies on this project have not been coordinated, but agency representatives present were very interested in seeing how other agencies were approaching the task. The group proposed that a recommendation be made to look into coordinating their efforts (see 2011 Recommendations).

The group discussed some current ecosystem studies (e.g., the Bering Sea and Gulf of Alaska Integrated Ecosystem Research Plans) and this led to a suggestion that an "Ecosystem Studies" item be added to the 2012 agenda under Other Related Studies and that each agency should include any ecosystem study activities in their 2012 agency reports.

E. Other Items

1. Marine Mammal Predation on Groundfish

CDFO: Stock assessment modelers are beginning to add consideration of pinniped consumption to their models and are finding that recovering stocks (e.g., yelloweye rockfish) will not recover as fast as prior runs of the model had predicted.

AFSC: Dave reported that whale predation during the AFSC sablefish longline survey continues. Both killer whales and sperm whales have been a problem. A recent Center of Independent Experts review of the sablefish surveys and stock assessment suggested the need to account for survey stations that previously were considered invalid due to whale predation. Chris Lunsford (ABL) and Claude Dykstra (IPHC) have worked to come up with standard criteria for evaluating predation effects more quantitatively.

Adjourned for the day at 4:45 pm.

<u>Wednesday, May 4</u>

Meeting resumed May 4 at 9:00 am.

IX. Progress on 2010 Recommendations

A. From TSC to Itself

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.*
   - Chairman Clausen and Stephen Phillips drafted and sent out the Letter to Supervisors last July following up on the accomplishments of the May 2010 meeting.
   - Copies will henceforth be distributed to participants of the annual meetings.
2. *The TSC requests that members of the Trawl Survey Working Group coordinate with individuals who conduct hook-and-line surveys to plan and host a 3-day workshop in Seattle in late February 2011. Mark Wilkins and Rick Stanley offered to organize the workshop.*
   - The Trawl and Setline Survey Workshop held in Seattle in March successfully and fully addressed this recommendation.
3. *The TSC notes the number of projects related to the development of no-take monitoring technologies. It recommends that these initiatives would benefit from a 1-2 day workshop. Theresa Tsou has offered to initiate organization of a workshop on no-take monitoring methods to be held later in 2010.*
   - Theresa has organized a symposium on non-lethal survey methodologies as part of the AFS annual meeting in Seattle this fall. This symposium will successfully and fully address this recommendation.

B. TSC to CARE

1. *Recognizing the value of carbon dating and other potential uses of archived ageing material, TSC recommends that CARE examine the feasibility of preparing an on-line summary of the material that is archived by each of the west coast groundfish research agencies.*
   - Following discussion of CARE's response to our recommendation, Lynne drafted the following response:

     TSC thanks CARE for their discussions and consideration of the 2010 request to examine the feasibility of preparing an on-line summary of archived ageing material from their member agencies. Since most agencies do not currently maintain publically accessible on-line inventories, TSC appreciates that this task is non-trivial.

     To clarify for CARE, TSC's 2010 information request includes the following by species:

     1. number of ageing structures collected by
        a. structure type
        b. agency
        c. year
     2. number of structures aged by year (already on the website)
     3. a link to a contact person at each agency

C. TSC to Parent Committee

1. *The TSC requests that the Parent Committee ask the AFSC to host the 2011 survey workshop in Seattle.*
   - The Parent Committee requested such of AFSC and a successful workshop was held in March.

2. *In the interim period while the Hake Treaty legislation is pending approval, TSC recommends that the Parent Committee create an interim Hake Working Group under the auspices of the TSC. Greg Workman has offered to initiate discussions with Canadian and US staff on developing the Terms of Reference for this Working Group.*
   - Since the Hake Treaty has been signed and implemented, following through with this recommendation is unnecessary. See TSC's 2011 Recommendation to the Parent Committee on this issue below.

X. 2011 Recommendations

A. From TSC to Itself

1. The Scientific and Statistical Committee of the Pacific Council has requested Washington, Oregon and California to reconstruct groundfish catch histories as far back as possible. Canada has also undertaken catch reconstructions for some

rockfish species and will proceed with reconstructions for all groundfish species. The TSC in its discussions noted that each agency is doing this independently and recommends a possible workshop to be held to discuss, compare and develop best practices of reconstructing species-specific catches from grouped species landing data. The goal of the workshop would be to produce consistent methods among agencies. TSC members are to investigate the utility of such a workshop and the possibility of adding a day for initial discussion at the PacFin meeting already scheduled in October.

B. TSC to CARE

1. TSC would like to fully endorse the activities of CARE and acknowledge their great contribution to groundfish research and stock assessment.
2. See also TSC's response to CARE's response to TSC's 2010 recommendation to them under item IX. B. 1.

C. TSC to Parent Committee

1. Since the agreement between the government of Canada and the government of the United States of America on Pacific Hake/Whiting (Hake Treaty) was signed off in 2010, TSC recommends that the Parent Committee dissolve the Hake Working Group under the auspices of the TSC in favour of the formal Joint Technical Committee structure outlined in Article II of the Hake Treaty and legislated working arrangements therein.

Text of the Hake Treaty is appended as Appendix 4.

2. TSC has recommended to itself (see above) that agencies currently reconstructing groundfish catch histories meet to compare the methods and assumptions that they are using in their reconstructions. The goal of this meeting would be to consider establishing the best practices for this exercise that would result in the most comparable data sets from the various agencies. The TSC recommends that the Parent Committee request that the PSMFC PacFIN manager consider whether it is appropriate and desirable to include the reconstructed data sets in PacFIN.

XI. Selection of Next Chairperson and Schedule and Location of 2012 Meeting

Susan Hilber, ODFW, was selected as TSC Chair for 2012-2013. [Editor's note: several months after the 2011 TSC meeting, Ms. Hilber resigned from her position in ODFW. Subsquently, Dave Clausen offered to remain as TSC Chair for 2012.]

The venue of the 2012 meeting will be somewhere in California. Some suggested that John Field or Steve Ralston of the NMFS SWFSC Santa Cruz Lab be approached to host the meeting at either Santa Cruz or Half Moon Bay. Proposed dates for the meeting are May 1-2, 2012.

XII. Adjournment

The meeting was adjourned by outgoing TSC Chair Dave Clausen at 11:05 am after presenting the fish club to incoming Chair Susan Hilber.

Appendix 1.

Agenda

Fifty Second Annual Meeting of the TSC
May 3-4, 2011
Cannery Pier Hotel
Astoria, Oregon

I. Call to Order (9:00 a.m; 5/3/2011) – Dave Clausen, Chair

II. Appointment Secretary

III. Introductions

IV Approval of 2010 Report

V. Approval of 2011 Agenda

VI Working Group Reports
- A. Committee of Age Reading Experts (CARE)
- B. Trawl Survey Working Group Report
  Trawl and Longline Survey Workshop
- C. Yelloweye rockfish working group

VII. Other Topics
- A. Marine Reserves
  1. Genetics and stock structure

VIII. Review of Agency Groundfish Research, Assessment, and Management
- A. Agency Overviews
- B. Multispecies Studies
  1. ERAEF (Canada DFO)
- C. By Species
  1. Pacific Cod
  2. Nearshore Rockfish
  3. Shelf Rockfish
  4. Slope Rockfish
  5. Thornyheads
  6. Sablefish

7. Halibut and IPHC activities
8. Flatfish
9. Lingcod
10. Pacific Whiting
11. Walleye Pollock
12. Dogfish and other sharks
13. Skates
14. Grenadiers
15. Other Species

D. Other Related Studies

E. Other Items

- Marine mammal predation on groundfish

IX. Progress on 2010 Recommendations

A. From TSC to itself

B. TSC to Parent Committee

C. TSC to Care

X. 2011 Recommendations

A. From TSC to itself

B. TSC to Parent Committee

C. TSC to CARE

XI. Selection of Next Chairperson and Schedule and Location of 2012 Meeting

XII. Adjourn ~ 12:00 p.m. May 4, 2011

Appendix 2.

Committee of Age-Reading Experts 2010 Committee Report, submitted and presented by Josie Thompson on behalf of CARE Chair, Shayne MacLellan.

Appendix 3.

REPORT OF THE TRAWL SURVEY WORKING GROUP: MARCH 22-24 TRAWL AND SETLINE SURVEY WORKSHOP HELD AT AFSC IN SEATTLE

This year's annual meeting of the Trawl Survey Working Group, which usually includes only trawl survey scientists from NMFS (NW and Alaska Centers) and CDFO (Nanaimo), was designed to draw participation from other west coast agencies as well as scientists using setline gear to conduct their groundfish surveys. From all reports, this strategy was a success. Scientists from Canadian and U.S. federal and state fisheries agencies gathered in Seattle at the AFSC March 22-24, 2011, for a workshop on trawl and setline groundfish resource surveys. Most attendees were from the Pacific coast and a few joined us from the Atlantic coast, as well (NOAA NEFSC, VIMS NEAMAP, and Maine Department of Marine Resources). The workshop was convened by the Trawl Survey Working Group of the TSC. The core Trawl Survey Working Group began meeting around 2002 to share expertise and knowledge of trawl survey methodology. In 2010, the TSC recommended that the Group expand their annual meeting by inviting participants from Pacific coast state agencies, as well as researchers using fixed gear methods to survey groundfish resources. The Trawl and Setline Survey Workshop in March, with nearly 60 participants, realized this recommendation.

Most of the first day was spent hearing researchers describe the trawl and setline surveys conducted by their respective agencies to assess various stocks of groundfishes. A particularly interesting focus session in the afternoon featured representatives from Rapp Hydema US, an international firm that provides trawl winches for research and fishing fleets. They presented a detailed functional description of the automatic tensioning systems ("autotrawl") featured in their winches and discussed the pros and cons of using autotrawl technology during trawl survey sampling with workshop participants employing that technology or considering it. The second day included over a dozen presentations on a variety of themes and issues ranging from ergonomics and safety to the effects of ambient light levels on catch rates to improvements in methods for data analysis and how to present results effectively. Lively discussions ensued following nearly every presentation. After a final presentation, a general discussion covering a wide variety of issues relating to groundfish resource surveys occupied the group for three hours on the third morning. Topics included peer review of survey methods, challenges of continuing to fund surveys, design problems related to missed station sampling opportunities, ever-increasing data requests and workloads, and the effect or threat of protected species catch limits on shutting down survey operations.

The workshop offered a wonderful opportunity for scientists from a wide range of agencies, all working on similar projects, to gather and share their insights, as well as their challenges and frustrations about this important work they do. Organizers Mark Wilkins (NOAA NMFS AFSC), Rick Stanley (CDFO PBS), and Aimee Keller (NOAA NMFS NWFSC) are particularly grateful to Bruce Leaman and the International Pacific Halibut Commission for hosting a convivial social gathering on the first evening, which effectively promoted and facilitated communication among participants (as well as being delicious!). A link to the proceedings of the Workshop can be found on the TSC homepage at http://www.psmfc.org/tsc2/Trawl_and_Setline_Survey_Workshop_2011.html . There you will be able to find a list of participants, the agenda, slideshows of the survey overviews and special topic presentations, and the minutes (construction of the site is still incomplete).

Appendix 4.—Hake Treaty between Canada and the United States.

AGREEMENT BETWEEN THE GOVERNMENT OF CANADA AND THE GOVERNMENT OF THE UNITED STATES OF AMERICA ON PACIFIC HAKE/WHITING

The Government of Canada and the Government of the United States of America (hereinafter referred to as “the Parties”),

Recognizing the transboundary nature of the offshore hake/whiting (*Merluccius productus)* resource off the Pacific coast of Canada and the United States,

Mindful of the importance of this resource to the social and economic sustainability of fishing communities, including harvesters, processors, license holders, and other stakeholders reliant on the offshore hake/whiting fishery,

Desiring to cooperate in the stewardship of this resource and to benefit the industries involved in this fishery, and

Recognizing the desirability of maintaining existing levels of scientific research with respect to the offshore hake/whiting resource,

Have agreed as follows:

ARTICLE I

DEFINITIONS

For the purposes of this Agreement:

“Catch” means all fishery removals from the offshore hake/whiting resource, including landings, discards, and bycatch in other fisheries;

“F-40 percent” means a fishing mortality rate that would reduce the biomass, calculated on a per recruit basis, to 40 percent of what it would have been in the absence of fishing mortality;

“40/10 adjustment” means an adjustment to the overall total allowable catch (TAC) that is triggered when the biomass falls below 40 percent of its unfished level. This adjustment reduces the TAC on a straight-line basis from the 40 percent level such that the TAC would equal zero when the stock is at 10 percent of its unfished level;

“Offshore hake/whiting resource” means the transboundary stock of *Merluccius productus* that is located in the offshore waters of the United States and Canada. The hake/whiting located in Puget Sound and the Strait of Georgia is not included in the offshore hake/whiting resource; and

"Potential yield" means the range of results obtained from applying the harvest rate established pursuant to paragraph 1 of Article III to a range of forecasted biomass estimates.

ARTICLE II

1. A Joint Technical Committee (JTC) is hereby established comprising up to five scientific experts, with up to two appointed by each Party and one independent member jointly appointed by the Parties from a list supplied by the Advisory Panel established pursuant to paragraph 4 of this Article. The Parties shall jointly bear the independent member's travel expenses associated with the work of the JTC. JTC members may seek advice from others as they deem appropriate. The JTC shall meet annually, and more often as necessary, to:

    (a) propose its terms of reference for approval by the Joint Management Committee (JMC) established in paragraph 3 of this Article;

    (b) develop stock assessment criteria and methods, and design survey methods;

    (c) exchange survey information, including information on stock abundance, distribution, and age composition;

    (d) exchange and review relevant annual catch and biological data, including information provided by the public;

    (e) provide, by no later than February 1 of each year unless otherwise directed by the JMC, a stock assessment that includes scientific advice on the annual potential yield of the offshore hake/whiting resource that may be caught for that fishing year, taking into account uncertainties in stock assessment and stock productivity parameters and evaluating the risk of errors in parameter estimates produced in the assessment;

    (f) take into account any adjustments pursuant to paragraph 5 of this Article as part of its stock assessment; and

    (g) perform other duties and functions that may be referred to it by the Scientific Review Group (SRG) established in paragraph 2 of this Article and by the JMC.

2. A Scientific Review Group (SRG) is hereby established to provide independent peer review of the work of the JTC. The SRG shall comprise up to six scientific experts, with up to two appointed by each Party and two independent members appointed jointly by the Parties from a list supplied by the Advisory Panel. All SRG members shall be different individuals than those who serve on the JTC. The Advisory Panel may also nominate, for appointment by the Parties, two public advisors to participate in SRG meetings. The public advisors shall have the right to provide their views on all aspects of the work of the SRG, both orally and in writing. The Parties shall jointly bear the travel expenses of

the independent members and the public advisors for meetings of the SRG. In addition, SRG members may seek advice from others as they deem appropriate. SRG meetings shall be open to the public. The SRG shall meet annually, and more often as necessary, to:

(a) propose its terms of reference for approval by the JMC;

(b) review the stock assessment criteria and methods and survey methodologies used by the JTC;

(c) provide, by no later than March 1 of each year, unless otherwise directed by the JMC, a written technical review of the stock assessment and its scientific advice on annual potential yield; and

(d) perform other duties and functions that may be referred to it by the JMC.

3. A Joint Management Committee (JMC) is hereby established comprising eight members, four appointed by each Party. The members appointed by each Party shall comprise the national section of that Party. Recommendations of the JMC shall be made by agreement of the two national sections. JMC meetings shall be open to the public, unless the JMC determines that, due to extraordinary circumstances, a closed session is necessary. The JMC shall meet at least once per year and more often as necessary to:

(a) adopt its terms of reference and approve the terms of reference of the JTC and SRG;

(b) provide the SRG and JTC the direction necessary to guide their deliberations;

(c) refer any technical issues or other duties to the SRG or JTC as it deems appropriate;

(d) consider information on management measures employed by the Parties; and

(e) review the advice of the JTC, the SRG, and the Advisory Panel and, by no later than March 25 of each year, recommend for approval of the Parties the overall TAC for that year, calculate each Party's individual TAC pursuant to paragraph 2 of Article III, and identify any adjustments pursuant to paragraph 5 of this Article.

4. An Advisory Panel on Pacific Hake/Whiting (Advisory Panel) is hereby established comprising members appointed by each Party. The members appointed by each Party shall comprise the national section of that Party. Decisions of the Advisory Panel shall be made by agreement of the two national sections. Members of the Advisory Panel shall be individuals knowledgeable or experienced in the harvesting, processing, marketing, management, conservation, or research of the Pacific hake/whiting fisheries and may not be employees of either Party. Meetings of the Advisory Panel shall be open to the public.

The Advisory Panel shall meet annually prior to the meeting of the JMC, or more often as necessary, to:

(a) establish its terms of reference;

(b) compile and provide to the Parties, by no later than March 25 of each year, the names of at least three scientific experts as candidates for the JTC and the names of at least five scientific experts as candidates for the SRG, for appointment in the following year;

(c) review the advice of the SRG and JTC;

(d) review the management of the fisheries of the two Parties during the previous year; and

(e) make recommendations to the JMC regarding the overall TAC.

5. Adjustments:

(a) If, in any year, a Party's catch exceeds its individual TAC, an amount equal to the excess catch shall be deducted from its individual TAC in the following year.

(b) If, in any year, a Party's catch is less than its individual TAC, an amount equal to the shortfall shall be added to its individual TAC in the following year, unless otherwise recommended by the JMC. Adjustments under this sub-paragraph shall in no case exceed 15 percent of a Party's unadjusted individual TAC for the year in which the shortfall occurred.

6. In any year in which the JMC has made recommendations pursuant to sub-paragraph 3(e) of this Article, paragraph 5 of this Article or paragraph 1 of Article III, the Parties shall manage their respective fisheries for the offshore hake/whiting resource consistent with such recommendations of the JMC as the Parties have approved.

ARTICLE III

1. For the purposes of this Agreement, the default harvest rate shall be F-40 percent with a 40/10 adjustment. Having considered any advice provided by the JTC, the SRG or the Advisory Panel, the JMC may recommend to the Parties a different harvest rate if the scientific evidence demonstrates that a different rate is necessary to sustain the offshore hake/whiting resource. If the Parties approve such a recommendation, they shall so inform the JMC.

2. The United States' share of the overall TAC shall be 73.88 percent. The Canadian share of the overall TAC shall be 26.12 percent. This division shall apply for an initial nine-year period, and thereafter unless the Parties agree in writing to adjust it. Any such adjustment shall take effect in the following year, unless the Parties agree otherwise.

ARTICLE IV

The Parties agree to conduct scientific research to support the effective implementation of this Agreement, including trawl, acoustic, and recruit surveys to provide adequate data on the offshore hake/whiting resource. The Parties should, where appropriate, conduct such research using private vessels.

ARTICLE V

1. This Agreement shall enter into force upon an exchange of written notifications by the Parties, through diplomatic channels, that they have completed their respective internal procedures.

2. This Agreement may be amended at any time by written agreement of the Parties.

3. Either Party may terminate this Agreement by notice in writing to the other Party through diplomatic channels. Unless such notice has been withdrawn, this Agreement shall terminate on December 31 of the calendar year following that in which such notice was received by the other Party.

IN WITNESS WHEREOF, the undersigned, duly authorized by their respective Governments, have signed this Agreement.

DONE at ________, this_____ day of _________, _______ in duplicate in the English and French languages, both texts being equally authentic.

FOR THE GOVERNMENT OF CANADA:	FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:
______________________________	______________________________

D. Parent Committee Minutes

Minutes of the 52nd Annual Meeting
of the
Canada-U.S. Groundfish Committee
(aka "Parent Committee")

I. Call to Order

Stephen Phillips PSMFC, represented the United States (for Randy Fisher PSMFC) and Ms. Lynne Yamanaka represented the Canada (for Tamee Karim, DFO). The meeting was called to order at 11:45 Wednesday, May 4, 2011.

II. Rapporteur

Stephen Phillips was appointed secretary for the meeting.

III. The Agenda

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

IV. The 2010 Parent Committee meeting minutes

The Parent Committee minutes were adopted as presented

V. Action on 2010 Parent Committee recommendations

1. Parent Committee agrees with the 2010 TSC recommendation to ask the AFSC to host the 2011 survey workshop in Seattle. ***Action: The workshop took place in March 22-24 2011 in Seattle, Washington.***

2. The Parent Committee agrees with 2010 TSC recommendation that in the interim period while the Hake Treaty legislation is pending approval, that TSC create a Pacific Hake Working Group. They also agree that this process starts with development of the Terms of Reference of this Working Group. ***Action: "See 2011 Parent Committee Recommendations" below***

VI. 2011 Parent Committee Recommendations

1. Parent Committee agrees with the TSC that since the agreement between the government of Canada and the government of the United States of America on Pacific Hake/Whiting (Hake Treaty) was signed off in 2010, that the TSC Hake Working Group be dissolved in favour of the formal Joint Technical Committee structure outlined in Article II of the Hake Treaty and legislated working arrangements therein.

2. The Parent Committee agrees with the TSC recommendation for a request to be made of the PSMFC PacFIN manager considering whether it is appropriate and desirable to include the reconstructed data sets in PacFIN.

2012 Meeting Location

Parent Committee agrees with the proposed location and schedule for the 2012 TSC and Parent Committee Meeting: California (exact location TBA), Tuesday May 1, and Wednesday May 2, 2011. Traci Larinto of CDFG has offered to host the meeting.

VII. Other Business

The Parent Committee thanks Dave Clausen for chairing the meeting and Mark Wilkins for being the recording secretary

The Parent Committee thanks PSMFC for its ongoing support for the Annual TSC meetings.

The TSC thanked mark Wilkins for his long standing contribution to, and support of, the TSC and congratulated her on her impending retirement.

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. INTERNATIONAL PACIFIC HALIBUT COMMISSION (IPHC)

4. NORTHWEST FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERIES SERVICE

5. SOUTHWEST FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERIES SERVICE

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

8. STATE OF CALIFORNIA – DEPARTMENT OF FISH AND GAME

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

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

Alaska Fisheries Science Center
of the
National Marine Fisheries Service

2011 AGENCY REPORT

to the
Technical Subcommittee
of the
Canada-US Groundfish Committee

April 2011

Compiled by
Mark Wilkins, Tom Wilderbuer, and David Clausen

VIII. REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENTS, AND MANAGEMENT IN 2010

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 Laboratories (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 2010, 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).

Three major bottom trawl surveys of groundfish resources were conducted during the summer of 2010 by RACE Groundfish Assessment Program (GAP) scientists; the annual eastern Bering Sea shelf survey, the biennial eastern Bering Sea Continental Slope survey, and the biennial survey of the continental shelf of the Aleutian Islands. In 2011 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 resources.

RACE scientists of the Habitat Research Team (HRT) continue research on essential habitats of groundfish including identifying suitable predictor variables for building quantitative habitat models, developing tools to map these variables over large areas, investigating activities with potentially adverse effects on EFH, such as bottom trawling, and benthic community ecology work to characterize groundfish habitat requirements and assess fishing gear disturbances.

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 2010 and around the Kenai Peninsula, Prince William Sound, and the Chirikof-Shelikof Strait areas in March 2010. A summer survey of pollock on the eastern Bering Sea shelf was conducted 5 June through 7 August 2010. 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.

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

AUKE BAY LABORATORIES

The Auke Bay Laboratories (ABL), located in Juneau, Alaska, is a division of the NMFS Alaska Fisheries Science Center (AFSC). ABL's Marine Ecology and Stock Assessment Program (MESA) is the primary group at ABL involved with groundfish activities. Major focus of the MESA Program is on 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. Several personnel changes occurred in 2010. Jeff Fujioka, the longest serving MESA employee who had been a key player in many groundfish activities over the years, retired in October 2010. Two new stock assessment scientists were hired, Pete Hulson and James Murphy. Also, Katy Echave was hired to be in charge of the Sablefish Tag Database at ABL. Several employees in other ABL programs have also been involved with groundfish-related research in the past year.

In 2010 field 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) an ongoing tagging study of spiny dogfish in the eastern Gulf of Alaska; 3) recompression experiments on rougheye rockfish; and 4) a large-scale, epipelagic trawl survey of the eastern Bering Sea shelf conducted by ABL's Ocean Carrying Capacity Program that provides data on abundance of age-0 walleye pollock.

Ongoing analytic activities in 2010 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: Alaska sablefish, Gulf of Alaska sharks, Bering Sea/Aleutian Islands sharks, and Alaska grenadiers. Short executive summary assessment reports were also prepared for Gulf of Alaska Pacific ocean perch, northern rockfish, pelagic shelf rockfish, rougheye and blackspotted rockfish, and shortraker rockfish and "other slope rockfish". Other analytic activities in 2010 included analysis of the results of an experimental rockfish acoustic/trawl survey, a rougheye/blackspotted rockfish identification study, and analysis of longline data to estimate bycatch of sharks in the IFQ Pacific halibut fishery.

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

B. Multispecies Studies

1. Research and Stock Assessment

2010 Eastern Bering Sea Continental Shelf Bottom Trawl Survey – RACE
The twenty-ninth annual bottom trawl survey of the eastern Bering Sea (EBS) continental shelf was conducted between 2 June and 15 August 2010 aboard the chartered fishing vessels *Alaska Knight*, *Aldebaran*, and the *Vesteraalen*. This year's survey expanded northward to include Norton Sound and areas above St. Mathew Island and St. Lawrence Island extending west to the U.S.-Russia Convention Line, adding over 65,000 square nautical miles to the survey area. The purpose of sampling these additional northern stations was to establish baseline information of crab and groundfish species within the northern Bering Sea as a part of a study examining the loss of seasonal sea ice due to climate change. The 2010 survey represents the greatest annual coverage of the eastern Bering Sea shelf dating back to start of the survey time series in the early 1970's.

Scientists from the AFSC, ADF&G, IPHC, and Kawerak Inc. participated in the survey and completed standardized biological sampling of crab and groundfish resources at 142 northern extension stations in addition to the 376 standard annual stations, with depths ranging from 11 to 200 m. In addition, the *Aldebaran* returned to Bristol Bay to resample 23 stations between 24 and 29 July due to the delaying effects of colder than average water temperatures on the red king crab reproductive cycle.

Bottom temperatures measured during the survey ranged from -1.6° to 12.3°C. Mean bottom temperatures of the standard shelf area in 2010 were slightly warmer (1.33 °C) than in 2009 (1.21°C), but continued a cold trend that began in 2006 where the cold pool (<2°C) has extended southward into the middle shelf and into Bristol Bay. In the northern shelf area the cold pool was expansive, covering most of the area between St. Matthew Island and St. Lawrence Island. Nearshore waters above Nunivak Island and all of Norton Sound, however, were relatively warm with bottom temperatures exceeding 6°C.

Data collections from the EBS shelf trawl survey included 192,000 individual length measurements representing 49 fish taxa; 9,991 age structures representing 17 fish taxa; 7,342 stomach samples representing 56 fish taxa; and 2,230 pathobiology samples from 42 different fish and invertebrate taxa.

<u>Groundfish</u> – In the standard area, a majority of trawl catches contained walleye pollock and pollock biomass estimates increased from 2.28 million t in 2009 to 3.75 million t in 2010. Pacific cod abundance also increased, from an estimated 0.43 million t in 2009 to 0.87 million t in 2010, likely due the individual growth of many smaller sized cod observed in 2009. Estimates of 2010 biomass for most of the major flatfish species, including yellowfin sole, northern rock sole, flathead sole, arrowtooth flounder, and Greenland turbot, increased by 18% to 115% compared to 2009 estimates. The most abundant of the flatfishes were yellowfin sole (2.37 million t) and northern rock sole (2.06 million t).

Northern area catches were smaller compared to the standard area, but distributions of some the major species including Alaska plaice, yellowfin sole, and snow crab extended significantly into the northern shelf. The four most abundant species in terms of estimated biomass in the northern area were yellowfin sole (0.42 million t), snow crab (0.32 million t), purple-orange seastar (0.28 million t), and Alaska plaice (0.30 million t). Bering flounder, overall a less abundant species, was found to have just over 50% of its estimated biomass in the northern area.

For further information, contact Robert L. Lauth, (206)526-4121, Bob.Lauth@noaa.gov .

2010 Eastern Bering Sea Upper Continental Slope Groundfish Survey – RACE
During June and July of 2010, the RACE Division conducted the biennial eastern Bering Sea upper continental slope groundfish survey. This effort was the fourth of a new series that includes previous surveys in 2002, 2004 and 2008. We conducted 200 successful tows between 200- 1200 meters along the continental slope of the eastern Bering Sea from Akutan Island toward the northwest to the international boundary using a stratified random design that distributes sampling effort in proportion to the area by depth and geographic subarea. The objectives of this survey are to describe the current composition, spatial and depth distributions, and relative abundance of groundfish and invertebrate resources, and to collect biological data from a variety of commercially and ecologically important species. At each trawl station we collected environmental parameters including bottom depth, surface and bottom water temperatures, light levels, and sea states to relate long term changes in fish and invertebrate distribution with changes in oceanographic conditions. In addition we completed >20 research projects requested from investigators.

For further information, contact Gerald R. Hoff (206)526-4580, Jerry.Hoff@noaa.gov .

2010 Biennial Bottom Trawl Survey of Groundfish Resources in the Aleutian Islands – RACE
The eleventh in a series of comprehensive bottom trawl surveys of groundfish resources in the Aleutian Islands (AI) region was conducted from June 6 through August 14, 2010, by the Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC), Seattle, Washington. Since 2000 this survey has been conducted biennially; earlier surveys were conducted on a mostly triennial schedule between 1980 and 2000.

The Aleutian Islands region is an extensive archipelago of volcanic origin typified by a relatively narrow continental shelf that is crossed by numerous deep passes. Very strong currents flow north into the Bering Sea through the passes and across the shelf, sometimes making productive fishing operations difficult or impossible. Commercially valuable species of flatfish (Pacific halibut and Greenland turbot), roundfish (Atka mackerel, Pacific cod, walleye pollock, and sablefish), rockfish (Pacific ocean perch and northern, blackspotted, and shortraker rockfishes), and invertebrates (golden king crab and scallops) inhabit the area. The rough, rocky bottom conditions provide abundant substrate for many species of bryozoans, hydroids, sponges and corals. The major goal of this survey is to continue the data time series begun in 1980 to monitor trends in distribution and abundance of important groundfish species, to collect data and specimens to describe and measure various biological and environmental parameters, and to collect biological samples and other data requested by other researchers or research groups.

Stations were sampled with the RACE Division's standardized Poly Nor'Eastern high opening bottom trawls rigged with roller gear (Stauffer 2004). Fishing dimensions of the trawls were measured using acoustic net mensuration equipment and fishing performance was monitored with electronic bottom contact sensors (BCS) and micro-bathythermographs. The survey area extends along the north side of the Aleutian Islands from Akutan Pass (165° W long) to Stalemate Bank (170° E long), west of Attu Island and along the south side of the archipelago from the Islands of the Four Mountains (170° W long) to Stalemate Bank from nearshore waters to as deep as 500 m.

The Aleutian survey area is composed of four of the North Pacific Fishery Management Council (NPFMC) statistical areas: the southern district of the Bering Sea Subarea (518) and the Eastern, Central, and Western Districts of the Aleutian Subarea (541, 542, and 543, respectively). The survey area is divided into 45 area-depth sampling strata to improve the accuracy and precision of resulting estimates of abundance and size and age composition of target species. In 2010 we set out to sample 420 stations during the 140 charter days of the survey. A Neyman optimum allocation strategy drawing on relative species catch rates from previous surveys and current ex-vessel fish values was used to allocate sampling stations among the 45 strata. Although a stratified-random sampling scheme is used for the Aleutian Islands survey, practical considerations of finding trawlable bottom are such that nearly all station locations for this survey are fixed. However, our 2010 station allocations required adding thirteen new stations in four strata.

Standard trawl hauls at each station were 15 minutes in estimated on-bottom duration. Acoustic mensuration devices continuously measured wingspread and headrope height above the bottom. Efforts were made to maintain a constant depth during a tow, however when depths changed, trawl warp length was adjusted appropriately to maintain firm bottom contact. Surface-to-bottom water temperature profiles were recorded using the headrope-mounted bathythermograph during all successful tows except four. After each tow, temperature-depth profile data and tilt data from a bottom contact sensor were downloaded to computer files and actual trawl time on bottom was determined by synchronizing the net configuration data, the time and depth recordings from the bathythermograph, and the bottom contact sensor tilt data. The position of the vessel was recorded during each entire tow trackline using GPS output, allowing us to calculate the duration and distance fished while the net was on bottom.

Catches of fish and invertebrates were sorted to species or species aggregate, weighed, and enumerated according to standard AFSC/RACE Division protocol. Extensive length composition data were collected from major fish species with barcode-based recording devices and downloaded to computer database files after each tow. Biological data including age structures (otoliths), lengths, and weights of individual specimens were collected and entered in the computer database. Special collections included additional samples and scans of fish stomach contents, tissues collected from various species for genetic studies, and ovaries collected from sculpins and Pacific ocean perch for maturity studies. Many whole fish and invertebrates of species of interest were retained (frozen or preserved) for studies of systematics and marine mammal prey energetics.

Results - Relatively little time was lost to bad weather but periods of extreme tidal flow sometimes caused work to be postponed until heavy currents subsided. Sampling proceeded from east to west from the Islands of Four Mountains. A total of 436 tows were attempted during this survey. Successful tows were achieved at 418 of the 420 assigned stations or alternates. Samples from these 418 successful tows, ranging in depth from 28 to 480 m, qualified for use to analyze abundance, distribution, and biological characteristics of the fish and invertebrates collected. Successful surface-to-bottom bathythermograph recordings, including sea surface and bottom temperatures, were recorded during all but four of the tows attempted.

In total, Pacific ocean perch (POP) was, by far, the dominant species in successful survey trawl catches when considering the entire survey area, the Aleutian region as a whole, and in all survey subareas except the Southern Bering Sea. Over the entire survey area, POP was followed in abundance by Atka mackerel, walleye pollock, northern rockfish, Pacific cod, and arrowtooth flounder. In the Aleutian region, Atka mackerel, northern rockfish, walleye pollock, and Pacific cod, in that order, were the species with the next highest total catches. Only walleye pollock catches exceeded those of POP in the Southern Bering Sea and catches of Atka mackerel, Pacific cod, and arrowtooth flounder followed POP in abundance in that area.

Length and individual weight measurements were recorded from over 8,600 fish (34 species). Over 7,700 pairs of otoliths were collected from twenty species of fish for age determination; these were collected from size-stratified samples (random samples for pollock). Generally, samples were collected from species with high commercial value or those of special scientific interest, such as the three species of sculpin. Length measurements were the most common biological data collected; 112,922 observations were collected from 56 different species. Special studies collections made as adjunct activities during the survey included feeding habits of groundfish, systematics and phylogeny of fishes and invertebrates, delineation of stock structure, and investigations of life history and biological characteristics. Collaborating scientists from other divisions within the AFSC, the University of Mississippi, and the University of Alaska Fairbanks participated aboard various legs of the survey. Staff from the REFM Division’s Resource Ecology and Ecosystem Modeling Program scanned the stomach contents of 1,231 fish of 33 species, primarily arrowtooth flounder, walleye pollock, Pacific cod, and Atka mackerel. Another 3,176 stomachs were collected from 25 species for later laboratory analysis. Hundreds of individual fish and invertebrates were frozen or preserved for later laboratory identification or other studies at the AFSC or other institutions.

For further information, contact Chris Rooper (206)526-4689, Chris.Rooper@noaa.gov .

RACE Groundfish Program Habitat Research Group (HRG)

EFH characterization – A variety of methods have been used to define the habitats of marine species. Some rely on purely geophysical characterizations but these are overly simplistic and may ignore significant factors, such as temperature, that affect species distributions. Similarly, standardized habitat-classification schemes are too restrictive in that they do not adequately account for the continuous nature of environmental variability or the associated continuous biological responses. In the eastern Bering Sea (EBS), we are combining abundance estimates from annual bottom trawl surveys with synoptic environmental data to develop basin-scale continuous-valued habitat models for groundfish and benthic invertebrates. The resulting habitat definitions are objective and have quantifiable uncertainty. Predictions are possible, and useful performance metrics can be developed when considering new environmental inputs. Our models are developed with an iterative process that assembles existing data to build 1st generation models. Promising new predictors are then evaluated in limited-scale pilot studies, followed by a direct comparison of alternative sampling tools. Finally, the most cost-effective tool is used to map the new variable over the shelf and the existing model for each species is then updated to complete the iteration.

Previous research has shown that surficial sediments affect the distribution and abundance of groundfish in the EBS. However, direct sampling with grabs and cores is prohibitively inefficient at the spatial scales involved, indicating a need for a different and more efficient sampling strategy. To this end, we know that acoustic systems are suitable for broad-scale surveying and that acoustic returns are influenced by seafloor characteristics, but it is unknown if acoustics measure sediment properties that are relevant to fish. As such, we have conducted several pilot studies with different acoustic systems to determine whether our habitat models for the EBS can be improved with quantitative information about seafloor characteristics. One recent study collected seabed returns from a calibrated single-beam echosounder during a 17,000 km survey covering the EBS shelf. A generalized additive model (GAM) analysis with ten species showed that the echo returns made statistically significant contributions to the best models for each species. The full models explained 28-77% of variability in abundance, with 2–13% of that total contributed by the acoustic predictors (QTCView principal components). Another pilot study using a sidescan sonar in the EBS found an even higher (9-54%) portion of variability in abundance of fish and invertebrates was explained by quantitative acoustic predictors.

Having noted important differences in the relative costs and benefits of different acoustic systems, we have initiated the FISHPAC experiment. Acoustic surveys will be conducted along strong gradients of groundfish abundance using five different sonar systems. The relative value of backscatter as a habitat-defining character will be judged for each system based on the statistical correlation between normalized backscatter and the time series of fish densities at selected trawl-survey stations. The five systems being compared include two hull-mounted hydrographic-quality multibeam echosounders (Reson models 7111 and 8160), a towed high-resolution interferometric sidescan sonar (Klein 5410), and a prototype towed long-range sidescan sonar system (Klein 7180 LRSSS) which also incorporates an independent 38 kHz single beam echosounder. The LRSSS is a new type of sonar for fisheries research that produces fully-corrected quantitative backscatter and bathymetry over a maximum swath of 1200 meters, while surveying at speeds up to 12 knots. Data from auxiliary sensors on the LRSSS that measure concentrations of dissolved organics, chlorophyll-a, and total particulates along the tow path will also be evaluated for use in future versions of the models.

Effects of Fishing – The TRAWLEX research program is examining potential effects of bottom trawls on a soft-bottom benthic community in the EBS. Similar scientific inquiries are being conducted in other historically important areas around the world. Because of the long history of trawl prohibitions in Bristol Bay and the availability of quality fishing effort data, the area is particularly well suited to studies of this type. Moreover, since responses to trawling are very site-specific, reflecting the diversity of benthic systems and fishing gears and the relative importance of natural phenomena such as storms, the interests of resource management, the public and the various harvest sectors are best served by a local study. This research addresses Congressional mandates to investigate potential adverse impacts of fishing gear on essential fish habitats.

RAWLEX was commenced in the summer of 2001 to examine the effects of commercial trawling on the density of benthic invertebrates in a naturally disturbed area in Bristol Bay. The study used a Before-After-Control-Impact (BACI) design. Six pairs of 20 km parallel corridors were laid out, three with a N-S and three with an E-W orientation. Within each pair, one was randomly selected as the impact or treatment corridor. Each corridor was subdivided along its length into sampling units, each separated from the next by 100 m. Sampling units were always selected at random without replacement. Four passes with the trawl were made along the length of each treatment corridor. The width of the corridor equaled that of the trawl. Before treatment, sampling was conducted in three sampling units. Sampling consisted of two sediment samples per unit followed by a single pass with a small research trawl. After treatment, the sampling protocol was repeated, again in three units. The work took roughly a month to complete. The sample size determination was based on prior data with a target of an 80% likelihood of detecting a 50% change in density within each taxonomic group. Catch-per-Unit Effort (CPUE) data were analyzed for 24 taxonomic groups (ranging from species to order) before and after trawling. In addition to the BACI design, covariates (depth, water temperature, and various sediment measurements) were included in the analyses to minimize effects of random variations in the habitat.

There was no evidence that the covariates were associated with changes in the CPUEs due to any commercial trawling effects. "Statistically significant" effects of commercial trawling were found in three of the 24 taxonomic groups. But given the level of the test that was used in the analysis, one would expect to find 2.4 significant results due to nothing more that random variation in the data. Hence we are concluding that the experiment yields no real evidence that the level of commercial trawling used in this experiment affects the CPUE in a substantial way. The study area was revisited during the summer of 2002 and the after-treatment sampling protocol was repeated to assess whether any long term (one year) effects on CPUE could be observed. Again, nothing other than minimal effects was observed, no effects that could not be differentiated from random variation. Details of the analyses and results are currently being written up for publication. Trawl impact studies based on the TRAWLEX designs are being planned for the Northern Bering Sea Research Area, a previously unfished area that may have potential for future fisheries development under a climate change scenario.

In addition to TRAWLEX research, two literature-reference databases are maintained listing peer-reviewed papers respectively on Mobile Fishing Gear Effects (MFGE) and on various subjects relating to ecologically important marine invertebrates. In 2009-2010 new article references were added to the respective databases, and the MFGE database was recently published online on the AFSC website (http://access.afsc.noaa.gov/mfge). Information from literature available using these databases should assist the design and interpretation of HRG experiments.

Another tool for directing further research are synopses of biological and ecological information on invertebrate taxa important to the benthic ecology of the EBS. Maps showing yearly abundance distribution of each taxon over the EBS from 1982 to 2010 will be included. The first in the series describes the general life history, food habits, and mortality sources for the four species of the prosobranch genus *Neptunea* most common in the EBS, *N. pribiloffensis*, *N. lyrata*, *N. heros*, and *N. ventricosa*. The manuscript was made ready for review. The synopses will be published online and as a series of technical memoranda.

Benthic ecology – Infauna are the principal prey for many flatfishes. Since food availability is a strong driving force in habitat selection, the structure of the infauna community can be a useful predictor of favorable fish habitats. 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. Ecological investigations of linkages between infauna, groundfish diets, and habitats in the EBS are continuing in collaboration with the Resource Ecology and Ecosystem Modeling (REEM) program (Mei-Sun Yang) of the AFSC Resource Ecology and Fisheries Management (REFM) division. The ultimate goals of these investigations are to improve models of fish distribution and abundance, and build an ecological knowledge base of the benthic community in the EBS for fisheries research. Field sampling has been conducted in cooperation with the RACE bottom trawl survey and the FISHPAC project to obtain concomitant benthic habitat and fish diet data. A pilot study in 2006 established the first new observations in nearly three decades on the polychaete assemblages – by far the most abundant infauna group – at 26 RACE bottom trawl survey stations in the EBS. Spatial associations among benthic habitat characteristics, groundfish predators, and polychaete prey were explored (Yeung et al. 2010). Further benthic sampling was conducted at 31 more trawl survey stations in 2009 during a FISHPAC survey. Stomach contents of major flatfish species (Alaska plaice, yellowfin sole, flathead sole, northern rock sole, and longhead dab) were collected at those same stations in the same period on the 2009 trawl survey. Analysis to correlate fish diets with infauna and biogeochemistry of the habitats is in progress. In 2010, resumption of the RACE bottom trawl survey in the northern Bering Sea (NBS) after a two-decade hiatus provided an opportunity to collect crucial habitat and groundfish diet information on an area that has not been commercially trawled, but that may have potential for future fisheries development (the Northern Bering Sea Research Area). Twelve stations along a north-south transect east of St. Lawrence Island were sampled. Benthic grab samples were collected for infauna and sediment analysis to characterize benthic prey field and habitats. Stomachs and tissue of target flatfish species were collected to analyze food habits and trophic dynamics. The suitability of the NBS for groundfish populations will be evaluated by comparison with corresponding datasets from the southeastern Bering Sea.

The literature database on marine invertebrates and synopses of ecology and life history of select invertebrate taxa essential to Eastern Bering Sea (see Effects of Fishing section above) will be useful to research in benthic ecology. Further, to assist effective use of catch data from annual RACE EBS bottom trawl surveys, an extensive computer program has been developed consisting of a SQL-Plus query and accompanying tables of taxonomic information and systematics. The query eliminates some ambiguity in catch classification resulting from past inconsistencies in the resolution of taxonomic identification of catch. One cannot always be sure records designated as for a particular taxon account for all of that taxon caught in a given set of field samples, if higher taxa technically inclusive of the one in question are also reported therefrom. Thus, the query searches for similarly-related taxa within the group of samples chosen, and reclassifies catch according to the lowest accountable inclusive taxon (LAIT), thereby eliminating such ambiguity. The possibility of changes in taxonomic classifications in historic RACE survey data and of newly identified taxa appearing in the data for the first time require that the tables and query be updated yearly.

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

Resource Ecology and Ecosystem Modeling Program (REEM) – REFM

Multispecies, foodweb, and ecosystem modeling and research are ongoing. Documents, symposia and workshop presentations, and a detailed program overview are available on the World Wide Web. These can be viewed from the Alaska Fisheries Science Center (AFSC) web site at: http://www.afsc.noaa.gov/REFM/REEM/Default.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. While continuing to collect stomach samples from fishes typically having a significant predatory impact on commercially important species, emphasis is being placed on collecting stomachs during seasons and from species and 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 REEM's spatial and seasonal coverage are obtained through the Observer Program and through coordinated studies with other agencies. In 2010, REEM collected samples and data during bottom trawl and/or midwater surveys of the Aleutian Islands, the eastern Bering Sea (EBS) continental slope and shelf, and the northern Bering Sea and Norton Sound. Stomach samples were also collected during surveys by other agencies and by Observers during fishery operations. Regionally, 8,340 stomach samples were collected from the EBS shelf and slope, 2,028 were collected from the northern Bering Sea, 3,197 were collected from the Aleutian Islands, and 168 were collected from the Gulf of Alaska (GOA). Laboratory analysis was conducted on 9,154 fish stomachs from the EBS, 693 fish stomachs from the GOA, and 21 fish stomachs from the Aleutian Islands. At-sea analysis was conducted on 1,231 fish stomachs from the Aleutian Islands. In the laboratory, 2,741 tissue samples were dried in preparation for stable isotope analysis. The REEM predator-prey database was updated with 41,461 records in 2010.

Rapid identification of prey species using morphological characteristics is not always possible because some common prey species disarticulate at the head and tail fairly rapidly, and the remains consist of an incomplete vertebral column with some flesh attached. In a collaborative project with FOCI, we are developing rapid and cost-effective methods of molecular identification to apply to groups of difficult to distinguish species (NPRB #924). The polymerase chain reaction (PCR) method and restriction fragment length polymorphisms (RFLP) were used to develop protocols for the identification of forage fish prey found in fish stomachs. Taxonomic identifications of the forage fish prey were made to species using the physical characteristics of the fish remains. Tissue samples from each of the digested forage fish prey were collected for molecular analysis using the PCR-RFLP protocols. We found 100% concordance in species identifications using the PCR-RFLP protocol and identifications using remaining physical characteristics. In addition, six taxonomically unidentifiable fish prey were sequenced, providing identification of a Pacific sand lance (*Ammodytes hexapterus*), a northern smoothtongue (*Leuroglossus schmidti*), a northern rock sole (*Lepidopsetta polyxystra*), and three sculpins (family Cottidae).

Predator-Prey Interactions and Fish Ecology
Accessibility and visualization of the predator-prey data through the web can be found at http://www.afsc.noaa.gov/REFM/REEM/data/default.htm. The predator fish species for which we have available stomach contents data can be found at http://access.afsc.noaa.gov/REEM/WebDietData/Table1.php. Diet composition tables have been compiled for many predators and can be accessed, along with sampling location maps at http://access.afsc.noaa.gov/REEM/WebDietData/DietTableIntro.php.
The geographic distribution and relative consumption of major prey types for Pacific cod, walleye pollock, and arrowtooth flounder sampled during summer resource surveys can be found at http://www.afsc.noaa.gov/REFM/REEM/map/DietMap.php. REEM also compiles life history information for many species of fish in Alaskan waters, and this information can be located at http://access.afsc.noaa.gov/reem/lhweb/index.cfm.

A study supported by the Essential Fish Habitat fund, is focused on correlating the diets of some small-mouth flatfish with their specific habitats in the eastern Bering Sea area. Benthic grab samples and stomachs from small-mouthed flatfish were collected at 27 stations. The habitat types for the stations were categorized as sandy (%sand $\geq$80), muddy sand (50 $\leq$%sand <80), sandy mud (50 $\leq$%mud <80), and muddy (%mud $\geq$80). The diets of these small-mouth flatfish included polychaetes, clams, amphipods, and brittle stars. Diets varied among flatfish species, among size-groups of the same species, and among habitat types. The finding that diet differed with habitat type, even for the same predator species, indicates that it is important to combine habitat and food habits information to understand predator-prey relationships in the marine ecosystem.

An analysis of 30 years of seasonal and geographic variability in marine foodwebs was conducted utilizing stomach contents and stable isotope data. This project was supported by the North Pacific Research Board (NPRB #622). Walleye pollock (*Theragra chalcogramma*) consume up to 60% of the secondary production in the Bering Sea annually, and thus are a keystone predator. The biogeographical patterns of their prey over time indicate oceanic domains, for example with copepods dominating pollock diets on the outer Bering Sea shelf, euphausiids dominating the inner shelf and southern portion of the Bering Sea, and amphipods being a primary prey associated with the Bering Sea Cold Pool (Fig. 1). Trophic level patterns, as calculated from stomach contents, showed higher trophic levels for walleye pollock on the outer shelf of the eastern Bering Sea than the inner shelf (Fig. 2, top), while analysis of stable isotope ratios of nitrogen showed higher trophic levels on the inner shelf, particularly in Bristol Bay (Fig. 2, bottom). This difference highlights that stomach contents analysis primarily measures trophic level as a function of zooplanktivory/piscivory within fish, while stable isotope results may be dominated by lower-trophic level (within zooplankton) processes such as uptake water mass and microzooplankton food-chain length.

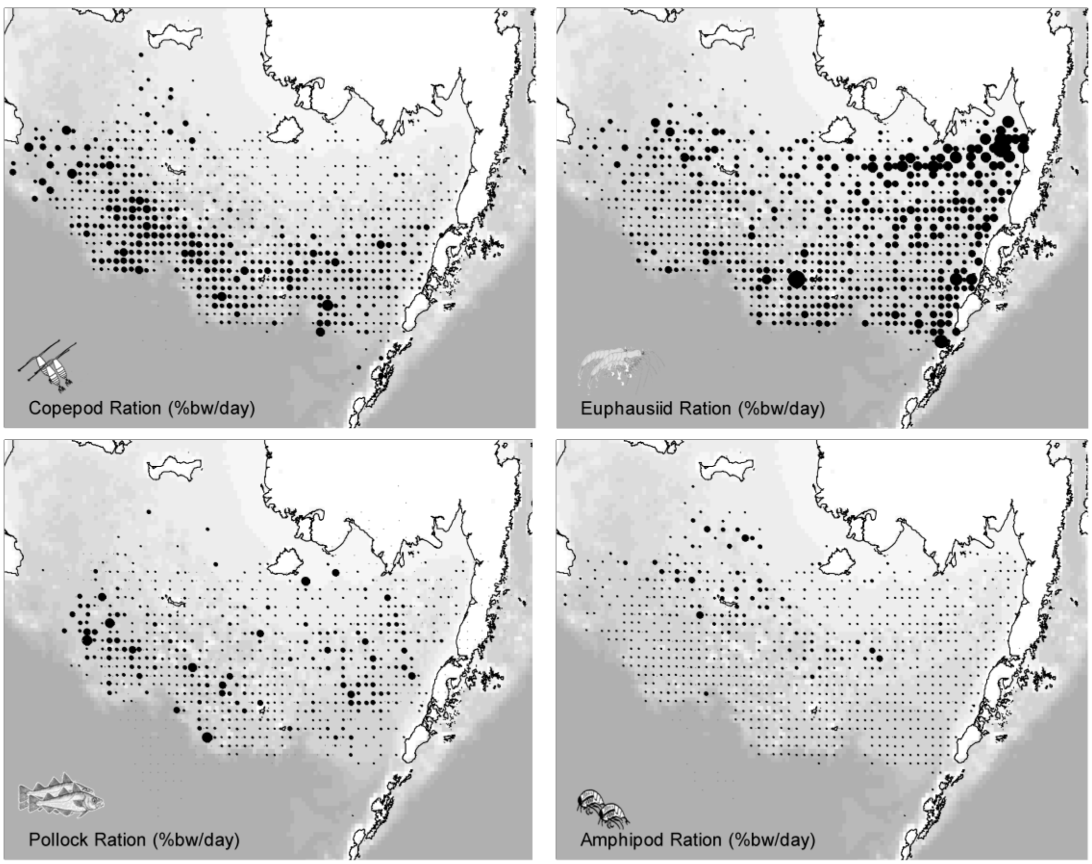

Figure 1. The relative ration of walleye pollock as measured from prey weights in pollock stomach contents, for four major prey types from May-September, combining all years 1982-2008.

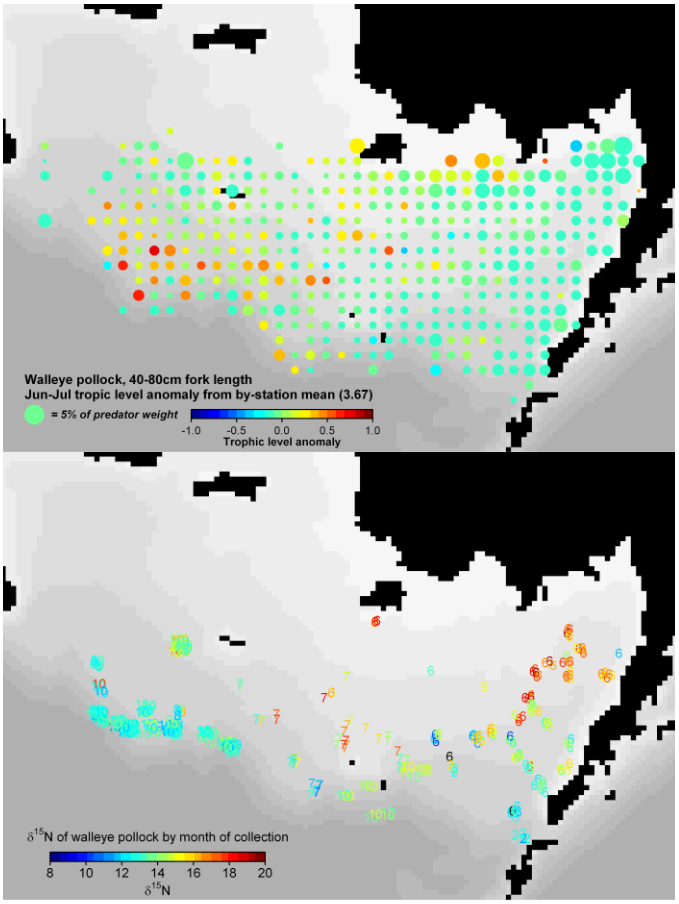

Figure 2. Trophic level anomalies as calculated from pollock stomach contents in June-July 1982-2008 (top; colors indicate calculated trophic level anomalies) and from stable isotope samples collected in 2006-2008 (colors indicate isotope anomalies of nitrogen; numbers indicate month of collection).

Relationships between walleye pollock and their zooplankton prey are being investigated to support parameterization of the FEAST model (Forage/Euphausiid Abundance in Space and Time) for the North Pacific Research Board's Bering Sea Integrated Ecosystem Research Program (BSIERP). One source of zooplankton community data is the Bongo net tows conducted during the Alaska Fisheries Science Center's bottom trawl survey of the eastern Bering Sea continental shelf. Walleye pollock stomach samples were targeted for collection at nearly the same location and time during 2006, 2007, and 2008. Generally, the Bongo net captured mostly copepods, some chaetognaths, and fewer euphausiids and larvaceans. As is typical in the pollock diet, copepods tended to be a greater percentage of the consumed zooplankton along the outer edge of the continental shelf, and copepods were generally more important in the diet of smaller pollock (FL $\leq$ 45 cm) than larger pollock (FL $\geq$ 46 cm). Preliminary results indicate that for smaller pollock, when copepods are eaten at the station, there may be a weak positive relationship between number of copepods eaten per fish and local copepod density in the water (Fig. 3). At stations where euphausiids occur in the Bongo net catch, the average number of euphausiids eaten by larger pollock may have a weak negative relationship to euphausiid density in the water (Fig. 4). In other words, when more euphausiids are found in pollock stomachs, there appears to be fewer in the water. This may suggest that pollock can rapidly graze down the local abundance of euphausiids.

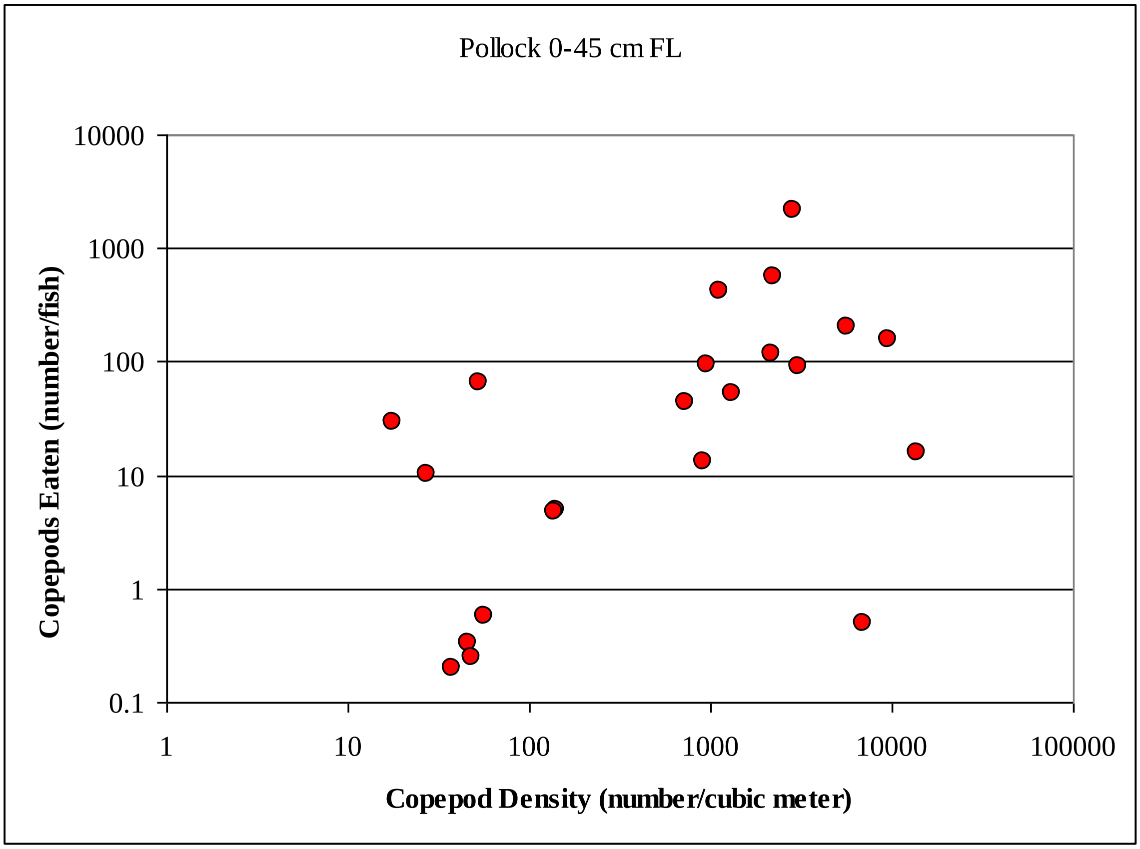

Figure 3. The average number of copepods eaten per fish by smaller pollock plotted against the copepod density found at that station.

Size-selectivity of euphausiids by walleye pollock and Methot nets were compared. These walleye pollock stomach samples and Methot euphausiid samples were collected during the 2009 EBS hydroacoustic survey. The length distribution of euphausiids in the diet of walleye pollock was similar to that caught in the nets with possibly a slight shift to the smaller side of the distribution for euphausiids consumed (Fig. 5). This difference did not appear to be caused by the physical or chemical effects of being consumed, nor by differences in measurement methods between the samples, because the opposite shift in length distribution appears to occur for two of the less abundant species, *Thysanoessa longipes* and *T. spinifera*. The body length of consumed euphausiids was found to be similar for all sizes of walleye pollock examined (Fig 6).

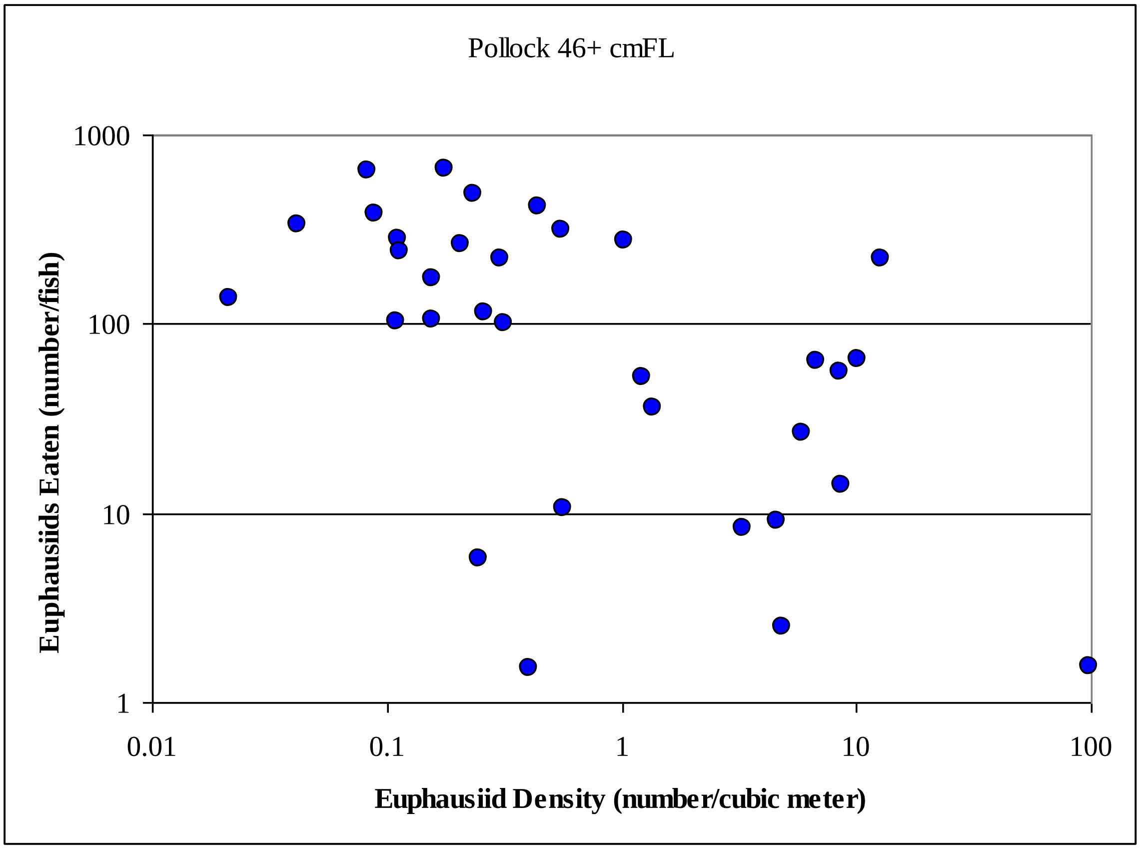

Figure 4. The average number of euphausiids eaten per fish by larger pollock plotted against the euphausiid density found at that station.

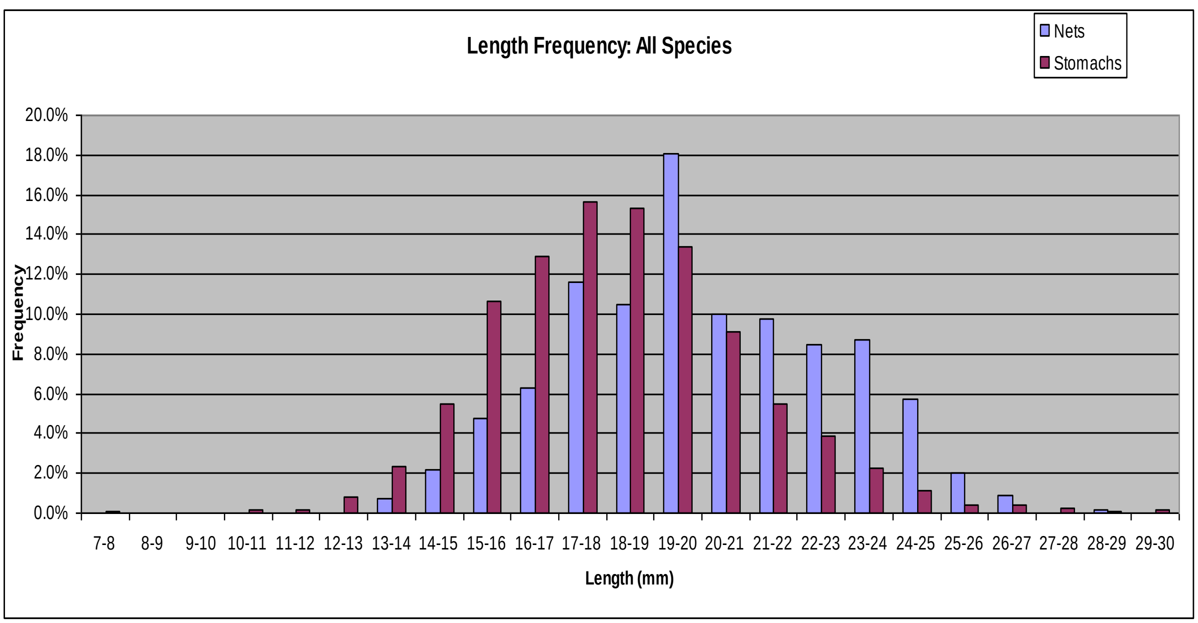

Figure 5. Length frequency of euphausiids caught by nets (blue) and consumed by walleye pollock (red) from the 2009 Hydroacoustic survey.

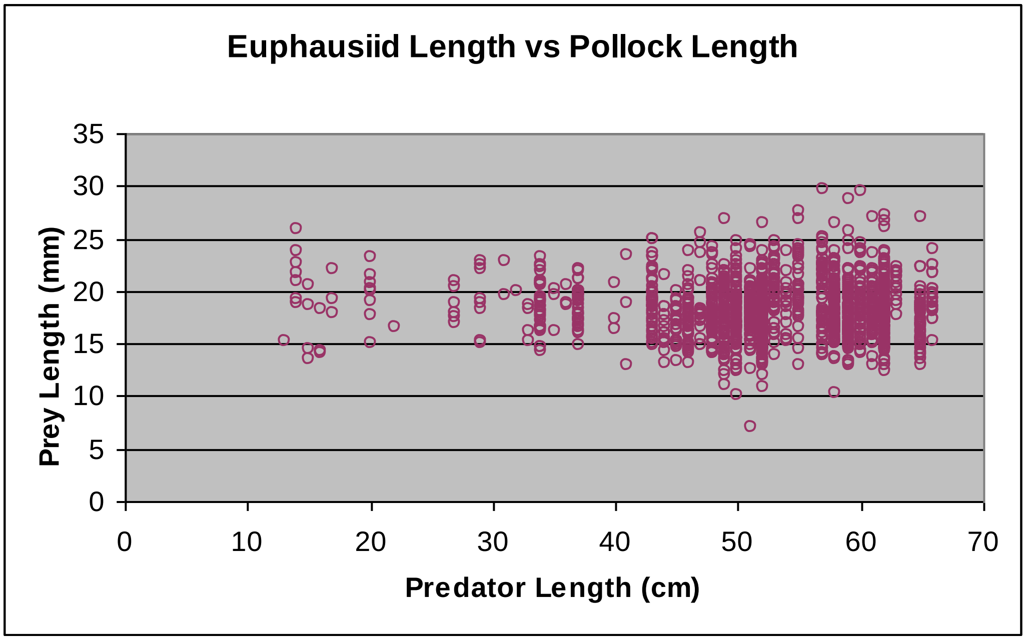

Figure 6. Consumed euphausiid lengths plotted against walleye pollock lengths.

<u>Seabird – Fishery Interaction Research</u>
The AFSC Coordinated Seabird Studies Group serves a broad suite of end-users. We use the term "Group" to signify the highly collaborative nature of the program, which relies on many others in and outside of the AFSC to produce the products that interest the end-users. One good example of this collaboration is our dependency on the Fisheries Management and Analysis Division in the production of high-quality data through observers deployed to commercial fishing vessels in the Alaskan Groundfish Fisheries. Seabird mitigation research has been conducted in partnership with the Washington Sea Grant Program for many years. Much of the core work currently involves seabird/fishery interactions and serving the needs of clients such as the USFWS, but we are also working with the National Seabird Program and other Science Centers to make apparent the great value of using seabirds as a tool for studies on marine ecosystems and processes. Recently, COASST was chosen by the AFSC Coordinated Seabird Studies Group to provide the Observer seabird training sessions in Seattle. By bringing in a team of experts in training of seabird identification (especially those seabirds recovered as bycatch) AFSC staff can focus resources on other products. As the core fishery interaction work is developed and stabilized with appropriate funding, we hope to report on the much broader aspect of NOAA's involvement with seabirds in Alaskan waters.

A high priority activity is to develop the systems and processes so that the AFSC can once again produce annual reports of seabird bycatch estimates for the Alaskan Groundfish Fisheries. We are currently collaborating closely with the Sustainable Fisheries Division in the Alaska Regional Office to provide some automation of that previously staff-intensive process by using the Catch Accounting System.

The current products focus primarily on seabird interactions with commercial fisheries. The aspects that we work on include basic data on seabird bycatch; a wide array of other information

and data from the field, including the collection of seabird carcasses for life history and food habits research; improving methods for monitoring seabird bycatch; monitoring the effectiveness of seabird mitigation measures; supporting or conducting research into bycatch mitigation measures; completing annual reports of seabird bycatch estimates in Alaskan Groundfish Fisheries; and making all this information available through conference presentations and posters, AFSC Reports and Technical Memos, white papers, and journal articles. More details about available information can be obtained through: the Pacific Seabird Group (PSG) website, http://www.pacificseabirdgroup.org/ under the heading Annual Meeting;
the World Seabird Conference at http://www.worldseabirdconference.com ;
http://alaskafisheries.noaa.gov/protectedresources/seabirds/national.htm#presentations ;
and at http://www.afsc.noaa.gov/REFM/REEM/REEMPosters.php.

In 2010, observed takes of short-tailed albatross in the cod freezer longliner fishery occurred for the first time since 1998. The short-tailed albatross is an endangered seabird and the groundfish demersal longline fishery operates under a biological opinion that provides an incidental take of 4 birds in a two year period. 2010 is the first year in the current 2-year period. Exceeding the allowable incidental take initiates an ESA Section 7 Consultation between NOAA and the USFWS. An excerpt from the information bulletin released by NMFS (see link below) notes: "The first bird was taken on August 27, 2010, at 56 37' N and 172 57' W in NMFS reporting area 523. The bird had an identifying leg band from its natal breeding colony in Japan. It was a subadult at 7 years and 10 months old. The second bird was also taken in the BSAI on September 14, 2010, at 59 20' N and 176 33' W in NMFS reporting area 521. This bird also had an identifying legband and was 3 years and 10 months."
http://alaskafisheries.noaa.gov/index/infobulletins/bulletin.asp?BulletinID=7271

The Alaskan cod freezer longliner fleet has been one of the most proactive fleets anywhere in the world in trying to reduce their bycatch of seabirds. They have been especially concerned with trying to eliminate the bycatch of short-tailed albatross. Given the high levels of observer coverage on these vessels, they can be commended for going 12 years without an observed take and for the nearly 80% reduction overall in seabird bycatch. Their history of collaboration and taking the lead in seabird bycatch reduction is a model for other fisheries. The fleet was an integral component of research led by Washington Sea Grant on streamer lines, voluntarily started using streamer lines two years before regulations required their use, and has worked throughout it all to take advantage of in-season data produced by the Observer Program (Fisheries Monitoring and Analysis Division, AFSC) to monitor individual vessel performance. Their efforts continue as AFSC staff works with the Freezer Longline Coalition to develop programs to further reduce seabird bycatch by its vessels. To date, a total of 7 Short-tailed albatross have been taken in the Alaskan demersal groundfish fishery (blackcod and cod) since 1993.

Multi-species and Ecosystem Modeling

Food web relationships for commercially important species were examined to identify sources of variability in mortality and production which are not included in standard single-species stock assessments. A static mass balance model was used to evaluate relationships between species in the coastal Gulf of Alaska. Four case study species groups were included to represent broader food web relationships: Pacific halibut, longnose skate, walleye pollock, and squids. For each, the species' position within the food web, the fishing mortality relative to predation mortality, and the diet composition were evaluated. High trophic level species, whether commercially valuable (halibut) or incidentally caught (skates), were found to have mortality patterns consistent with single-species assessment assumptions, where fishing mortality dominates natural mortality. However, assessments for commercially valuable (pollock) or incidentally caught (squids) mid-trophic level species were enhanced by including food web-derived predation information, because fishing mortality is small compared with high and variable predation mortality (Fig. 7). Finally, food web relationships were outlined that suggest how production of species may change with diet composition or prey availability.

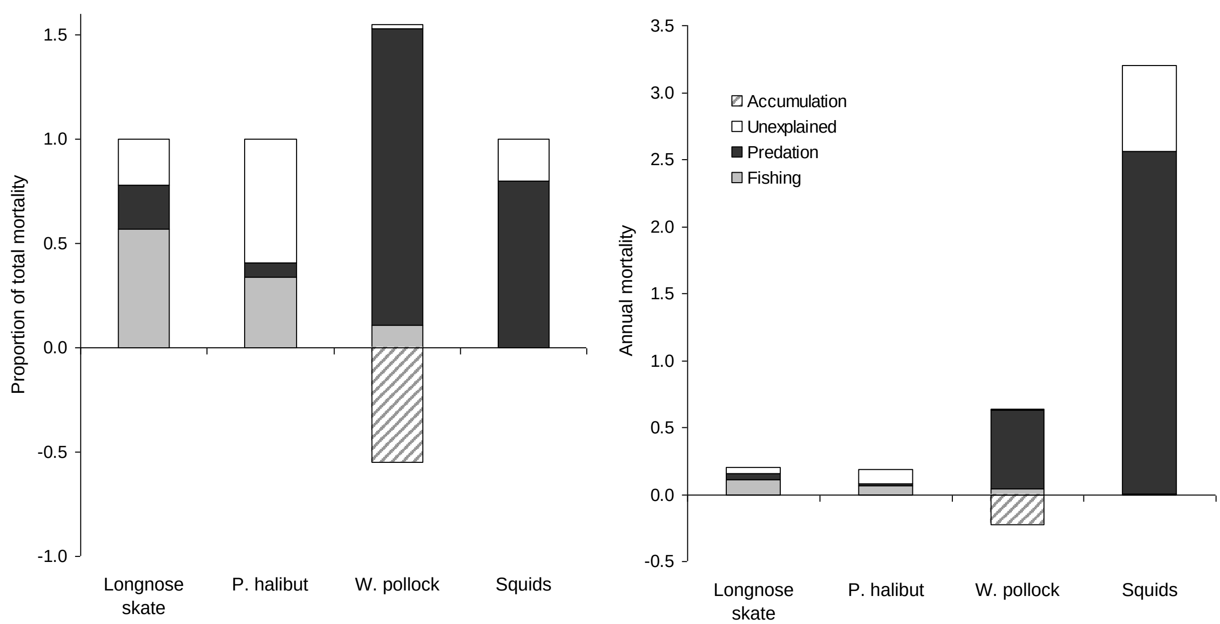

Figure 7. Mortality of species groups as partitioned by the GOA food web model, with case study groups arranged from highest (left,) to lowest (right) trophic level. (a) fishing, predation, and unexplained mortality as a proportion of total mortality for each species (mortality sums to 1). (b): fishing, predation, and unexplained mortality relative to the total annual production rate of each case study species group (mortality sums to annual P/B ratio; P/B = Accumulation + Unexplained mortality + Predation mortality + Fishing mortality). Note that for pollock, the Accumulation (BA) term is negative in this sum.

Development of the Forage and Euphausiid Abundance in Space and Time (FEAST) model has undergone substantial progress through incorporation of feedback from specialists on biological parameters and processes, and through additional code to incorporate age-length structure, three additional fish species and catch removals. FEAST is part of the Bering Sea Integrated Ecosystem Research Program (BSIERP), a partnership between the North Pacific Research Board and NSF, funding 35 linked projects on the Bering Sea. FEAST is a multispecies bioenergetics model for forage and predatory fish species linked to NPZ (Nutrient-Phytoplankton-Zooplakton) and ROMS (Regional Ocean Modeling System) models for the Northeast Pacific and Bering Sea at a 10km resolution. This 3D model of the Bering Sea will model the coupling between physics, plankton, forage fish, and predatory fish. FEAST models twelve fish species which have a two way interaction with the seven zooplankton groups in the NPZ model (small/large microzooplankton, small/large copepods, euphausiids, jellyfish, and benthic infauna). Additionally, temperature and advection from the ROMS model are used in the bioenergetics and movement components. The operating hypothesis in FEAST is that forage fish and macrozooplankton (e.g. euphausiids) are tightly coupled in a two-way interaction, and the dynamics of this interaction under different climate scenarios is a strong structuring element for the ecosystem as a whole.

Another BSIERP-supported collaboration is exploring the concept of "calorie-sheds" based on subsistence harvest of marine species by native Alaskan communities. Through mapping the seasonal distributions of the major harvested species, the extensive geographic range from which calories are drawn through central-place harvesting is illustrated (Fig. 8).

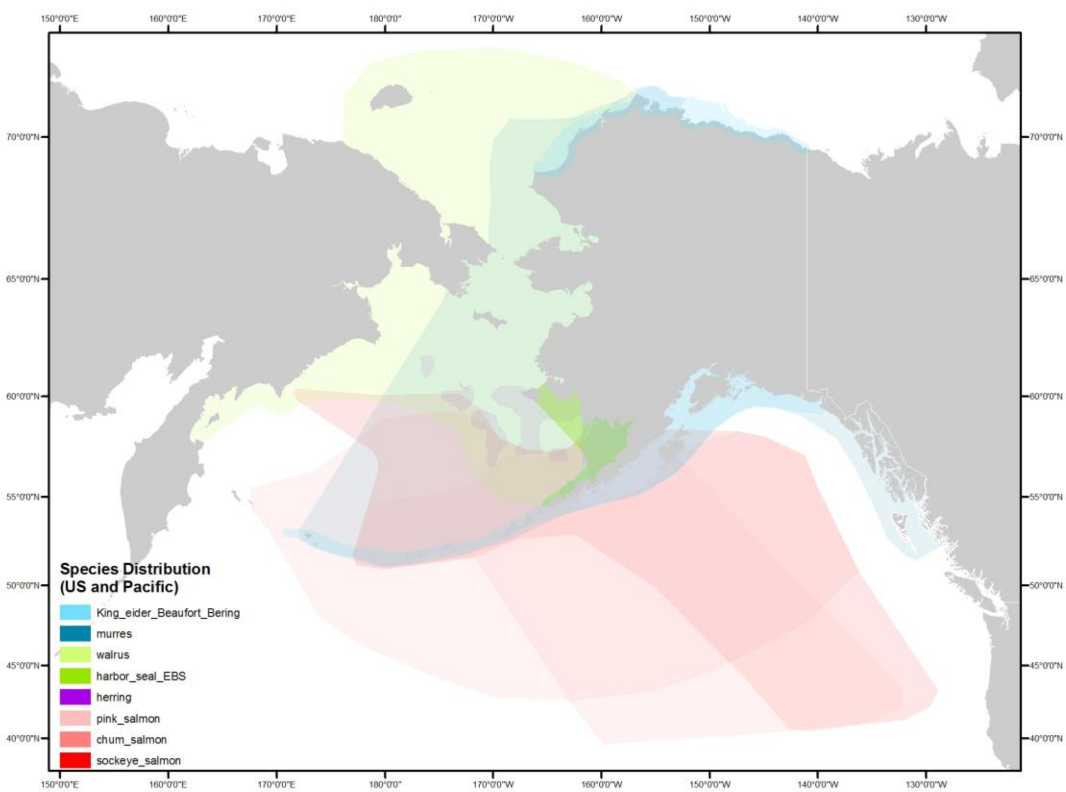

Figure 8. Calorie-shed mapping for top marine subsistence harvest species in Togiak, Alaska. Shading represents the area where the species/populations harvested are distributed throughout the year in the North Pacific.

REEM ecosystem modelers participated in the international Stock Production Modeling Workshop funded through the CAMEO program. Fifteen U.S scientists from the NMFS Alaska and Northeast Fisheries Science Centers, the Universities of Washington, Maryland, Rhode Island, and Alaska worked together with seven Canadian and three Norwegian colleagues to assemble data on eight ecosystems for comparisons using production modeling methods. The ultimate goal of the comparisons is to elucidate how three types of drivers—fishing, feeding, and physical—interact to affect ecosystem production. Data from Gulf of Alaska and Eastern Bering Sea ecosystems were compared with data from the Straight of Georgia ecosystem in the northeast Pacific, the Gulf of Maine/Georges Bank, Scotian Shelf/Bay of Fundy, Labrador/Newfoundland, and Gulf of St. Lawrence ecosystems in the northwest Atlantic, and the Norwegian/Barents Sea ecosystem in the northeast Atlantic.

Ecosystem Considerations

The Ecosystem Considerations chapter is produced annually as part of the Stock Assessment and Fishery Evaluation (SAFE) report for the North Pacific Fishery Management Council (NPFMC) to provide an overview of marine ecosystems in Alaska. This year, the Ecosystem Considerations chapter includes both updated and new sections, supported by the Science and Statistical Committee (SSC).

The section describing ecosystem and management indicators includes updates to 41 individual contributions and presents 4 new contributions. These include: (1) Late Summer/Fall Abundances of Large Zooplankton in the Eastern Bering Sea, (2) Fall Condition of YOY Predicts Recruitment of Age-1 Walleye Pollock, (3) Juvenile Salmon Growth and Temperature Change as Predictors of Subsequent Recruitment of Groundfish in the Gulf of Alaska and the Bering Sea, and (4) Pribilof Islands Seabird Trends. One of the additional contributions presents zooplankton data for the eastern Bering Sea, contrasting the community composition in warm and cold years and between northern and southern portions of the shelf (Fig. 9).

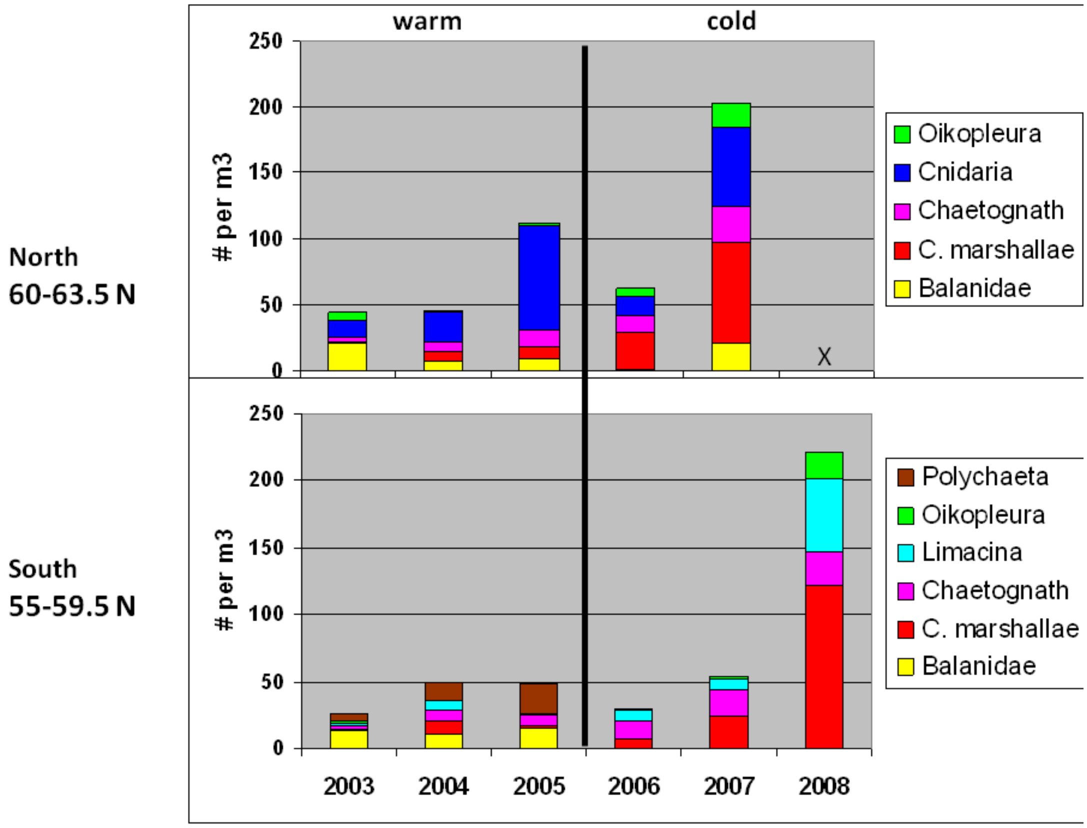

Figure 9. Mean abundance of large zooplankton (excluding euphausiids) collected with oblique bongo tows (505 µm mesh) on the Bering Sea shelf (< 100 m) during BASIS surveys in the northern (top panel) and southern (bottom panel) Bering Sea.

The ecosystem assessment section includes a new synthetic Eastern Bering Sea Ecosystem Assessment which was developed by a multidisciplinary team of experts during a series of workshops in 2010. In addition, a Hot Topics subsection was designed to present a succinct overview of potential concerns for fishery management, including endangered species issues and early warnings of potential future fishery management interest. Endangered species information critical to fishery management presented this year include updates on short-tailed albatross bycatch and Steller sea lions in the Eastern Bering Sea. Early warnings of potential future fishery management interest this year includes a summary of rare species observed in recent years in the Eastern Bering Sea. Findings from this chapter were presented to the NPFMC joint plan teams and to the SSC. To see the chapter in its entirety, see the website at: http://access.afsc.noaa.gov/reem/ecoweb

Also new for 2010, the Ecosystem Considerations chapter contains a "Report Card" on the status and trends of 10 comprehensive ecosystem indicators for the Eastern Bering Sea. The EBS Report Card provides a two page summary of the new synthetic Eastern Bering Sea Ecosystem Assessment which was developed by a multidisciplinary team of experts during a series of workshops in 2010. All of this work was completed with the support of the Fisheries and the Environment (FATE) program, as well as the North Pacific Climate Regimes and Ecosystem

Productivity program (NPCREP). The initial EBS Ecosystem Assessment focused on a subset of 10 broad, community-level indicators to determine the current state and likely future trends of ecosystem productivity overall, including switches between major pathways (benthic/pelagic). Indicators were selected that were thought to best guide managers on ensuring the needs of non-fishery apex predators and on maintaining a sustainable species mix in the harvest, given the current state and likely future trends of overall productivity and the distribution/strength of the pathways. The EBS report card and Ecosystem Assessment were presented to the NPFMC Groundfish Plan Teams and to the NPFMC as part of the annual catch specification process. The final report, including the Report Card and the Ecosystem Assessment, is available at http://access.afsc.noaa.gov/reem/ecoweb/Eco2010.pdf

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.

North Pacific Fisheries Observer Program – FMA Division

<u>FY 2010 Program Highlights</u>
In 2010, the North Pacific Groundfish Observer Program (NPGOP) celebrated 20 years of observing the domestic groundfish fishery. Over 600 different NPGOP observers were trained, briefed, and equipped for deployment to vessels and processing facilities operating in the Bering Sea and Gulf of Alaska groundfish fisheries. These observers collected data onboard 263 vessels and at 18 processing facilities for a total of 35,681 days at sea.

The data provided by NPGOP observers enabled the tracking of over 1,500 separate management quotas for Alaska groundfish. The program provides real-time catch estimation for North Pacific groundfish fisheries and is supported through combined NMFS and industry funding. NMFS allocated approximately $6,500,000 in observer program funds to the Alaska Fisheries Science Center in 2010, whereas the fishing industry contributed approximately $13,000,000 to the overall program in payments to NMFS certified contractors for observer salaries, insurance, and travel expenses.

Maps of publicly available observer data from the North Pacific Groundfish Observer Pimpingement datarogram are available at: http://www.afsc.noaa.gov/fma/spatial_data.htm. These maps are designed to provide a better understanding of where groundfish are caught in the Aleutian Islands, Bering Sea and Gulf of Alaska. Further information on the program can be found at: http://www.afsc.noaa.gov/FMA/default.htm.

Observer Program Restructuring
NMFS and the North Pacific Fishery Management Council made significant progress in addressing longstanding issues related to the structure, scope and funding for the North Pacific Groundfish Observer Program. In October of 2010, the North Pacific Council took final action

and selected a restructuring alternative. The restructuring will: 1) establish a system of fees from all vessels less than 100 percent covered, and 2) provide NMFS the authority to select observers for placement aboard fishing vessels as necessary. As a replacement for the existing vessel length-based categories, the selected alternative proposes a two tier system of coverage. Under the restructured program, NMFS will develop and implement a statistically designed vessel selection process for observer coverage on all vessels that are not covered 100% of the time. This will give NMFS flexibility to decide when and where to deploy observers. An ex-vessel value fee authorized under MSA Section 313(d) will be implemented for all landings made by vessels with less than 100% coverage. The fee percentage (and the level of Federal funding, if available) will determine the program's budget and will directly affect coverage levels in the fisheries covered by the program and costs paid by industry. This action addresses an outstanding recommendation by the Department of Commerce Office of the Inspector General for NMFS to work with the North Pacific Council to establish a scientifically valid and unbiased vessel selection process for obtaining observer coverage.

The NPGOP is currently working with the North Pacific Fishery Managment Council (NPFMC) and their Observer Advisory Committee to develop the regulations which will implement these changes to the observer program. The rule making phase of this project will be conducted in 2011 and 2012, with a potential implementation in 2013, depending, in part, on start up funding being available. More information on restructuring can be found on the North Pacific Council website: www.alaskafisheries.noaa.gov/npfmc/current_issues/observer/observer.htm

The Development of Amendment 91 to the Bering Sea Aleutian Islands FMP

The NPGOP was actively engaged in the planning and rule making to implement Amendment 91 to the Bering Sea and Aleutian Islands Fishery Management Plan. This amendment implemented a cap on the bycatch of Chinook salmon in the pollock fishery, and required an extensive re-working of the observer data collections to support the need for highly accurate counts of salmon of that amendment. Included are extensive tissue collections from salmon in support of genetic studies on the stock composition of the bycaught salmon.

Redesigned Bird Data Collections

The NPGPOP rolled out a redesigned data collection system in 2010 with major changes to the information collected on seabirds. While we have included birds that were in our samples in the database for many years, a considerable amount of other information on bird interactions was being collected in hand written notes and comments. The practice of recoding information in hand written notes made it very difficult to access, compile, and interpret the information. Our efforts reviewed these data collections and established defined processes for their collection, recording, debriefing, and inclusion in the database. Thus, commencing in 2010, the bird information collections are now organized, quality control checked, and stored in a database accessible to end users.

Last, staff of the NPGOP participate in several meetings of the NPFMC, their Observer Advisory subcommittee, and their enforcement committee. We have also contributed to several analyses supporting Council decision making and work closely on many issues with the Alaska Regional Office's and the NPFMC's staff.

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

C. By Species

1. Pacific Cod

a. Research

Juvenile Pacific cod nursery and habitat study – RACE Kodiak, collaboration with FBEP
From 2006-2010, researchers from the Kodiak Laboratory and the Fisheries Behavioral Ecology Program conducted studies to examine the habitat use of juvenile Pacific cod in nursery areas around Kodiak Island in the Gulf of Alaska. One objective 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 multiple nearshore nursery sites around Kodiak Island, AK during the summer months 2007-2009. Preliminary results revealed the gadids consumed primarily benthic invertebrates and displayed a high degree of dietary overlap (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 displayed 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 either 2007 or 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 gadids 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) 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 within the nursery areas can fluctuate greatly inter-annually and it is possible that cannibalism is density dependent and may be an important function when densities are high.

Juvenile Pacific cod movement, habitat, and overwintering study – RACE Kodiak Lab
In 2010, researchers from the Kodiak Laboratory undertook a project to examine the seasonal habitat use and over wintering habits of juvenile Pacific cod within nearshore nursery areas of Kodiak Island. Previous investigations have described the nursery requirements and habitat use of age-0 and age-1+ juvenile Pacific cod mainly during the summer. The current project is an extension of this work and focuses on examining the habitat use patterns of older juvenile age classes (age 2+) still residing in the nursery areas. The project will examine the hypotheses that older juvenile Pacific cod preferentially utilize bare substrate habitats and show strong site fidelity prior to the winter season and that juvenile cod winter migratory behavior will be variable among individuals. In 2010, juvenile cod were brought back to Kodiak Laboratory to examine the short and long term effects of intra-peritoneal tag implantation. The initial results

indicate intra-peritoneal implantation is a valid tagging technique for juvenile Pacific cod. In 2011, a combination of acoustic telemetry and a drop camera system will be used to define the seasonal habitat use and monitor the overwintering habits of juvenile Pacific cod. During the summer and fall, active telemetry will be conducted to acquire habitat patch use of individual cod. Additionally, a continued passive gate telemetry system will be utilized to measure the movement of individual cod outside the nursery habitat into the winter. The combination of acoustic telemetry (both active and passive) and drop camera techniques will allow us to effectively determine the habitat use patterns of older age classes of juvenile Pacific cod. Results of this project will contribute significant knowledge about seasonal habitat use of juvenile Pacific cod. In addition, this knowledge will allow us to examine the interactions of multiple age classes of juvenile Pacific cod within nearshore nursery areas. Ultimately, this project will allow researchers to obtain a more comprehensive understanding of EFH for juvenile Pacific cod which is needed for effective management and conservation of this species.

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

b. Stock Assessment

BERING SEA AND ALEUTIAN ISLANDS

Considerable effort to respond to the public and the Council comments on the Pacific cod assessment continued in 2010 with meetings in May, and September-December. Survey data indicate that after all-time lows from 2006 through 2008, the 2009 Bering Sea survey biomass was slightly higher than the 2008 estimate, and the 2010 biomass estimate was more than double the 2009 estimate. The 2006 and 2008 year classes appear to be strong, and stock abundance is expected to increase substantially in the near future.

The accuracy of age readings for this stock has been a continuing concern, mainly because the mean size at age from age readings does not match the first three clear modes of cod length frequencies in the Bering Sea trawl survey. Other issues have been the natural mortality rate, the trawl survey catchability coefficient, the modeling of commercial selectivity (variable or not, asymptotic or not, fishery by fishery) and the modeling of growth (constant, cohort-specific, year-specific). In 2010, there were two rounds of model proposals, trials, and reviews by the Plan Teams and SSC (May/June and September/October) that produced the three candidate models (A, B, and C) for the 2011 OFL/ABC specifications. Model A was the 2009 preferred model, whose main features were:

(i) Natural mortality $M = 0.34$ fixed externally.
(ii) Length-specific commercial selectivities were estimated in blocks of years, some forced to be asymptotic. Commercial age compositions fitted where available (only one record is available), length compositions where not. Commercial CPUE not fitted.
(iii) Age-specific trawl survey selectivity with annually varying left limb. Trawl survey age composition and CPUE fitted. The average product of catchability and selectivity of 60-80 cm fish requireed to be 0.47 based on a small set of data from archival tag recoveries.

(iv) IPHC longline survey length compositions (not CPUE) fitted.
(v) Cohort-specific growth parameters, with the standard deviation of length at age estimated externally.
(vi) Aging bias of +0.4 years at ages 2+ estimated by profiling and accounted for.
(vii) Input standard deviations of a number of parameters estimated iteratively so as to match output standard deviations. Model B was the same as Model A with some incremental modifications, viz:
(i) Smaller length bins (1 cm instead of 3 and 5) to make full use of the length data.
(ii) Five fishery seasons were modeled instead of 3.
(iii) A single growth schedule was fitted.
(iv) The few fishery length-at-age data and age composition data were left out.
(v) IPHC survey length data were left out.
(vi) Parameter values estimated iteratively in the 2009 assessment were carried over to Model B. Model C was the same as Model B but all age composition and length-at-age data were left out because of concern about ageing bias.

All model fits to EBS survey abundance were good. All models produced similar estimates of EBS trawl survey selectivity at age, although the estimates from Model C appeared to be shifted by one year relative to Models A and B. Historical abundance estimates for all models were similar. All models fitted the catch length compositions well. Models A and B fitted the age compositions well. Model A approximated the modes in EBS survey length frequencies reasonably well, but Model B did so less well. Model C matched the modes very closely but at ages that were higher by a year because the fitted growth schedule was unconstrained. The author explained that this could happen because there were no age or size-at age data whatsoever in the model, so the model could fit the data with length-at-age, survey selectivity at age, and cohort strengths shifted relative to Models A and B. This anomaly could probably be fixed in a future assessment.

The author adopted a number of criteria for choosing a best model, according to which Model B was better than Model A (better bin and season structure, more parsimonious), and Model C was disqualified because of the anomalous length-at-age in the EBS. (the impossibly high abundance estimates from Model C in the GOA also influenced the decision.) The BSAI and GOA Plan Teams both agreed with the author's choice of Model B and his rationale.

$B_{40\%}$ for this stock is estimated to be 384,000 t and projected spawning biomass in 2011 according to Model B is 358,000 t, so this stock is assigned to tier 3b. While there remains some concern about the value of trawl survey catchability used in the assessment, neither the author nor the Team saw any compelling reason to recommend OFL or ABC values lower than prescribed by the standard control rule. The current values of $F_{35\%}$ and $F_{40\%}$ are 0.31 and 0.26, respectively; the tier 3b adjusted values are 0.29 and 0.25, respectively.

Pacific cod is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition. Recent catches have been well below OFL. The stock is not overfished, or being overfished. The 2006 and 2008 year classes appear to be strong, and stock abundance is expected to increase substantially in the near term.

GULF OF ALASKA

Three models were included in the GOA Pacific cod assessment which were developed from a set of models presented in the preliminary assessment presented to the Plan Team in September 2010. Model A is identical to the model accepted by the GOA Plan Team and SSC in 2009. Model B includes the following changes: 1) exclusion of data on fishery age composition and mean length at age; 2) use of 1 cm bins for the length composition (replacing the combination of 3 cm and 5 cm bins); 3) partition of catch into five seasons (between which fishing mortality can change) and fishery selectivity into three seasons (two of which span multiple catch seasons); and 4) removal of cohort-specific growth. Model C includes all the changes in model B, plus removal of all mean length at age data and age composition data and use of a length-based rather than age–based maturity ogive.

The authors used the following criteria for selection of the final model: 1) full use of the information content in the size compositions; 2) statistical justification of the fishery seasonal structure; 3) model parsimony; and 4) "plausible" estimates of biomass. Models B and C are preferable to Model A with regard to the first three criteria. However, Model C estimates biomass to be approximately 2.5 times that for either Models A or B, with an estimate of total biomass in the late 1970s in excess of 2 million tons. The authors concluded that the fishery would have expanded more rapidly if the biomass in the 1970s had been this large, and thus selected Model B as the preferred model.

Model B results produced an estimated 2011 spawning biomass of 124,100 t, or 48% of unfished spawning biomass. The $B_{40\%}$ estimate was 102,500 t. Model B estimates of spawning biomass indicate a slight decline in subsequent years. This is in contrast to last year's assessment which projected an increase in biomass. In the current assessment, recent year classes (2006 – 2008) are estimated to be substantially lower than in last year's assessment.

The Plan Team accepts the author's preferred model (Model B) and therefore recommends Tier 3 for this stock. The model estimate of 2011 spawning biomass exceeds B40%, thus Gulf of Alaska Pacific cod are in Tier 3a. The Plan Team accepted the author's recommendation to use the maximum permissible F value from Tier 3a. The projected 2011 age-3+ biomass estimate is 428,000 t. The probability of the stock being below $B_{20\%}$ was estimated to be less than 1% in 2011 and subsequent years. Therefore, the ABC for 2011 is 86,800 t (F_{ABC} =0.42). The 2011 OFL under Tier 3a is 102,600 t (F_{OFL} = 0.51).

Pacific cod are not overfished nor are they approaching an overfished condition. Catches remain well below levels where overfishing would be a concern.

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

3. Shelf Rockfish

a. Research

DUSKY ROCKFISH MATURITY STUDY
Dusky rockfish (*Sebastes variabilis*) has recently been resurrected as a distinct species in the genus *Sebastes*. Reproductive biology and growth were examined for this re-described species in the central Gulf of Alaska. Prior to this research study, estimates of the size and age at 50% maturity for this species were based on visual observations of gonad maturity taken from a limited sample collection. In order to improve these estimates for the stock assessment and fishery evaluation report, this study determined the maturity stage of female dusky rockfish at the histological level from samples collected over a two year period. Dusky rockfish age and length at 50% maturity are 9.2 years and 365 mm fork length, respectively, which are lower than previously reported. Fertilized ova and eyed embryos were observed in April while evidence of post-parturition was not observed until May. The gonadosomatic index decreased with the onset of post-parturition in May. Von Bertalanffy growth parameters of female dusky rockfish estimated from the maturity samples were L_∞=449 mm, k=0.219, and t_0=0.855 and significantly different than the growth parameters derived from Gulf of Alaska fishery-independent survey data of L_∞=480 mm, k=0.211, and t_0=1.106 (X^2=158.8, df =3, P<0.001).

For further information, please contact Elizabeth Chilton (907) 481-1725.

b. Stock Assessment

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Stock Assessment for Pelagic Shelf Rockfish in the Gulf of Alaska - ABL
The pelagic shelf rockfish assemblage in the Gulf of Alaska is comprised of three species: dusky rockfish (*Sebastes variabilis*), yellowtail rockfish (*S. flavidus*), and widow rockfish (*S. entomelas*). This assemblage is one of three management groups for *Sebastes* in the Gulf which were implemented in 1988 by the North Pacific Fishery Management Council (NPFMC). Until 1998, black rockfish (*S. melanops*) and blue rockfish (*S. mystinus*) were also included in the assemblage. However, in April 1998, a NPFMC Gulf of Alaska Fishery Management Plan amendment went into effect that removed these two species from the federal management plan and transferred their jurisdiction to the state of Alaska. In 2010, dark rockfish (*S. ciliatus*) was also removed from Federal management (including the associated contribution to OFLs and ABCs under the respective assemblages in both regions) and full management authority was turned over to the State. Partial justification for this is that dark rockfish share an inshore reef or kelp environment with black rockfish and the two species are often caught together, suggesting that darks should be managed with black rockfish and other inshore species rather than within the pelagic shelf assemblage.

Gulf-wide, dusky rockfish are the most abundant species in the assemblage, whereas yellowtail and widow rockfish make up a very small proportion of the biomass in Alaska waters. Dusky rockfish have one of the most northerly distributions of all rockfish species in the Pacific. They range from southern British Columbia north to the Bering Sea and west to Hokkaido Is., Japan, but appear to be abundant only in the Gulf of Alaska (GOA).

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 2010, an executive summary assessment was produced for the pelagic shelf rockfish complex as there was no new trawl survey information available. For dusky rockfish, which are assessed using a single-species age-structured model, we run only the projection model with updated catch to determine ABC and the overfishing level (OFL). For widow and yellowtail rockfish, ABC and OFL are determined using the average of exploitable biomass from the three most recent trawl surveys

For the pelagic shelf rockfish assemblage, ABC and OFL for dusky rockfish are combined with the ABC and OFL for widow and yellowtail rockfish. For the 2011 GOA fishery, a maximum allowable ABC for pelagic shelf rockfish was set at 4,754 mt. This ABC is similar but slightly lower than last year's ABC of 5,059 mt. The stock is not overfished, nor is it approaching overfishing status.

For more information, contact Chris Lunsford at (907) 789-6008 or chris.lunsford@noaa.gov

4. Slope Rockfish

a. Research

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GULF OF ALASKA

Hybrid Rockfish Acoustic/Trawl Survey Studies - ABL
Scientists from ABL, REFM, and RACE divisions of the Alaska Fisheries Science Center have completed a joint North Pacific Research Board grant to investigate new rockfish survey designs. The project objective was to evaluate an experimental survey design (TAPAS, Trawl Acoustic Presence Absence Survey) to reduce the variability in estimated biomass for Pacific ocean perch (POP). In this design, hydroacoustic data are monitored in real-time to detect high-density patches, which are sampled at a higher rate than low-density background areas.

Analysis of acoustic data from AFSC Gulf of Alaska groundfish surveys and a 2009 rockfish survey indicated generally low correlations between acoustic energy and rockfish trawl catch per unit effort. Additionally, a wide variety of rockfish aggregation patterns were observed, including 'layer' aggregations that extended > 800 m, and smaller 'discrete' aggregations. Simulation modeling indicates that the TAPAS can perform well when a strong relationship between acoustic energy and trawl catches exists. Because TAPAS is designed to sample each patch encountered, it also performs well when the population consists of relatively many small patches rather than fewer, but larger, patches. However, when a poor relationship exists between acoustic energy and trawl catches, TAPAS generally does not result in higher precision estimates than provided by simple random sampling.

This was the situation observed for a 2009 field application of the TAPAS design, although a post-cruise analysis of an alternative patch definition resulted in some improvement in precision of the biomass estimates. The potential gains from the TAPAS design when a strong relationship exists between acoustic energy and trawl catches provides motivation to refine this relationship, particularly focusing upon isolating the portion of acoustic energy attributable to rockfish and quantifying the relative catchability of the trawl and acoustic gear.

For more information, contact Dana Hanselman at (907) 789-6626 or dana.hanselman@noaa.gov.

Rougheye and Blackspotted Rockfish Species I.D. Experiment – ABL & RACE

The rougheye rockfish was recently split into two species, rougheye rockfish (*Sebastes aleutianus*) and blackspotted rockfish (*S. melanostictus*). The presence of a second species was established through genetic analysis and formally verified in 2008. However, a series of field identification experiments since 2005 have led scientists to be concerned about their ability to accurately distinguish between the two species during surveys. The high at-sea misidentification rates from these experiments prompted a special project on the 2009 AFSC Gulf of Alaska (GOA) bottom trawl survey. The goal of this project was to collect relevant biological and genetic data to improve at-sea identification and examine differences in life history characteristics between the rougheye and blackspotted rockfish. Field scientists collected length, weight, and muscle tissue from most rougheye and blackspotted rockfish being sampled for otoliths.

A total of 934 fish were sampled for otoliths and tissues during the 2009 GOA bottom trawl survey. Of these, 420 were identified in the field as blackspotted, 495 as rougheye, and 19 as unidentified blackspotted/rougheye. During the summer of 2010, otolith samples from this project were aged by the AFSC REFM Division Age and Growth Lab, and the genetic samples were analyzed by scientists at the Auke Bay Laboratories. Analysis of these samples indicated similar misidentification rates to the previous experiments with 66% of genetically identified blackspotted rockfish correctly identified in the field and 91% of rougheye rockfish correctly identified. Combining this genetic information with the age data will allow for estimating more accurate misidentification rates and biological parameters such as growth and distribution by species. Preliminary analysis of age and growth of the two species indicates that blackspotted rockfish grow slower and attain smaller maximum size than rougheye rockfish. Currently, we are evaluating the management implications of possible differences in biological parameters for the two species.

For more information, contact Jon Heifetz at (907) 789-6054, jon.heifetz@noaa.gov or Kalei Shotwell at (907) 789-6056, Kalei.Shotwell@noaa.gov.

Recompression Experiments on Rougheye Rockfish with Barotrauma - ABL

Because rockfish (*Sebastes spp.*) are physoclystic, i.e. their gas bladders are closed off from the gut, they often suffer internal injuries from rapid decompression when caught. If these fish are brought to surface by fishermen and then discarded, many do not survive either because they cannot submerge due to excessive buoyancy or because of internal damage caused by rapid gas expansion during ascent. There is some evidence that recompression may greatly increase the survival of barotrauma-injured rockfish. However, survival can be species-specific, and it is therefore important to gauge the impacts of rapid decompression on each species of interest. Research completed at the Auke Bay Laboratories in 2010 demonstrated that rougheye rockfish, caught at depths greater than 700 feet and exhibiting severe barotrauma, could survive if recompressed immediately after capture with portable pressurized tanks. These 12"x42" tubular tanks were constructed in-house adapted from a design described by Jeff Smiley at Hubbs SeaWorld. They are small and light enough to be transported by hand when empty and with a crane or on a hand-truck when full of water. This result is noteworthy because it is the deepest known successful capture and recompression of any rockfish species and it opens the door to scientific tagging studies to track movements and behavior of deepwater rockfish. Future objectives are to tag captured rougheye and shortraker rockfish and rapidly recompress them by dropping them back to depth. Fish will also be recompressed with portable pressure tanks, for estimates of survival of tagged fish.

For more information, contact Cara Rodgveller at (907) 789-6052 or cara.rodgveller@noaa.gov.

Rockfish reproductive study – RACE, Kodiak Laboratory

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, 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 until the end of 2011 but it is anticipated that most samples will be obtained during the Rockfish Pilot Program in the months of May through November. In addition, on-going 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 that occurred during the summer months of 2009. Additional funds were obtained from the National Cooperative Research Program to fund a charter during November 2009, December 2009, and January 2010. During this charter Pacific ocean perch, rougheye, blackspotted, shortraker, northern and dusky rockfish samples were collected. 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. During the upcoming year studies on the reproductive biology of Pacific ocean perch and rougheye rockfish will be completed. During 2012 it is anticipated studies on the reproductive biology of blackspotted and shortraker rockfish will be completed.

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

b. Stock Assessment

GULF OF ALASKA – ABL

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 2009), we run a full assessment with all new survey and fishery data accumulated since the last full assessment. In 2010, an executive summary stock assessment was produced. For the 2011 fishery, we recommended the maximum allowable ABC of 16,997 t from the updated projection model. This ABC is a slight decrease from last year's ABC of 17,584 t. The stock is not overfished, nor is it approaching overfishing status.

For more information, contact Dana Hanselman at (907) 789-6626 or dana.hanselman@noaa.gov.

Northern Rockfish

Northern rockfish is 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 20009 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 2009), we run a full assessment with all new survey and fishery data accumulated since the last full assessment. In 2010, an executive summary stock assessment was produced. For the 2011 fishery, we recommended the maximum allowable ABC of 5,784 t from the updated projection model. This ABC is a slight increase from last year's ABC of 5,100 t. The stock is not overfished, nor is it approaching overfishing status. For 2011, there will be a new senior author of the northern rockfish assessment, Pete Hulson.

For more information, contact Pete Hulson at (907) 789-6060 or Pete.Hulson@noaa.gov.

Rougheye and Blackspotted Rockfish

Since 2005, Gulf of Alaska (GOA) rockfish have been assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. We use a separable age-structured model as the primary assessment tool for Gulf of Alaska rougheye and blackspotted rockfish (RE/BS complex). The model consists of an assessment, which uses survey and fishery data to generate a historical time series of population estimates, and a projection which uses results from the assessment model to predict future population estimates and recommended harvest levels. For Gulf of Alaska rockfish in even years (such as the 2010 assessment for the 2011 fishery) we present an executive summary stock assessment to recommend harvest levels for the next (odd) year. For the 2011 fishery, we recommend the maximum allowable ABC of 1,312 t from the updated projection model. This ABC is very similar to last year's ABC of 1,302 t. The stock is not overfished, nor is it approaching overfishing status.

In addition to the executive summary, we provided a thorough evaluation of research regarding GOA rougheye and blackspotted rockfish stock structure as an appendix in the assessment document. We followed the stock structure template recommended by the Stock Structure Working Group (SSWG) to the Groundfish Plan Teams in 2009 and elaborated on each category within this template. Also included were discussions on distribution, speciation, misidentification, and implications for management. Given this evaluation, we recommend continuing the current management of area-specific ABCs and gulf-wide overfishing levels (OFLs) for rougheye and blackspotted rockfish.

For more information, contact Kalei Shotwell at (907) 789-6056 or kalei.shotwell@noaa.gov.

Shortraker Rockfish and "Other Slope Rockfish"

Shortraker rockfish and "other slope rockfish" are distinct management categories in the Gulf of Alaska (GOA), but their assessments have been 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. Because these surveys occur in odd years, one was conducted in 2009, and therefore the last full assessment was completed in fall of that year for shortraker rockfish and "other slope rockfish". As in previous assessments since 1994, an average of the Gulf-wide biomass from the three most recent trawl surveys (presently the 2005, 2007, and 2009 surveys) is used to determine current exploitable biomass. This results in an exploitable biomass of 40,626 mt for shortraker rockfish and 76,867 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 2010 and 2011 of 914 mt for shortraker rockfish and 3,749 mt for "other slope rockfish". Neither shortraker rockfish nor "other slope rockfish" is considered overfished in the Gulf of Alaska, and neither is approaching overfishing status. Gulfwide catch of shortraker rockfish was 567 mt in 2009, and estimated catch in 2010 was 446 mt. Gulfwide catch of "other slope rockfish" in 2009 was 881 mt, and estimated catch in 2009 was 926 mt.

Some changes are proposed for the assessment of GOA shortraker rockfish and "other slope rockfish" in 2011. The GOA Groundfish Plan Team has recommended that the assessment of shortraker rockfish and "other slope rockfish" be separated into two reports. The Plan Team has also recommended that two minor species in the Pelagic Shelf Rockfish Assemblage, yellowtail rockfish and widow rockfish, be moved to the "other slope rockfish" group, and that this latter group be renamed "other rockfish".

For more information, contact Dave Clausen at (907) 789-6049 or dave.clausen@noaa.gov.

BERING SEA AND ALEUTIAN ISLANDS

Pacific ocean perch (POP)

The biomass estimates and harvest recommendations for Pacific ocean perch substantially increased from the last full assessment in 2008, and resulted in not only a large survey biomass estimate in 2010 but also an increasing trend in survey biomass estimates since 2002 and the estimated strong recruitments of the 1994-2000 cohorts. The substantial increase in estimated biomass from the most recent full assessment can also be attributed to the four-year gap between the 2006 and 2010 trawl surveys occurring during a period of apparently increasing biomass.

New data includes:

- 2010 AI survey biomass estimate and length composition
- 2006, 2007, and 2008 fishery age compositions.
- 2009 fishery length composition was included in the assessment.

The model configuration for the 2008 assessment estimated annual varying selectivity. For the 2010 assessment, fishery selectivity was set to vary between 4-year blocks of time. The growth parameters and age-length conversion matrix were also re-estimated. The years in which recruitment for recent year classes is not estimated was reduced from 7 to 3. The AI trawl survey biomass estimate for 2010 was a substantial increase (46%) from the last AI survey in 2006.

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 158,000 t, 0.061, and 0.074 respectively. There was a concern that a substantial shift in the estimate of catchability that was based on compositional data, and not just a large survey biomass estimate, which resulted in a scale change for the entire time series of biomass and recruitment. Given that the authors' ABC recommendation was such a substantial increase from the 2009 assessment (61%) and POP are a long-lived species, the Plan Team recommended a stair-step approach to raising the ABC, where the ABC would be increased halfway to the authors' recommended 2011 ABC until a new Aleutian Islands survey is conducted in 2012. The estimate of the 2011 spawning biomass is much greater than $B_{40\%}$ (225,000 t > 158,000 t).

Therefore POP is in tier 3a. For this tier, F_{ABC} is constrained to be < $F_{40\%}$, and F_{OFL} is constrained to equal $F_{35\%}$. The 2011 and 2012 ABCs associated with the $F_{40\%}$ level of 0.061 are 30,400 t and 28,800 t, respectively. The Plan Team recommended a stair-step value for 2011 and 2012 halfway between the 2010 ABC and the maximum permissible value for 2011, which is 24,700 t. The 2011 and 2012 OFLs under tier 3a are 36,300 t and 34,300 t, respectively.

The ABC was apportioned regionally based on the proportions of combined survey biomass. For 2011-2012, this procedure results in the following ABC: EBS = 5,710 t, Eastern Aleutians (Area 541) = 5,660 t, Central Aleutians (Area 542) = 4,960 t, Western Aleutians (Area 543) = 8,370 t. The OFL is not regionally apportioned. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Northern Rockfish (BSAI)
The 2010 Aleutian Islands survey was the first new survey since 2006. New data includes updated 2009 catch data, 2010 catch and survey biomass and length estimates.

Age 3+ biomass has been on an upward trend since 2002. Spawning biomass has been increasing slowly and almost continuously since 1977. Spawning biomass is projected to be 71,500 t in 2011. 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), $F_{40\%}$ (0.058), and $F_{35\%}$ (0.071). Because the female spawning biomass of 71,500 t is greater than $B_{40\%}$, sub-tier "a" is applicable, with maximum permissible F_{ABC}=$F_{40\%}$ and F_{OFL} =$F_{35\%}$. Under tier 3a, the maximum permissible ABC is 8,670 t, which is the authors' and Plan Team's recommendation for the 2011 ABC. Under tier 3a, the 2011 OFL is 10,600 t for the Bering Sea/Aleutian Islands combined. The Team continues to recommend setting a combined BSAI OFL and ABC. As the catch has routinely been lower than the ABC, a catch of 4,500 t was assumed as the 2010 catch in order to make projections to 2011. The recommended ABC and OFL for 2012 are 8,330 t and 10,400 t, respectively.

Northern rockfish is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

Shortraker Rockfish
The shortraker rockfish assessment was separated from the blackspotted and rougheye rockfish complex in 2008. Prior to 2008, shortraker and rougheye rockfish were assessed with a two-species surplus production model that accounted for potential covariance in catch estimates. The 2010 assessment applied a single-species surplus production model to BSAI shortraker rockfish.

New data in this year's assessment includes:
- 2010 Aleutian Islands and EBS slope trawl survey
- catch estimates were updated for 2009 and added for 2010.

Estimated shortraker rockfish biomass is 17,500 t, which is a slight increase from the 2009 assessment biomass estimate of 17,200 t. Overall, total biomass has trended slowly downward from 28,900 t in 1980.

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 a surplus production model. The F_{ABC} was set at the maximum permissible level under tier 5, which is 75% of M. The accepted value of M for this stock is 0.03 for shortraker rockfish, resulting in a $maxF_{ABC}$ value of 0.023. The biomass estimate for 2011 is 17,500 t for shortraker rockfish, leading to a 2011 and 2012 BSAI OFLs of 524 t and ABCs of 393 t.

Blackspotted/rougheye rockfish complex

New data for the 2010 assessment for the 2011 fishing season include:

- 2010 AI survey
- 2008 fishery age composition
- 2009 fishery length composition
- 1983 and 2010 survey length compositions

Total biomass for 2011 was estimated at 24,200 t, up slightly from 2010. In last year's assessment, spawning biomass was estimated to have trended slowly upward since 1998, but was projected to decline slightly after 2009. In this year's assessment, spawning biomass is projected to continue increasing. Projected spawning biomass for 2011 (AI only) is 5,800 t.

The 1998 year-class data appears strong in the 2004 and 2006 survey age data and leads to the high estimate of recruitment for this cohort. This estimate has changed substantially since the 2008 assessment with the inclusion of 2009 fishery and 2010 survey length composition data. In general, recent estimates of recruitment (post-1995 year classes) have high estimation error because they have been incompletely observed in the fishery and survey data. However, the high estimate of recruitment for the 1998 year class has a large effect on the estimate of $B_{40\%}$. Given the uncertainty in these recent recruitments and their influence on $B_{40\%}$, the authors considered various options: i) adjusting the input weight on the 2009 fishery and 2010 survey length compositions; ii) adjusting the input variance of recruitment residuals; and iii) excluding recent high uncertain recruitment estimates from the computation of $B_{40\%}$. The Plan Team decided to use only the recruitment estimates of the 1977-1995 year classes in the calculation of $B_{40\%}$ because of the high uncertainty of the estimates of succeeding year classes.

The SSC has determined that this stock qualifies for management under tier 3 due to the availability of reliable estimates for $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$. Because the female spawning biomass of 5,800 t is greater than $B_{40\%}$, (4,740 t, AI only), sub-tier "a" would be applicable, giving $FOFL$ = 0.041 and $maxF_{ABC}$ = 0.034. Under tier 3a, the maximum permissible 2011 and 2012 ABCs are 454 t and 465 t, respectively (EBS and AI combined), which are the Plan Team's recommended values. Under tier 3a, the 2011 and 2012 OFLs are 549 t and 563 t, respectively, for the Bering Sea/Aleutian Islands combined.

The blackspotted/rougheye rockfish stock complex is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition. Several options for allocating the ABC within the BSAI were considered. The Plan Team recommended allocating the ABC to two areas: 1) Western and Central AI area, and 2) Eastern AI and

EBS area. The rationale for this recommendation is that the available information for blackspotted rockfish indicates an isolation by distance pattern without clear physical breaks in stock structure, and this division of the ABCs results in management areas that are more consistent with the available information on stock structure. Although the current pattern of harvest does indicate disproportionate harvesting within the western Aleutian Islands, the Plan Team did not feel the scale of harvests in this area warranted a separate western AI ABC at this time.

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.

New data in this year's assessment includes 2010 AI and EBS slope trawl survey biomass estimates. The assessment uses a three survey weighted average to estimate biomass similar to the methodology used in the Gulf of Alaska rockfish assessments. This was deemed an appropriate compromise between smoothing variability and emphasizing the most recent information. Trends in spawning biomass for these species are unknown. Stock biomass, as measured by trawl surveys of the Aleutian Islands and the EBS slope, has increased since the 2008 assessment.

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.

The ABC was set at F_{ABC} (the maximum allowable) under tier 5 ($FABC$ = 0.75M). Multiplying these rates with the best estimates of SST and other "other rockfish" biomass yields 2011 and 2012 ABCs of 710 t in the EBS and 570 t in the AI. The Plan Team recommended 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 natural mortality values and adding the results, which yields an OFL of 1,700 t for 2011 and 2012. The "other rockfish" complex is not being subjected to overfishing. It is not possible to determine whether this complex is overfished or whether it is approaching an overfished condition because it is managed under tier 5.

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

5. Thornyheads

b. Stock Assessment

GULF OF ALASKA

Thornyheads continue to be on a biennial stock assessment schedule to coincide with the timing of the NMFS trawl survey data. Since no new survey data were available for 2010, the 2009 stock assessment is rolled over to provide management for 2011.

The 2009 assessment information included updated biomass and length compositions from the 2009 NMFS trawl survey data, total catch weight for 2007, 2008 and partial 2009 data and length composition from the 2007 and 2008 longline fisheries. Additionally, Relative Population Numbers (RPN's) and weight and size composition from the AFSC 2008 and 2009 longline surveys were included.

Estimates of spawning biomass are not available for thornyheads since they are assessed under Tier 5. Thornyhead biomass from the 2009 GOA trawl survey showed a decline of 9% relative to the 2007 survey results. However, most of this decrease was observed in the central GOA with a decrease of 24%. Biomass increased by 54% and 10% in the Western and Eastern Gulf areas, respectively.

Thornyhead rockfish are in Tier 5 and will likely remain there until such time as satisfactory age data can be generated and an age structured model can be developed. Age assessment is currently hampered by insufficient age data for this species; two recent studies showed widely variable maximum ages of 115 and 150 years, highlighting the difficulty in ageing thornyheads. It is possible that production ageing could occur, but only for individuals younger than 10 years of age. An average natural mortality (M) of 0.03 is used in this assessment as it is currently considered the best estimate based on the age data available.

The 2010 ABC recommendation from the current assessment (where F_{ABC} =0.0225) is 1,770 t and the OFL (F_{OFL} =0.03) is 2,360 t. Information is insufficient to determine stock status relative to overfished criteria. Catch levels for this remain below the TAC and below levels where overfishing would be a concern.

For shortspine thornyhead (and a number of other species), it is critically important to the assessment that the GOA trawl surveys continue and that they extend to 500m in order to cover the range of primary habitat for this (and other) species.

An examination of the trophic relationships of shortspine thornyheads suggests that the direct effects of fishing on the population are likely to be the major ecosystem factors to monitor for this species, because fishing is the dominant source of mortality for shortspine thornyheads in the Gulf of Alaska, and there are currently no major fisheries affecting their primary prey. However, if fisheries on the major prey of thornyheads—shrimp and to a lesser extent deepwater crabs—were to be re-established in the Gulf of Alaska, any potential indirect effects on thornyheads should be considered.

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

6. Sablefish

a. Research – ABL

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

2010 Sablefish Longline Survey

The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987 to 2010. 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 2010, the thirty-second annual longline survey of the upper continental slope of the Gulf of Alaska and eastern Aleutian Islands was conducted. One hundred-fifty-two longline hauls (sets) were completed during May 25 – August 28, 2010 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*), Pacific cod (*Gadus macrocephalus*), and arrowtooth flounder (*Atheresthes stomias*). A total of 84,343 sablefish were caught during the survey. Sablefish, shortspine thornyhead, Greenland turbot (*Reinhardtius hippoglossoides*), spiny dogfish (*Squalus suckleyi*) and lingcod (*Ophiodon elongates*), were tagged and released during the survey. Length-weight data and otoliths were collected from 2,203 sablefish. Killer whales *(Orcinus orca)* took fish from the longline at three stations in the Aleutian Islands region, one station in the western Gulf of Alaska, and one station in the central Gulf of Alaska. Sperm whales *(Physeter macrocephalus)* were often present during haul back and were observed depredating on the longline at six stations in the East Yakutat/Southeast region, two stations in the West Yakutat region, and two stations in the central Gulf of Alaska. These numbers, although apparently high, represent a decline in sperm whale interactions compared with previous years.

Several special projects were conducted during the 2010 longline survey. Lingcod and spiny dogfish were tagged with archival, electronic 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. Beginning in 2010, spiny dogfish lengths by sex were included as part of the standard length collections. A new electronic data collection system was tested using handheld data loggers to record catch at the rail, and lengths were collected using the existing barcode system integrated with new handheld data loggers. With several refinements the system is expected to be deployed again in 2011.

For more information, contact Chris Lunsford at (907) 789-6008 or chris.lunsford@noaa.gov.

Sablefish Tag Program

The ABL MESA Program continued the processing of sablefish tag recoveries and administration of the tag reward program and Sablefish Tag Database during 2010. Total sablefish tag recoveries for the year were around 575. Eleven fish were recovered in 2010 that were at liberty for over 30 years, and about 10 percent of the total 2010 recoveries were recovered over 1,000 nautical miles (great circle distance) from their release location. Five sablefish tagged with archival tags were recovered in 2010. Data from these electronic 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. Twenty-four thornyheads and two turbot tags were recovered in 2010. One of the recovered turbot had an archival tag attached.

Releases in 2010 totaled 3,740 adult sablefish, 225 juvenile sablefish (including 125 with archival tags), 947 shortspine thornyheads, 248 spiny dogfish (including 20 with pop-up satellite tags and 24 archivals), 19 lingcod, and three Greenland turbot.

For more information, contact Katy Echave at (907) 789-6006 or katy.echave@noaa.gov.

Juvenile Sablefish Studies

Juvenile sablefish studies have been conducted by the Auke Bay Laboratories in Alaska since 1984 and were continued in 2010. A total of 100 juvenile sablefish (age 1+) were tagged with spaghetti tags and released during a cruise to St. John Baptist Bay near Sitka between August 22th-August 28th. During the cruise, 125 juvenile sablefish were implanted with electronic archival tags. Approximately 96 rod hours were recorded to catch the fish that were tagged during the cruise. Total catch-per-unit-effort (CPUE) equaled 2.17 sablefish per rod hour fished. This was the highest CPUE since 2005, but was still considerably lower than catch rates in the 1990s. 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 726 electronic archival tags have been released in 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 have recovered six archival tags and expect more as these young fish continue to enter the fishery. The St. John Baptist Bay juvenile sablefish tagging cruise will be conducted again in 2011.

For more information, contact Dana Hanselman at (907) 789-6626 or dana.hanselman@noaa.gov.

Factors Affecting Sablefish Recruitment in Alaska

In 2009, stock assessment authors were requested to review current groundfish Fishery Management Plan (FMP) text regarding Essential Fish Habitat (EFH) for each species or species complex and report any updates or changes since the 2005 EFH Environmental Impact Statement (EIS). Amendments to the EFH FMP text for Alaska sablefish included suggestions for future consideration of small, unobtrusive research closures in areas of intense fishing. In April 2010, the North Pacific Fisheries Management Council (NPFMC) discussed these recommendations and issued a request that NMFS prepare a discussion paper on all factors that may affect sablefish recruitment. The request was issued to allow for the Council to determine what type of management tools or research efforts may be available for protecting juvenile sablefish and the resulting conservation measure required.

The ABL MESA Program responded to this Council request in the 2010 November assessment cycle and produced a review paper on a variety of aspects concerning sablefish recruitment. The first two sections of the document included a general overview of sablefish early life history and issues surrounding the estimation of recruitment in the stock assessment model. We followed this with a three stage rationale for defining sablefish recruitment, summaries of available data for each stage, and an evaluation of factors influencing the three stages. The document concluded with a discussion section that introduced three current research projects, identified data gaps and research priorities, and considered implications for conservation efforts. In the paper, we further emphasized that it was premature at this juncture to recommend habitat conservation measures specifically for sablefish. However, we continued to suggest that research closures were one effective tool for understanding effects of fishing, and we recommended that any new conservation measures be designed within a multi-species context as an effort by management to seek a better understanding of changes to the ecosystem and EFH.

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b. Stock Assessment – ABL & REFM

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

Sablefish Stock Assessment
One important change in the 2010 assessment is that we have discontinued use of the Relative Population Weight index from the AFSC longline survey, and only use the survey's Relative Population Numbers index, because the indices were redundant and it will facilitate the inclusion of a whale depredation corrected index. We added relative abundance and length data from the 2010 longline survey, relative abundance and length data from the 2009 longline and trawl fisheries, age data from the 2009 longline survey and 2009 longline fishery, updated 2009 catch, and estimated 2010 catch to the assessment model.

The fishery abundance index was down 17% from 2008 to 2009 (the 2010 data are not available yet). The survey abundance index increased 13% from 2009 to 2010 following a 16% decrease from 2006 to 2009. Spawning biomass is projected to be lower from 2011 to 2014, and then stabilize. Sablefish are currently below biomass targets. We recommended the maximum permissible yield for 2011 from an adjusted *F40%* strategy is 16,040 t. The maximum permissible yield for 2011 is a 5% increase from the 2010 ABC of 15,230 t. This increase is supported by a substantial increase in the domestic longline survey index that offset the prior year's decrease in the fishery abundance index. There was also a slight increase in estimates of incoming recruitment year classes. Spawning biomass is projected to decline through 2013, 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 14,697 t in 2012 and 13,978 in 2013.

Projected 2011 spawning biomass is 37% of unfished spawning biomass. Spawning biomass has increased from a low of 30% of unfished biomass in 2002 to 37% projected for 2011. The 1997 year class has been an important contributor to the population but has been reduced and should comprise 10% of the 2011 spawning biomass. The 2000 year class appears to be larger than the 1997 year class, and is now 95% mature and should comprise 24% of the spawning biomass in 2011. The 2002 year class is beginning to show signs of strength and will comprise 9% of the spawning biomass in 2011 and be 86% mature.

For more information, contact Dana Hanselman at (907) 789-6626 or dana.hanselman@noaa.gov

8. Flatfish

a. Research

Juvenile flatfish (Rock sole and Pacific halibut) – RACE, Kodiak Laboratory in collaboration with FBEP:
Juvenile flatfish typically utilize nearshore, shallow coastal waters in Alaska as nursery areas. Field studies around Kodiak Island, AK reveal that juvenile flatfish abundance is highly correlated with abundance of ampharetid polychaete *Pseudosabellides sibirica* worm tubes within the nurseries. In some years, concentrated aggregations of *P. sibirica* can form a dense lawn covering large sections of the seafloor in the bays around Kodiak. Juvenile flatfish, most notably northern rock sole *Lepidopsetta polyxystra*, aggregate along the edge of this habitat where tube density is low to moderate and patchy. From 2007 to 2009, researchers conducted a series of integrated field and laboratory studies to examine the ecological processes controlling this fish-habitat relationship. One hypothesis examined was that juvenile flatfish aggregate in areas of sparse to moderate tube density to feed either directly upon the worms or upon associated fauna. Researchers examined differences in the diet composition, feeding activity, and general body condition of juvenile rock sole across the depth gradient (and between substrates). Additionally, benthic sampling was conducted to assess the differences in prey availability between the substrates. Stomach analyses revealed that polychaetes, mostly ampharetid species, were the most important prey in the diets of rock sole collected along the edge of the worm habitat; whereas, cumaceans and/or harpacticoid copepods were the key prey in shallow waters with bare substrate. There were no significant differences found in rock sole feeding activity or body condition along the depth gradient (between habitats) even though benthic sampling revealed a greater diversity and abundance of benthic invertebrates along the worm tube habitat. This suggests that other mechanisms (i.e. predation risk) are modifying the foraging benefits of juvenile flatfish in the worm tube habitat. It appears that polychaete worm tubes area a key habitat feature influencing the foraging opportunities of juvenile flatfish within shallow water nurseries.

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

b. Stock Assessment

BERING SEA

Yellowfin sole
The 2010 EBS bottom trawl survey biomass estimate increased 36% from the low estimate of 2009 but is more consistent with the levels estimated for 2006 – 2008. The stock assessment model indicates that yellowfin sole have slowly declined over the past twenty years, although they are still at a fairly high level (73% above B_{MSY}), 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. However, the 2003 year class appears to be as strong as any observed since 1983 and should contribute to the reservoir of female spawners in the near future. The 2010

catch of 119,000 t represents the largest flatfish fishery in the world and the five-year average exploitation rate has been 4% for this stock (consistently less than the ABC).

New data for this year's assessment include:

- 2009 fishery and survey age compositions
- 2010 trawl survey biomass point estimate and standard error
- estimates of the discarded and retained portions of the 2009 catch
- estimate of total catch through the end of 2010.

The current assessment model was modified in 2008 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. New for 2010 is the inclusion of the estimates of time varying fishery selectivity, by sex.

The projected female spawning biomass estimate for 2011 is 587,000 t. Based on the most recent time series of estimated female spawning biomass, the projected 2011 female spawning biomass estimate continues the generally monotonic decline in model estimates of spawning biomass exhibited since 1994. Above average recruitment from the 1995 and 1999 year-classes is expected to maintain the abundance of yellowfin sole at a level above $B_{40\%}$ for the next several years. Projections suggest a stable female spawning biomass in the near future if the fishing mortality rate continues at the same level as the average of the past 5 years.

The SSC has determined that reliable estimates of B_{MSY} and the probability density function for F_{MSY} exist for this stock. Accordingly, yellowfin sole qualify for management under tier 1; however, the Plan Team would like to see more explicit criteria established for making this determination. The estimate of B_{MSY} from the present assessment is 374,000 t. The 1978-2003 spawner recruit data were used this year as the basis to determine the tier 1 harvest recommendation. This provided an F_{ABC} = Fharmonic mean of F_{MSY} = 0.12. The current value of $F_{OFL} = F_{MSY}$ is 0.13. The product of the harmonic mean of F_{MSY} and the geometric mean of the 2011 biomass estimate produces the author- and Plan Team-recommended 2011 ABC of 239,000 t and the corresponding product using the arithmetic mean produces the 2011 OFL of 262,000 t. For 2011, the corresponding quantities are 242,000 t and 266,000 t, respectively.

Yellowfin sole is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition. The assessment contains an ecosystem feature that represents catchability of the EBS shelf trawl survey as an exponential function of average annual bottom temperature.

Northern rock sole

The Northern rock sole stock is currently at a high and increasing level due to strong recruitment from the 2001, 2002 and 2003 year classes which are now beginning to contribute to the mature population biomass. The 2010 bottom trawl survey resulted in a biomass estimate of just over 2 million t, 34% higher than the 2009 point estimate. The northern rock sole harvest primarily comes from a high value roe fishery conducted in February and March which usually takes only a small portion of the ABC because it is constrained by prohibited species catch limits and market conditions.

The stock assessment model indicates that the stock declined in the late 1990s and early 2000s due to poor recruitment during the 1990s but is now projected to increase in the near future due to the recently observed strong recruitment. It is currently estimated at twice the B_{MSY} level.

New information for the 2010 analysis include:
• 2009 fishery age composition;
• 2009 survey age composition
• 2010 trawl survey biomass point estimate and standard error
• updated fishery catch and discards for 2009
• fishery catch and discards through 26 September 2010.

The assessment model was modified last year 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. The major change to the model for 2010 is the implementation of time-varying, sex-specific fishery selectivity.

The stock assessment model resulted in a 2011 age-2+ biomass estimate of 1,870,000 t. This was an increase in the biomass estimate compared to the 2011 estimate of 1,580,000 t obtained in last year's assessment. The rock sole stock is expected to remain stable or increase because of good recruitment from the 2000- 2005 year classes.

The SSC has determined that northern rock sole qualifies as a tier 1 stock. In past years, one difficulty with applying the tier 1 formulae to rock sole is that the harmonic and arithmetic means of the F_{MSY} distribution are extremely close, resulting in little buffer between recommendations of ABC and OFL. This closeness results from estimates of F_{MSY} that are highly certain. The use of a time-varying fishery selectivity increased the buffer between ABC and OFL from 1.4 percent in 2009 to 9.6 percent in 2010. The tier 1 2011 ABC harvest recommendation is 224,000 t (F_{ABC} = 0.13) and a 2010 OFL of 248,000 t (F_{OFL} = F_{MSY} = 0.15). Because of the implementation of the time-varying fishery selectivity this year there was a 24,000 t difference between the ABC and OFL levels, an increase of 20,000 t over the difference estimated in the 2009 assessment.

Northern rock sole is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition. The exploitation rate is about 0.03.

Flathead sole

Data on the flathead sole stock showed improved conditions compared to 2009. Bottom trawl survey estimates of total biomass for 2010 were 19% higher than for 2009. The 2007 year class is estimated to be above average, but it follows 3 years of poor recruitment. As a consequence, ABC for 2011 is only slightly (0.2%) higher than last year.

New data in this year's assessment include the following:

- 2009 fishery catch data was updated and the 2010 catch through September 25, 2010 was added to the assessment.
- Sex-specific size compositions from the 2010 fishery, based on observer data, were added to the assessment. Fishery size compositions from 2009 were updated.
- estimated survey biomass and standard error from the 2010 EBS trawl survey were added to the assessment.
- Sex-specific size compositions from the 2010 EBS trawl survey were added to the assessment.
- Sex-specific age compositions from the 2009 EBS trawl survey were added to the assessment.
- Mean bottom temperature from the 2010 EBS trawl survey was added to the assessment.

The preferred model is identical to that selected in last year's assessment.

The assessment model indicates that spawning biomass has declined continuously from a high of 328,000 t in 1997 to a minimum of 240,000 t in 2009 and 2010. The projected 2011 and 2012 values are 241,000 t and 237,000 t, respectively. The 2001, 2003, and 2007 year classes are estimated to be above average, but recruitments from 1988-2007 on average have been much lower than recruitments from 1974-1987.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying flathead sole for management under tier 3. The current values of these reference points are $B_{40\%}$=134,000 t, $F_{40\%}$=0.28, and $F_{35\%}$=0.34. Because projected spawning biomass for 2011 (241,000 t) is above $B_{40\%}$, flathead sole is in sub-tier "a" of tier 3. The ABCs for 2011 and 2012 were set at the maximum permissible values under tier 3a, which are 69,300 t and 68,300 t, respectively. The 2011 and 2012 OFLs under tier 3a are 83,300 t and 82,100 t, respectively. Flathead sole is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

Alaska plaice

The Alaska plaice resource continues to be estimated at a high and stable level with very light exploitation. The 2010 survey biomass was 498,000 t, a bit lower than the 2009 estimate but consistent with estimates from resource assessment surveys conducted since 1985. Of interest in 2010 is that the combined results of the eastern Bering Sea shelf survey and the northern Bering

Sea survey indicate that 38% of the Alaska plaice biomass was found in the northern Bering Sea in 2010. The stock is expected to increase further in the near future due to the presence of a strong year class estimated from 2002. Exploitation occurs primarily as bycatch in the yellowfin sole fishery and has averaged only 1% from 1975-2010.

New data for 2010 included:
the updated 2010 survey catch
- fishery catch through 15 October 2010
- 2010 trawl survey biomass estimate and standard error
- 2010 length composition of survey catch
- 2009 survey age composition

Sex-specific natural mortality was included in the split-sex model developed last year. Natural mortality was re-estimated for each sex in this year's assessment at a value of 0.13, replacing the previous literature-derived value of 0.25. This halving of the natural mortality rate from last year's assessment lowered the current and historic estimates of total and female spawning biomass and recruitment.

Female spawning biomass decreased from 1985 to 1998, and has been relatively stable since then. Total biomass peaked in 1984, then decreased through 2001, and has increased steadily since. The increase in total biomass is expected to continue. The shelf survey biomass has been fairly steady since the mid-1980s.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, therefore qualifying it for management under tier 3a. The updated point estimates are $B_{40\%}$ = 178,000 t, $F_{40\%}$ = 0.15, and $F_{35\%}$ = 0.19. As a consequence of the reduced M used in the model, these are values are now in the range expected for flatfishes. Given that the projected 2011 spawning biomass of 319,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2011 were calculated under sub-tier "a" of tier 3. Projected harvesting at the $F_{40\%}$ level gives a 2011 ABC of 65,100 t. The OFL was determined from the tier 3a formula, which gives a 2011 OFL of 79,100 t. The estimated total biomass of Alaska plaice is now much lower than in the past because of the new estimates of natural mortality. The ABC is about one-third that of 2010.

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 90% of the "other flatfish" catch in 2009. Because of insufficient information about these species, no model analyses are possible and trawl survey estimates are used to determine stock biomass. The latest assessment incorporates 2010 total catch and discard and 2010 trawl survey information. The 2010 EBS bottom trawl survey resulted in biomass estimates of 114,200 t, a little higher than the 2009 estimate. The biomass of these species in the Aleutian Islands is 13,100 t from the 2010 survey.

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 2011 ABC of 14,500 t for the "other flatfish" species. The corresponding 2011 OFL is 19,500 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.

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 0.15. 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.

Greenland turbot

The 2010 EBS shelf trawl survey biomass estimate was more than double the 2009 estimate, the highest biomass since 2003. More significantly, the population numbers were the highest ever recorded (since the standard survey began in 1982). The total 2010 population estimate (in numbers, all ages) from the EBS survey was over five times the average for Greenland turbot. The high numbers were almost entirely due to indications of 1 year-old Greenland turbot in this survey. While the EBS region is showing good signs of Greenland turbot, the 2010 Aleutian Islands survey is the lowest on record and about one-third of the value estimated in 2006. This may be a concern because in recent years their proportion in commercial catches in the Aleutian Islands has increased significantly.

The projected 2011 female spawning biomass is 45,500 t. Compared to the 2010 spawning biomass of 40,000 t. This represents an increase and a reversal of the general decline that had been prevalent since the mid-1970s. While spawning biomass continues to decline, age 0 recruitment appears to have improved substantially in 2008 and 2009.

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. The Plan Team discussed indicators suggesting that the long-term decreasing abundance of Greenland turbot may finally be ending, including the marked rise in trawl survey biomass and the very large influx of new recruits. Given these changes and the model results, the ABC and OFL recommendations were set at the maximum levels. Updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 28,400 t, 0.25, and 0.29, respectively. Projected spawning biomass for 2011 is 45,500 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 ABC of 6,140 t for 2011 and 5,750 t for 2012. In keeping with past management, the ABC was apportioned on the basis of 75 percent EBS and 25 percent AI. The OFLs for 2011 and 2012 under the tier 3a formula are 7,220 percent and 6,760 t, respectively. Greenland turbot is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

Arrowtooth flounder

BERING SEA

2010 was unique in that the Bering Sea shelf, slope and the Aleutian Islands were all surveyed in the same year. Since arrowtooth flounder are present in all these waters, a good update was available for arrowtooth flounder stock status. The combined survey estimates indicate that the stock is in an upward trend in all areas and the stock assessment model indicates that the resource has steadily increased from a low biomass in the late 1970s to a very high current biomass. Good recruitment from seven of the ten years from 1998-2007 combined with light exploitation should continue this trend.

Increasing interest in harvesting Kamchatka flounder has caused a concern about managing both species under a single ABC. Although Kamchatka flounder comprise only 7% of the composite Atheresthes biomass, there has been a disproportionate harvest in recent years whereby the potential exists to overharvest Kamchatka flounder under the present combined management. Beginning in 2011, Kamchatka will be assessed separately from arrowtooth flounder and receive an individual ABC and TAC.

New data for 2010 include:

- fishery catch and discards for 2009 and through 15 October 2010
- 2010 shelf, slope and Aleutian Islands surveys size composition and biomass point-estimates and standard errors. The current model includes the Aleutian Islands, Bering Sea slope and Bering Sea shelf. The biomass is modeled with 76 percent of the stock on the shelf, 14 percent in the Aleutian Islands and 10 percent on the Bering Sea slope. Examination of Bering Sea shelf survey biomass estimates indicate that some of the annual variability seemed to positively co-vary with bottom water temperature. The 2010 stock assessment model resulted in a 2011 biomass projection of 1,120,000 t. This is a small increase from the value of 1,100,000t projected in last year's assessment for 2010. There is a long-term trend of increasing arrowtooth flounder biomass in the EBS. If the harvest rate remains close to the recent average, this trend is expected to continue for the next few years as strong recruitment was observed in the early part of this decade.

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 280,000 t, 0.23, and 0.29, respectively. Given that the projected 2011 spawning biomass of 806,000 t exceeds $B_{40\%}$, the Team's ABC and OFL recommendations for 2011 were calculated under sub-tier "a" of tier 3. The Team recommends setting F_{ABC} at the $F_{40\%}$ (0.23) level, which is the maximum permissible level under tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2011 ABC of 153,000 t. The OFL fishing mortality rate under tier 3a is $F_{35\%}$ (0.29), which translates to a 2011 OFL of 186,000 t.

As there is little to no fishery for arrowtooth flounder, the model is mostly driven by the survey data. More female arrowtooth flounder are caught than males in the surveys, resulting in estimates of differential mortality for males and females. With fixed female M=0.2, the run with male M=0.35 provides a reasonable fit to all the data components and is consistent with observations of differences in sex ratios observed from trawl surveys. The maximum shelf survey selectivity for males occurs at 0.93 for age 8 fish. The base model includes Aleutian Islands data again this year.

Arrowtooth flounder is a largely unexploited stock in the BSAI. Arrowtooth flounder will be managed on its own (i.e., as something other than a constituent stock of the former arrowtooth/Kamchatka complex) for the first time in 2011. Strictly speaking, therefore, there is no arrowtooth-only OFL against which annual catch of arrowtooth can be compared. However, given that arrowtooth accounted for the vast majority of the biomass in the Arrowtooth/ Kamchatka complex, it could be argued that the OFL for the complex should be viewed as a proxy for an arrowtooth-only OFL, in which case it would be concluded that arrowtooth is not being subjected to overfishing. Arrowtooth flounder is not overfished and is not approaching an overfished condition.

GULF OF ALASKA

Arrowtooth flounder in the Gulf of Alaska continue to be on a biennial stock assessment schedule to coincide with the timing of the NMFS trawl survey data. Since no new survey data were available for 2010, the two-year ahead stock projection made in the 2009 stock assessment is used to provide management for 2011.

The 2009 survey biomass and length data, catch for 2008 and 2009, 2007 and 2008 fishery length data were added to the model. The estimated age 3+ biomass from the model increased by an order of magnitude since 1961 and peaked at about 2.2 million t in 2006. Since then, the stock has stabilized. Female spawning biomass in 2009 was estimated at 1,252,550 t, a 4% decline from the projected biomass from the 2007 assessment. The results of the 2009 GOA survey indicate that arrowtooth flounder are still the highest biomass groundfish species and remain lightly harvested.

Survey abundance estimates were low in the 1960’s and 1970’s, increasing from about 146,000 t in the early 1970’s to about 2,822,830 t in 2003. Survey biomass declined to 1,899,778 t in 2005 and in 2009 declined to 1,772,029 t from the 2007 estimate of 1,939,055 t.

Arrowtooth flounder has been determined to fall under Tier 3a. The 2010 ABC using $F_{40\%}$=0.183 is 215,882 t, which is 5,630 t less than the 2009 ABC. The 2010 OFL using $F_{35\%}$ (0.219) is 254,271 t. The 2011 ABC and OFL were projected by setting 2010 catches equivalent to the average 5 year F (0.0206).

The recommended ABC for arrowtooth flounder in 2010 is equivalent to the maximum permissible ABC. The stock is not overfished nor approaching an overfished condition. Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern.

Area apportionments of arrowtooth flounder ABCs for 2010 and 2011 are based on the fraction of the 2009 survey biomass in each area. The new ABC recommendation for 2010 is slightly lower than that recommended for 2009 using last year's full assessment model (269,237 t). The ABC is apportioned in proportion to the survey biomass results, by area.

Gulf of Alaska flatfish

Both the shallow-water and deep-water flatfish complexes rely on current year survey data to determine their stock status. Since a Gulf of Alaska trawl survey was not conducted in 2010, the 2009 assessment results are used to manage the 2011 harvest.

The shallow water flatfish complex is made up of northern rock sole, southern rock sole, yellowfin sole, butter sole, starry flounder, English sole, sand sole, Alaska plaice and other minor species. New data for the shallow water flatfish complex from the 2009 assessment included final total catch from 2008, current catch for 2009 and the 2009 NMFS bottom-trawl survey biomass estimates.

Stock status for shallow water flatfish is based on the NMFS bottom trawl survey (triennial from 1984 to 1999 and biennial from 1999 to 2009). Survey abundance estimates for the shallow-water complex were lower in 2009 compared to 2007; decreasing by 37,630 t. By species, abundance estimates increased between 2007 and 2009 for southern rock sole and English sole, while all other species in the complex (northern rock sole, yellowfin sole, butter sole, starry flounder, sand sole and Alaska plaice) showed decreases in abundance.

Northern and southern rock sole are managed in Tier 4 while other shallow water flatfish are in Tier 5, since maturity data are not available. The F_{ABC} and F_{OFL} values for southern rock sole were estimated as: $F_{40\%}$=0.162 and $F_{35\%}$ = 0.192, respectively. For northern rock sole, the values are: $F_{40\%}$=0.204 and $F_{35\%}$ =0.245. Other flatfish ABCs were estimated with F_{ABC}=0.75 M and F_{OFL}=M.

The ABC and OFL for 2010 and 2011 shallow-water flatfish are lower than the 2008 and 2009. The GOA Plan Team agrees with authors recommended ABC for the shallow water flatfish complex which was equivalent to maximum permissible ABC. Information is insufficient to determine stock status relative to overfished criteria. Catch levels for this complex remain below the TAC and below levels where overfishing would be a concern.

Flatfish consume a variety of benthic organisms. Fish prey make up a large part of the diet of rock sole adults and possibly sand sole (although the sample size was small for sand sole). Other flatfishes consume mostly polychaetes, crustaceans and mollusks. Area apportionments of shallow water flatfish ABC's (using F40% = FABC) for 2010 and 2011 are based on the fraction of the 2009 survey biomass in each area

The deep water flatfish complex is comprised of Dover sole, Greenland turbot, and deep sea sole. Catch and trawl survey biomass data for Greenland turbot and deepsea sole are updated for 2009. For Dover sole, the assessment model presented in 2007 is updated with 2008 and 2009 fishery catch and size compositions, 2009 trawl survey biomass, and 1987 and 2007 trawl survey age compositions. Six alternative model configurations exploring selectivity parameterizations are presented, but none outperform the base model.

An age-structured model is used to determine stock status for Dover sole. Dover sole female spawning biomass was relatively flat until 1991 and then declined until 2006. Spawning biomass has been unchanged since 2006. Dover Sole are in Tier 3a while both Greenland turbot and deepsea sole are in Tier 6. The Tier 6 calculation (based on average catch from 1978-1995) for the remaining species in the deep water flatfish complex ABC is 183 t and the OFL is 244 t. These values apply for 2010 and 2011 ABC and OFLs.

For the Dover sole Tier 3a assessment, the 2010 ABC using $F_{40\%}$=0.119 is 6,007 and 6,142 t for 2011. The 2010 OFL using $F_{35\%}$=0.149 is 7,436 t and 7,603 t for the 2011 OFL. The recommended 2010 and 2011 ABC's and OFL's for the deep water flatfish complex are equivalent to the maximum permissible ABC. The stock assessment author noted that the 2008 catch of deepsea sole (8 t) exceeded the average catch of deepsea sole for 1978-1995 (6 t). The Plan Team discussed whether biomass data were reliable for application of Tier 5 assessment methods to deepsea sole and Greenland turbot, and requested that the authors include survey CV and M estimates for all species in the complex in the next assessment.

Information is insufficient to determine stock status relative to overfished criteria. Catch levels for this complex remain below the TAC and below levels where overfishing would be a concern.

Area apportionments of deep water flatfish (*excluding Dover sole*) are based on proportions of historical catch. Area apportionments of Dover sole (using $F40\%$) are based on the fraction of the 2009 survey biomass in each area.

Flathead sole
Flathead sole in the Gulf of Alaska continue to be on a biennial stock assessment schedule to coincide with the timing of the NMFS trawl survey data. Since no new survey data were available for 2010, the two-year ahead stock projection made in the 2009 stock assessment is used to provide management for 2011.

Survey biomass decreased from 280,290 t in 2007 to 225,377 t in 2009 (20% decline). Projected female spawning biomass is estimated at 110,387 t for 2010. Two models were presented for this assessment. The base model was an age-structured model that was unchanged from 2007. A new model was presented that estimated selectivity between sexes. The fishery catch and length compositions for 2008 and 2009 were incorporated in the models. The 2007 fishery catch and length compositions were updated. The 2009 GOA groundfish survey biomass estimate and length composition data were added to the model. Survey biomass estimates and length compositions were recalculated for all survey years.

The Plan Team encouraged the author to continue investigating approaches to model selectivity, but recommended using the authors' base model. The Plan Team disagreed with the authors' choice to use the different scaling of male selectivity relative to females. The mechanisms for the resulting differences between the sex-specific survey and fishery selectivities were unclear. The Plan Team also encouraged the author to investigate length based selectivity and examine age data from the fishery. Flathead sole are determined to be in Tier 3a based on the age-structured model. The Team's preferred model gives a 2010 ABC using $F_{40\%}$ (0.406) of 47,422 t which is 958 t higher than the 2009 ABC. The 2010 OFL using $F_{35\%}$ (0.530) is 59,295 t.

The stock is not overfished nor approaching an overfished condition. Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern.

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11. Walleye Pollock

a. Research

EASTERN BERING SEA

Epipelagic Trawl Surveys to Determine Abundance of Age-0 Walleye Pollock and Understand Impacts of Climate Change on Bering Sea Ecosystems – ABL

The eastern Bering Sea (EBS) shelf is a highly productive ecosystem, where atmospheric forcing, duration and extent of sea ice cover, and transport through ocean passes in the Aleutian Islands dominate the physical processes on the shelf. Inter-annual variability in these processes is believed to influence the distribution, feeding, growth, and recruitment of important fisheries stocks. Physical oceanographic features (e.g. sea surface temperature (SST), fronts, mixed layer depth) and lower trophic level dynamics (e.g. primary production, zooplankton prey availability) also are critical to understanding migration, distribution, and survival of forage fish. Research on the interaction between physical oceanography, plankton, and forage fish such as age-0 walleye pollock (*Theragra chalcogramma*) and juvenile Pacific salmon (*Oncorhynchus spp.*) has been conducted annually by Auke Bay Laboratories Ocean Carrying Capacity (OCC) researchers in 2000–2010, with surveys planned for 2011 and onward. These surveys have been part of an international effort, the Bering-Aleutian Salmon International Survey (BASIS) program. Epipelagic trawl surveys have occurred each year in late summer/early fall (August-October) to assess the abundance and condition of these fish at the end of their early marine growth period and prior to their first winter.

The few large-scale studies of walleye pollock in the Bering Sea have mainly focused on their distribution in relation to sea-ice conditions (Wyllie-Echeverria 1995). In contrast, the BASIS time series on age-0 walleye pollock is presently the only shelf-wide data available during fall in the EBS. This time series provides integrated information on energy density, diet, abundance, and distribution in relation to changing ocean conditions. Such information coupled with an age-0 abundance index provides a unique opportunity to evaluate survival of juvenile walleye pollock relative to the reproductive output estimated from pollock stock assessments. For example we have found a direct correlation ($r^2 = 0.73$) between the energy content of age-0 pollock (kJ/fish) and the number of age-1 recruits as predicted in the pollock stock assessment. These data are currently being considered by the North Pacific Fishery Management Council to help reduce the uncertainty in stock assessments for EBS walleye pollock.

Our BASIS results have been used to document the rapidly changing marine conditions in the EBS during the past nine years and provide baselines and analogues for different climate regimes. The EBS SST's underwent large-scale warming from 2002-2005 followed by substantial cooling in 2006-2009. These shifts altered fisheries distributions and have the potential to affect the overall ecology of this region. Coincident with changes in the SST we have observed changes in the energy density (kJ/g) of age-0 pollock. Currently, age-0 pollock appear to have maximized their energy content. The extent of winter sea ice and its rate of retreat influences spring bloom dynamics, secondary production, and the spatial extent of the cold-water pool during the summer. Because most fish growth occurs during the summer, the winter and spring climatic forcing along with summer atmospheric and oceanographic conditions will dramatically affect fish distribution and production.

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GULF OF ALASKA

Pollock Echo Integration Trawl Surveys – RACE, Midwater Assessment and Conservation Engineering (MACE) Program

Winter acoustic-trawl surveys in the vicinity of Shumagin Islands, Sanak Trough, Morzhovoi Bay, Pavlof Bay, throughout the Kenai Peninsula bays, Prince William Sound, Marmot Bay, along the shelf break southeast of Chirikof Island, and in the Shelikof Strait area

The MACE Program conducted winter acoustic-trawl (AT) surveys aboard the NOAA ship *Oscar Dyson*, targeting walleye pollock (*Theragra chalcogramma*) in the Shumagin Islands, Sanak Trough, Morzhovoi Bay, Pavlof Bay, throughout the Kenai Peninsula bays, Prince William Sound, Marmot Bay, along the shelf break southeast of Chirikof Island, and in the Shelikof Strait area.

The Shumagin Islands portion of the survey was conducted 23-25 February 2010 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 26-27 February along transects spaced 2-nmi apart. Morzhovoi Bay was surveyed on 27 February along transects spaced 2.5-nm apart. Pavlof Bay was surveyed on 28 February along transects spaced 2-nmi apart. The Kenai Peninsula bays were surveyed during 2-5 March using zig-zag transects because of the narrowness of many of the bays. Prince William Sound was surveyed during 5-7 March along transects spaced 2.5-nm apart. Marmot Bay was surveyed during 8-9 March along transects spaced 1-nmi apart.

In the Shumagin Islands, the densest walleye pollock aggregations were located in northeastern Unga Strait and off Renshaw Point. Age-1 fish were only caught in easternmost Shumagin Trough. Elsewhere, age-2 and -3 fish dominated, except in West Nagai Strait, where age-4 fish dominated. The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 21% developing, 45% pre-spawning, 32% spawning, and 3% spent. The maturity composition of females longer than 40 cm FL was 0% immature, 30% developing, 60% pre-spawning, 10% spawning, and 0% spent. The mean gonado-somatic index (GSI: ovary weight/body weight) for mature pre-spawning females was 0.11. The pollock AT survey abundance estimate in the Shumagin Islands area was 18,200 metric tons, based on catch data from 7 trawl hauls and acoustic data from 266 nmi of survey transects. The 2010 estimate was the lowest in the time series.

The densest pollock aggregations in Sanak Trough, which consisted of only adult pollock, were located over the center of the trough. The unweighted maturity composition for males longer than 40 cm was 0% immature, 0% developing, 44% pre-spawning, 6% spawning, and 50% spent. The unweighted maturity composition for females longer than 40 cm FL was 0% immature, 0% developing, 54% pre-spawning, 0% spawning, and 46% spent. The large percentage of spent females indicated that the survey timing was late. The average GSI for pre-spawning females was 0.19. The abundance estimate for Sanak Trough was 26,700 t, based on catch data from 2 trawl hauls and acoustic data from 95 nmi of survey transects.

The densest pollock aggregations in Morzhovoi Bay were detected near the mouth of the bay. Most of the walleye pollock captured were age-2 fish ranging from 21-31 cm and larger adult fish ranging up to 74 cm. The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 33% developing, 42% pre-spawning, 8% spawning, and 17% spent. The maturity composition of females longer than 40 cm FL was 0% immature, 2% developing, 22% pre-spawning, 4% spawning, and 72% spent. The large percentage of spent females indicated that the survey timing was late. The average GSI for pre-spawning females was 0.20. The abundance estimate for Morzhovoi Bay was 1,800 t, based on catch data from 1 trawl haul and acoustic data from 44 nmi of survey transects.

No significant acoustic backscatter was measured along the 81 km of transects in Pavlof Bay, and no trawl hauls were conducted.

All Kenai Peninsula bays contained substantial walleye pollock aggregations, with densities increasing towards the center of the peninsula and with the greatest abundance in Resurrection Bay. Most fish caught along the Peninsula were adults ranging in length from 30 to 50 cm FL, except in northern Nuka Bay, where the fish were a mixture of age-1 and adult fish. The unweighted maturity composition for males longer than 40 cm FL was 1% immature, 19% developing, 69% pre-spawning, 11% spawning, and 0% spent. The unweighted maturity composition for females longer than 40 cm FL was 0% immature, 24% developing, 76% pre-spawning, 0% spawning, and 0% spent. The average GSI for pre-spawning females was 0.20.

The abundance estimate was 111,200 t, based on catch data from 10 trawl hauls and acoustic data from 221 nmi of survey transects.

The densest pollock aggregations in Prince William Sound were detected along the eastern side of the main channel. Most of the walleye pollock caught were adults ranging in length from 40 to 55 cm FL and were generally larger than along the Kenai Peninsula. The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 0% developing, 29% pre-spawning, 71% spawning, and 0% spent. The unweighted maturity composition for females longer than 40 cm FL was 0% immature, 2% developing, 98% pre-spawning, 0% spawning, and 0% spent. The average GSI for pre-spawning females was 0.20. The abundance estimate was 111,500 t, based on catch data from 3 trawl hauls and acoustic data from 270 nmi of survey transects.

The densest pollock aggregations in Marmot Bay occurred northwest of Spruce Island and in Spruce Gully. Walleye pollock ranged in length from 11 to 74 cm with modes at 13 cm, 29 cm, and 47 cm FL. The unweighted maturity composition for males longer than 40 cm FL was 61% immature, 33% developing, 6% pre-spawning, 0% spawning, and 0% spent. The maturity composition of females longer than 40 cm FL was 0% immature, 67% developing, 33% pre-spawning, 0% spawning, and 0% spent. The average GSI for mature pre-spawning females was 0.10. The abundance estimate was 19,800 t, based on catch data from 2 trawl hauls and acoustic data from 85 nmi of survey transects.

The MACE Program also conducted winter EIT surveys aboard the *Oscar Dyson*, targeting walleye pollock along the shelfbreak southeast of Chirikof Island and in the Shelikof Strait area. The shelf break was surveyed during 18-19 March along parallel transects spaced 6-nmi apart. The Shelikof Strait sea valley was surveyed from south of Chirikof Island to north Kuliak Bay on the Alaska Peninsula during 22-28 March along parallel transects spaced 7.5-nmi apart.

This was the second consecutive year when very low densities of walleye pollock were observed along the Chirikof shelf break. A small amount of walleye pollock backscatter was detected near the mouth of Barnabas Trough. Most of the walleye pollock caught were adults ranging in length from 50 to 70 cm FL. The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 0% developing, 67% pre-spawning, 33% spawning, and 0% spent. The unweighted maturity composition for females longer than 40 cm FL was 1% immature, 6% developing, 93% pre-spawning, 0% spawning, and 0% spent. The average GSI for pre-spawning females was 0.14. The abundance estimate was 9,300 t, based on catch data from 6 trawl hauls and acoustic data from 141 nmi of survey.

In the Shelikof Strait area, the densest walleye pollock aggregations were detected along the west side of the Strait proper between Cape Unalishagvak and Cape Kuliak. Dense aggregations were also detected along the eastern sides of the southernmost transects. Most near-bottom walleye pollock catches consisted of a mixture of age-1, age-2, age-3, and older adult fish, with older fish dominating along the western side in the deepest part of the Strait between Cape Kuliak and Cape Unalishagvak, and the reverse being true outside of this area. Predominantly age-3 fish were caught in midwater schools on the Kodiak side of the Strait and along the eastern sides of the southernmost transects. The unweighted maturity composition for males longer than 40 cm

FL was 6% immature, 5% developing, 24% mature pre-spawning, 65% spawning, and 0% spent. The maturity composition of females longer than 40 cm FL was 5% immature, 9% developing, 81% pre-spawning, 4% 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. The average GSI for mature pre-spawning females was 0.13. The pollock abundance estimate was 415,600 t, which was substantially higher than the 2009 (266,000 t) and 2008 (208,000 t) estimates and was the largest seen in the Strait since 2001. The 2010 estimate was based on catch data from 15 trawl hauls and acoustic data from 726 nmi of survey transects.

BERING SEA

Summer acoustic-trawl survey on the eastern Bering Sea shelf

The MACE Program conducted an acoustic-trawl (AT) survey of midwater walleye pollock between 5 June and 7 August 2010 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 physical oceanographic environment, and supplemental trawls to improve species identification and to obtain an index of euphausiid abundance using multiple frequency techniques. A number of specialized sampling devices were used during or after the survey, including light level sensors, a Simrad ME70 multibeam sonar to image fish schools, a Tucker trawl to sample euphausiid layers near the surface and near the seafloor, a lowered echosounding system to measure target strength, a sideways-looking 70kHz transducer, and a trawl-mounted, stereo camera ("Cam-Trawl") designed to determine the species identification, density, and size of animals as they pass by the camera and out through the rear of the open trawl. During daylight hours, while on transect, U.S. Fish and Wildlife observers recorded seabird species abundances.

Survey results showed that ocean conditions continued to be cold in 2010, as they were in 2009 and in the previous three years, compared to 2000-2005. Over eighty percent of the summed acoustic backscatter at 38 kHz observed during the 2010 survey was attributed to adult or juvenile walleye pollock. The remaining 38 kHz backscatter was attributed to an undifferentiated plankton-fish mixture, or in a few isolated areas, to Pacific herring, rockfish species, or unidentified fish. The majority of the pollock biomass spanned a region south of St. Matthew Island and inshore of Zhemchug and Pervenets Canyons, northward to and slightly across the U.S./Russia Convention Line 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 12.55 billion fish weighing 2.323 million metric tons; in the Russian EEZ, there were 1.0 billion fish weighing 0.131 million metric tons (5.3% of the total midwater biomass). Of the pollock observed in the region east of 170°W (7.3% of total biomass), most were outside the Steller Sea Lion Conservation Area (SCA), whereas most were inside the SCA in 2009, and the predominant length mode was 42 cm. In the U.S. west of 170°W (87.4% of total biomass) modal lengths were 26, 16 and 39 cm, in decreasing order of importance. The percentage of walleye pollock biomass found to the west of 170°W has increased steadily since 2002. In Russia, modal lengths were similar to those observed west of 170°W in the U.S.

Preliminary age results using a NMFS bottom trawl survey age-length key indicated that inside the U.S. EEZ, age-2 and -1 fish were dominant numerically (49% and 21%, respectively) and together represented 35% of the total biomass. Walleye pollock age 4 totaled 17% of the population numerically and made up 40% of the total biomass, whereas age 3 pollock comprised 9.5% numerically and 12% of biomass. Ages 5+ accounted for only 4% of the population numbers and only 13.5% of the total biomass. Analyses of walleye pollock vertical distribution indicated that 85% of adult biomass was within 40 m of the seafloor. Juveniles were found both near the seafloor and higher in the water column; 13% of juvenile biomass was within 45 m of the surface and 65% was within 40 m of the seafloor.

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

b. Stock Assessment

GULF OF ALASKA

The 2010 assessment indicates an increase in Gulf of Alaska pollock following years of decline. The age-structured model developed using AD Model Builder and used for GOA W/C/WYK pollock assessments in 1999-2009 is unchanged. This year's pollock assessment features the following new data: (1) 2009 total catch and catch at age from the fishery, (2) 2010 biomass and age composition from the Shelikof Strait EIT survey, (3) 2009 age composition from the NMFS bottom trawl survey, and (4) 2010 biomass and length composition from the ADF&G crab/groundfish trawl survey. Model fits to fishery age composition data were good in most years. The fit of Shelikof Strait EIT survey age composition show large residuals at age 2 and age 3 in 2006-2009 due to inconsistencies between the initial estimates of abundance and subsequent information about the magnitude of these year classes. Model fits are similar to previous assessments, and general trends in survey time series fit reasonably well. The model was unable to fit all the 2009 survey estimates simultaneously. All survey time series in the last two years (2009 and 2010) indicate an increase, but the magnitudes differ.

The 2010 biomass estimate of Shelikof Strait fish ≥43 cm (a proxy for spawning biomass) increased 2.5 times from the 2009 estimate due to increased recruitment to the spawning population. Additional EIT surveys in winter 2010 covered the Shumagin Islands spawning area, Sanak Gully, Morzhovoi Bay, Pavlov Bay, Chirikof, and Marmot Bay. In comparison to 2009, biomass estimates were lower in the western Gulf of Alaska, and generally higher in the central Gulf of Alaska. An exploratory survey along the Kenai Peninsula and through Prince William Sound found significant quantities of pollock. The discovery of significant pre-spawning aggregations along the Kenai Peninsula is difficult to interpret at the population level because it is unclear whether these aggregations have always been present at this level of abundance, or whether they represent an eastward shift in spawning. In 2010, the ADF&G crab/groundfish survey biomass estimate decreased 15% from 2009, but increased approximately 60% from the mean of the previous three years (2006-2008).

This year, the model estimate of the 2007 year class was 0.794 billion recruits (which is 13% higher than average recruitment). This is in contrast to last year's initial estimate which was 1.7 times the average recruitment. Since additional information is available on the magnitude of this year class, it is appropriate to use the model estimate rather than assuming that it was equal to average recruitment.

The author recommended using the standard model projection and the more conservative adjusted $F_{40\%}$ harvest rate. While there are some elements of risk-aversion in this recommendation, such as fixing trawl catchability at 1.0, our recommendation is to delay treating those elements until an ABC framework is in place that deals explicitly with scientific uncertainty.

The model estimate of spawning biomass in 2011 is 198,767 t, which is 28.8% of the unfished spawning biomass. The $B_{40\%}$ estimate is 276,000 t. This represents an 11% increase from the 2009 assessment, and reflects both the increase in mean weight at age during spawning and an increase in average recruitment. Estimates of 2011 stock status indicate that spawning biomass will increase but remain below $B_{40\%}$.

Pollock are not overfished nor are they approaching an overfished condition. Catches remain below levels where overfishing would be a concern. Because model estimated 2011 female spawning biomass is below $B_{40\%}$, the W/C/WYK Gulf of Alaska pollock are in Tier 3b. The Plan Team accepted the author's recommendation to reduce F_{ABC} from the maximum permissible using the "constant buffer" approach (first accepted in the 2001 GOA pollock assessment). The projected 2011 age-3+ biomass estimate is 893,700 t (for the W/C/WYK areas). Markov Chain Monte Carlo analysis indicated the probability of the stock being below $B_{20\%}$ will be negligible in all years. Therefore, the ABC for 2011 based on this precautionary model configuration and adjusted harvest control rule is 88,620 t (F_{ABC} = 0.12) for GOA waters west of 140°W longitude. **The ABC is 86,970 t for 2011** (reduced by 1,650 t to account for the Prince William Sound GHL). The 2011 OFL under Tier 3b is 118,030 t (F_{OFL}= 0.16).

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 2009 survey. The biomass from the 2009 NMFS bottom trawl survey increased to 41,088 t. This results in a **2011 ABC of 9,245 t**, and a **2011 OFL of 12,326 t**.

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

EASTERN BERING SEA:
In summer 2010, a panel of three experts outside of NMFS was convened to review the assessment approaches used for this stock. They developed a series of reports which detailed recommendations for improvements. These reports were presented to the Plan Teams and Council during September and October and subsequently incorporated into the assessments for the December analysis.

Data on the EBS pollock stock showed improved conditions compared to 2009. The acoustic and bottom trawl surveys suggest that the 2006 and 2008 year classes are above normal and because of that, the biomass is projected to increase to above B_{MSY} level in 2011. This resulted in an ABC of 14% over what was previously projected for 2011.

New data in this year's assessment include the following:
- Updated total catch for 2009 and a preliminary estimate of the 2010 catch.
- Updated age composition data and weight-at-age data from the 2009 fishery.
- Updated age composition data from the 2009 acoustic-trawl survey.
- Age composition data from the 2010 NMFS bottom trawl survey.

- Preliminary age composition from the 2010 acoustic-trawl survey (based on the age-length key from this year's bottom trawl survey, supplemented with 100 otoliths from this year's acoustic-trawl survey).
- Biomass estimates from the 2010 bottom trawl survey and the 2010 acoustic-trawl survey. The estimate from the bottom trawl survey was 3.75 million t, up 64 percent from the 2009 estimate, but still below average for the 1987-2010 time series. The estimate from the acoustic-trawl survey was 2.32 million t, up 151 percent from the 2009 estimate, but still below average for the 1979-2010 time series.
- Annual estimates of relative precision for the acoustic-trawl survey abundance data from 1994-2010 (previous assessments assumed a constant CV of 20 percent for these data).
- The only change to the final model was exclusion of the three most recent year classes from the data used to estimate the stock-recruitment relationship. Two changes were included in exploratory model runs, but not the final model: 1) Use of an ageing error matrix. 2) Use of a new acoustic index derived from opportunistic acoustic recordings from the fishing vessels chartered to conduct the bottom trawl survey, which has been shown to be consistent with the acoustic-trawl survey data and will be used in future assessments to provide mid-water abundance estimates during off-years for the acoustic-trawl survey.

Generally speaking, estimates of biomass from this year's assessment are higher than those from last year's assessment, particularly for the most recent part of the time series. For example, estimates of age 3+ biomass from this year's assessment are within 3 percent of those from last year's assessment for the period 2000-2003 and within 9 percent for the period 2004-2008, but they are 31 percent and 43 percent higher for 2009 and 2010, respectively.

Spawning biomass for 2008 was the lowest since 1980, but has increased steadily since then, with a further increase of 30 percent projected from 2010 to 2011. The 2008 low was the result of extremely poor recruitments from the 2002-2005 year classes. Recent and projected increases are fueled by strong recruitments from the 2006 and 2008 year classes (it should be noted, however, that the strength of the 2008 year class is still highly uncertain). Spawning biomass is estimated to be 4 percent below B_{MSY} in 2010, and projected to be 25 percent above B_{MSY} in 2011.

The SSC has determined that EBS pollock qualifies for management under tier 1 because there are reliable estimates of B_{MSY} and the probability density function for F_{MSY}. The assessment author has concluded that the tier 1 reference points continue to be reliably estimated. The updated estimate of B_{MSY} from the present assessment is 1.95 million t. Projected spawning biomass for 2011 is 2.44 million t, placing EBS walleye pollock in sub-tier "a" 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 0.564, up 51 percent from last year's value of 0.373. The harvest ratio of 0.564 is multiplied by the geometric mean of the projected fishable biomass for 2011 (3.82 million t) to obtain the maximum permissible ABC for 2011, which is 2.15 million t, up 164 percent from the 2010 ABC and up 94 percent from the 2011 ABC projected in last year's assessment.

The authors recommend setting ABCs for 2011 and 2012 below the maximum permissible level, specifically, at values corresponding to the average harvest rate over the most recent five complete years (0.33). Projected harvests at this rate results in ABCs for 2011 and 2012 equal to 1.27 million t and 1.60 million t, respectively. The Plan Team agreed with the authors' recommended ABCs well below the maximum permissible due to the large gap in the population age structure created by poor recruitments from the 2002-2005 year classes. While the Plan Team has recommended ABCs in excess of 2 million t in previous years when biomass was very high, the stock contained multiple large cohorts in those years, whereas about half of next year's catch is likely to come from a single year cohort (2006). Because recruitment is largely driven by environmental conditions, it was advised to not take full advantage of the present large biomass as a hedge against the possibility that the environment might return to the conditions that produced poor recruitment during the 2002-2005 period. The OFL harvest ratio under tier 1a is 0.640, the arithmetic mean of the ratio between MSY and the equilibrium fishable biomass corresponding to MSY. The product of this ratio and the geometric mean of the projected fishable biomass for 2011 gives the OFL for 2011, which is 2.45 million t. The current projection for OFL in 2012 given a 2011 catch of 1.27 million t is 3.17 million t.

The walleye pollock stock in the EBS is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition. Multiple sources of information indicate that EBS pollock biomass is increasing. Relative abundance of euphausiids, a key item in the diet of pollock, increased for several years through 2009. This indicates that pollock prey is generally abundant, while the slight downtrend euphuausiid abundance observed in 2010 should be monitored to determine if top-down control resulting from increased pollock abundance may be occurring. Also, the current draft of the Steller sea lion Biological Opinion does not indicate that reductions in the EBS Pollock ABC are necessary to avoid jeopardizing the recovery of species listed under the ESA.

ALEUTIAN ISLANDS

The new data in the model consists of updated catch information -- 2010 catch estimates and updated values for 2003 through 2009, catch at age data from the 2007 and 2008 Aleutian Islands Cooperative Acoustic Survey Study, and the 2010 Aleutian Islands bottom trawl survey biomass estimate. In this year's assessment, the model adopted last year by the Plan Team and SSC was presented, along with one other model. The only difference is that the latter model includes an ageing error matrix.

This year's assessment estimates that spawning biomass reached a minimum level of about $B_{22\%}$ in 1999, then increased steadily through 2006 to a level around $B_{33\%}$, and remained fairly close to that level through the present. The increase in spawning biomass since 1999 has resulted more from a decrease in harvest than from good recruitment, as there have been no above-average year classes spawned since 1989, and the 2000 year class was the first to exceed the median level since the 1993 year class. Spawning biomass for 2011 is projected to be 80,900 t. The SSC determined that this stock qualifies for management under tier 3. The Plan Team supported the continued use of the reference model with the addition of an ageing error matrix (Model A1_AE) for evaluating stock status and recommending ABC. The reference model estimates $B_{40\%}$ at a value of 108,000 t, placing the AI pollock stock in sub-tier "b" of tier 3. Under tier 3b, with $F_{40\%}$=0.35, the maximum permissible ABC is 36,700 t for 2011. The Plan Team recommends setting 2011 ABC at this level. Following the tier 3b formula with $F_{35\%}$=0.44, OFL for 2011 is 44,500 t. Given a 2011 catch of 19,000 t, the maximum permissible ABC is 35,600 for 2012 and the projected OFL is 43,300 t. If the 2011 catch is only 1,090 t (i.e., equal to the five year average), the 2012 maximum permissible ABC would be 41,600 and the 2012 OFL would be 50,400 t. The Plan Team recommends setting 2012 ABC at this level.

The walleye pollock stock in the Aleutian Islands is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

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

12. Dogfish and Other Sharks

a. Research – ABL

GULF OF ALASKA

Spiny Dogfish Ecology and Migration - ABL
Spiny dogfish is a long-lived, slow-growing species. Data collected from 2004-2007 in cooperation with the NMFS AFSC Longline Survey, the Alaska Observer Program, ADF&G, and the University of Alaska Fairbanks were examined to determine the growth, age structure, demographic characteristics, and ecology 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. Diet analysis revealed that spiny dogfish feed primarily on shrimp and squid, but also have a generalized diet and are opportunistic feeders. Spiny dogfish tend to feed on small fish and invertebrates when young and incorporate larger prey items as they grow, which is reflected in an increasing trophic level as the fish grows.

Scientists at the Auke Bay Laboratories have begun an annual tagging program for spiny dogfish including both numerical Peterson disk tags and pop-off, electronic archival tags. Thirty-five pop-off and >300 numeric tags were deployed in Yakutat Bay in the summers of 2009 and 2010. At this time, all but one of the pop-off tags have been "recovered" (i.e., the data is downloaded from them, but they are not physically recovered), and the remaining tag is programmed to pop-off and transmit its data in May 2011. Recovered data from the pop-off tags, which includes temperature, depth, and geographic location, are still being analyzed.

For more information, contact Cindy Tribuzio at (907) 789-6007 cindy.tribuzio@noaa.gov.

Salmon shark life history – RACE, Kodiak Laboratory
Sharks in Alaska waters are currently managed as a part of the 'Other Species' group by the North Pacific Fishery Management Council. Shark catches within the Gulf of Alaska (GOA) are

dominated by three species, the spiny dogfish, *Squalus acanthias*, the Pacific sleeper shark, *Somniosus pacificus*, and the salmon shark, *Lamna ditropis*. While not the target of commercial fisheries, salmon sharks are captured by recreational fishers and as bycatch in several fisheries within the GOA. The stock assessment and management of this species is hindered by a lack of life history data to input into models. Parameters needed to support stock assessment include reproductive timing and periodicity, fecundity, and improved age and length at maturity estimates. The life history of this species is being examined by researchers at the Kodiak Laboratory. Salmon sharks captured incidentally in other fisheries are being collected and dissected to examine: length at maturity, fecundity, reproductive periodicity, and age and growth. During 2010, 11 salmon sharks were collected including nine mature females of which four were pregnant and five were in a resting stage. It is anticipated more salmon sharks will be examined in the upcoming fall pollock fisheries.

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

b. Stock Assessment – ABL

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

Sharks in Alaskan Waters - ABL

The shark bycatch assessment chapters from 2010 for the Bering Sea/Aleutian Islands (BSAI) and for Gulf of Alaska (GOA) were updated for 2011 and presented to the North Pacific Fishery Management Council's Groundfish Plan Teams in November 2010.

Incidental catch estimates for sharks in the commercial fishery 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 2010 Eastern Bering Sea (EBS) shelf, slope, and Aleutian Islands. Previous survey data were available from NMFS AFSC bottom trawl surveys in the EBS shelf (1979–2009), 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 (1984–2009).

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. Catch estimates from 2003-2010 were updated from the AKRO's Catch Accounting System. In the BSAI, Pacific sleeper sharks are the primary species caught and average incidental catch from 1997–2007 (598 mt) represented 11.6% 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, 2004, 2008 and 2010) showed a substantial biomass of Pacific sleeper sharks on the EBS slope in 2002 (25,445 mt) but not other years. The EBS shelf survey did not encounter sharks from 2007-2009, but did catch them in 2010 and estimated 5,299 mt biomass. In 2009 only spiny dogfish were encountered on the shelf survey and biomass was estimated at 72 mt.

In the GOA, spiny dogfish are the primary species caught and average bycatch of spiny dogfish from 1997–2007 (703 mt) represented 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 over the same years). Average bycatch of Pacific sleeper sharks from 1997–2007 (316 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 (64 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.

Catch in unobserved fisheries is a major concern for shark species, in particular the halibut IFQ fisheries. Methods for estimating bycatch in the halibut IFQ fishery have recently been developed by AFSC scientists, and these methods were examined and approved by the North Pacific Fishery Management Council's Scientific and Statistical Committee. Results will be available for the 2011 assessment cycle. Similar methods are being used to estimate shark bycatch in ADF&G groundfish fisheries in Southeast Alaska and results are also expected for the 2011 assessments.

The "other species" assessment group was dissolved starting in 2011 and separate ABCs and OFLs are now being set for the shark complex in both the BSAI and GOA Fishery Management Plan areas. In the GOA, spiny dogfish are being considered a Tier 5 assessment species for 2011 and all other sharks are still a Tier 6 species. The GOA-wide ABC and overfishing level (OFL) for the entire complex is based on the sum of the ABC/OFLs for the individual species, which resulted in ABC=6,197 mt and OFL= 8,262 mt for 2011, compared to the 2010 ABC of 839 and OFL of 1,118. In the BSAI, all shark species are still considered Tier 6 with no changes to the ABC (449 mt) and OFL (598 mt) calculations from previous years.

For more information, contact Cindy Tribuzio at (907) 789-6007 cindy.tribuzio@noaa.gov.

15. Grenadiers – ABL

b. Stock Assessment

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

Grenadiers in Alaska - ABL
In 2010, a full assessment was done for grenadiers in Alaska and incorporated as an appendix to the North Pacific Fishery Management Council's (NPFMC) annual Stock Assessment and Fishery Evaluation Report. The assessment provided an update to the full assessment for grenadiers done in 2008 and presented new survey information and updated catches. Giant grenadier (*Albatrossia pectoralis*) is by far the most abundant grenadier in Alaska at depths <1,000 m, is the major bycatch species in directed fisheries for sablefish and Greenland turbot,

and is the only grenadier species to warrant management concern in Alaska at present. Therefore, the assessments have been based on giant grenadier serving as a proxy for entire grenadier group. For the 2010 assessment, revised biomass estimates for giant grenadier were computed that included new longline survey and trawl survey data from 2009-2010. These estimates are: eastern Bering Sea (EBS), 592,271 mt; Aleutian Islands (AI), 1,141,526 mt; and Gulf of Alaska (GOA), 597,884 mt. Similar to the 2008 full assessment, we 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, 34,648 mt; AI, 66,779 mt, and GOA, 34,976 mt. When these values are compared with the estimated catches of giant grenadier, it appears that giant grenadier are not being overfished at this time. However, the reported longevity, slow growth, and deep-sea habitat of this species make it susceptible to overfishing. 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 NPFMC for many years has categorized grenadiers as "not specified" (i.e., not included) in its Groundfish Management Plans. This means there are no regulations concerning grenadiers in Alaska, and fishermen have been free to catch as many as they want. Because of this "not specified" status, our recent assessments for grenadiers in Alaska and recommendations of OFLs and ABCs have not been official and are not binding. However, in response to NMFS guidelines developed to comply with the reauthorized version of the Magnuson-Stevens Fishery Conservation and Management Act, we have recommended that grenadiers be re-classified as "in the fishery" and be included in the Groundfish Management Plans, in which case an official assessment would be required. However, a NPFMC amendment to the Groundfish Management Plans will be required to enact this recommendation.

For more information, contact Dave Clausen at (907) 789-6049 or dave.clausen@noaa.gov.

16. Other Species

a. Research

Life history of the giant Pacific octopus – RACE, Kodiak Lab, in collaboration with REFM
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 initiated a life history study of giant Pacific octopus during 2009. This study will co-occur with gear studies to examine the feasibility of an octopus fishery. During the fall pod cod fishery, 25 giant pacific octopus specimens were obtained. An additional 73 octopus specimens were obtained during spring and fall charters. The condition of the reproductive tract was assessed and samples were preserved for future histological analysis. In addition structures for aging (beak, statolith, and stylet) were dissected out and preserved. Three stages for each sex were identified to be utilized in a guide to identifying the reproductive stage of octopus in the future. Initial analyses indicate male octopus mature at 10-12 kg and female octopus mature at 11-15 kg with little evidence of reproductive seasonality. Additional samples are needed to clarify seasonality and female size at maturity. A

charter will occur during the spring/summer months of 2011 to acquire additional samples. During the upcoming year samples obtained from the Aleutian Islands and the Bering Sea will be analyzed and the fecundity of Gulf of Alaska specimens will be determined.

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

VIII. D. Other Related Studies

Forage Fish - A New Tool for Predicting Spawn Timing in Pacific Sand Lance – ABL
Pacific sand lance is one of the most widely distributed and abundant forage fishes in nearshore waters of southeastern Alaska. Spawning, however, has not been documented in the region. Because there are no spawning migrations in any species of sand lance, it is likely that spawning occurs near habitat used by adults. It is hypothesized that accurate predictions of imminent spawning in female sand lance will identify temporal windows of opportunity to observe spawning activity in areas of routinely used overwintering habitat. Ovary maturation is similar in most teleost species, with developing eggs (oocytes) undergoing primary growth, cortical alveoli, vitellogenesis, and final oocyte maturation (FOM). During FOM, the centrally located nucleus migrates to the periphery of the oocyte where it breaks down prior to ovulation. The onset of FOM is indicative of imminent spawning. The duration of FOM, however, is species-specific and unknown for sand lances. In this study, we monitored the initiation and duration of FOM in an overwintering aggregation of sand lance in Juneau, Alaska. A total of 63 adult females were captured and sampled for oocyte maturity; 28 of these fish were held in captivity and iteratively sampled on a weekly basis during November and December 2010. Whole oocytes (~30) were extracted from anesthetized sand lance by applying gentle suction on a syringed, plastic tube (1.0-mm inner diameter) inserted into the genital vent. Using light microscopy, the fresh oocytes were measured for diameter and staged for maturity. Staging of FOM involved quantifying the distance traveled by the nucleus from the center towards the animal pole, the coalescence of lipid droplets, and the degeneration of the nucleus upon reaching the oocyte periphery. The resultant time-series of oocyte diameter and FOM staging will be developed into a maturity classification system for predicting spawn timing of in-vivo sampled, wild sand lance.

For more information, contact Darcie Neff at (907) 789-6066 or darcie.neff@noaa.gov.

RACE Groundfish Program Habitat Research Group (HRG)

USBL Performance -- The HRG has been working collaboratively with NOAA's Office of Coast Survey and NOAA Ship Fairweather (FA) to integrate the ocean mapping activities of these two organizations in the eastern Bering Sea (EBS). This work involves a variety of towed instruments, including two different side scan sonar systems, a towed camera system, and an over-the-side grab sampler. In all cases, a subsurface tracking system is required to provide accurate positioning of the overboard object. As such, the AFSC purchased a wideband-enabled Sonardyne Fusion ultra-short baseline (USBL) system for FA in order to provide this capability. Field operations were conducted in 2009 and 2010 to isolate and describe performance problems associated with acoustic interference and multipath conditions created by the transceiver's installation design, and to recommend short- and long-term solutions for subsea positioning capabilities on FA. Our results demonstrated inconsistent and therefore unreliable performance from a system that did not calibrate according to manufacturer's standards due to the installation characteristics specifically related to transceiver mount location on the hull. Instrument-specific effects on positioning that are related to tow speed and layback angle can limit certain multi-mission research and hydrographic surveying operations from the platform as configured. Future efforts will be undertaken to address the noted mounting deficiencies to permit a more satisfactory sensor calibration and better overall tracking performance.

GIS Metadata - To address the Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act, the Habitat Research Group has initiated several projects in the Eastern Bering Sea (EBS) to better understand the role habitat plays in the health and sustainability of marine resources in Alaska. Data describing infauna distribution and various sediment characteristics (including grain size, acoustic backscatter properties, and optical imagery) are being assembled and archived in geodatabase format with accompanied NGDC-compliant metadata.

Pribilof Canyon Bathymetry and Backscatter - In June of 2009, the HRG participated in a collaborative effort to conduct the first comprehensive high-resolution multibeam survey of Pribilof Canyon in the Bering Sea. Multibeam bathymetry and backscatter were collected using Kongsberg's EM710 and EM120 echosounders aboard R/V Mt. Mitchell. The survey covered approximately 900 square nautical miles and depths ranging from 200 to 2100 meters. This project lays an important foundation for the planning of future habitat studies in the area, as well as providing a large data set of bathymetry and backscatter for any future projects in Pribilof Canyon.

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

Automated Image Analysis Workshop – RACE

The automated image processing workshop was convened on September 7-9, 2010 in Seattle, Washington to provide information, facilitate exchanges of ideas, and foster future collaboration between NOAA scientists working with image based sampling systems and experts in the field of computer vision. The priorities were to present developments in automated image processing of data from marine applications, discuss common challenges, and exchange ideas for current and future efforts. It was funded by the Advanced Sampling Technology Working Group (NMFS – OST).

The workshop began with presentations by scientists describing image sampling systems currently in use at the six NOAA science centers. These presentations demonstrated a broad variety of image – based surveying and research projects. The majority of projects presented were aimed at assessing abundance, with some well established programs such as the diver based surveys and baited cameras in the PIFSC and the scallop surveys in the NEFSC and other more exploratory projects involving AUVs, ROVs, and other towed platforms. The level of sophistication in the image collection systems and the analytical tools varied greatly among projects, from fully automated systems such as the scallop survey, to technician-assisted analyses of coral density, and fully manual analyses of fish length and identification from ROV images.

Next, computer vision experts presented selected projects from their work, and discussion sessions were held to identify key issues and the common challenges in automated image analysis. Expert presentations were grouped by topic, resulting in five groups: (1) Plankton identification, (2) Stereo-camera based fish measurements, (3) Seafloor imaging and habitat studies, (4) Fish classification, and (5) Object tracking and behavior analysis. Following is a brief overview of each topic, based on presentations and associated discussions.

In addition to the question periods following each presentation, discussion sessions were held to provide an open forum for interaction between participants. Two sessions involved the entire group and one consisted of three break-out groups to further facilitate an open conversation on topics of interest. The full group sessions focused on higher-level discussions of common areas in processing among the image-based sampling projects presented, and the merits of certain approaches in hardware and software systems. The discussion also touched on the degree to which image quality and image background control the potential for automation. The breakout groups discussed the automation of stereo-measurements, benthic-habitat images, and the challenges of feature extraction of fish targets for automated species classification.

At the end of the workshop, several central issues were identified in going forward with automation of image processing in marine environments. First, specific situations were identified as better candidates for automation, such as those with featureless background, even illumination, and targets with highly diverse appearances. Additionally, automation projects are best accomplished through multidisciplinary collaboration, where the expertise of computer vision professionals can be leveraged to find effective methods of extracting data of interest. In many instances expertise is not available within the institution collecting the image data. A full description of the workshop presentations, discussion, conclusion and recommendations will be available as a NOAA Technical Memorandum in late 2011.

For further information, contact Chris Rooper (206)526-4689, Chris.Rooper@noaa.gov or any of the following participants of the workshop:
K. Williams[1], C. Rooper[1], J. Harms[2], J. Godlewski[3], G. Cutter[4], J. Butler[4], and C. Thompson[5]
AFSC[1], NWFSC[2], NEFSC[3], SWFSC[4], SEFSC[5]

Fisheries Resource Pathology Program – RACE

During the 2010 survey season, the Fisheries Resource Pathobiology sub-task continued its monitoring effort of potentially important diseases of a number of species found in the Bering Sea shelf region. As part of an ongoing study, non-lethal hemolymph withdrawals were collected from Tanner crabs, *Chionoecetes bairdi* and *C. opilio*, to determine the prevalence and distribution of bitter crab syndrome caused by *Hematodinium sp.*, a parasitic dinoflagellate.

As a disease program, we frequently get inquiries regarding the nature of encountered anomalies. It is our goal to develop a web-based reference site or information center. Therefore, we inspected numerous fish and shellfish for assorted visual anomalies during the 2010 EBS RACE survey. Abnormalities were photographed, excised, and placed in fixative for subsequent microscopic diagnosis and for genetic characterization of the respective etiological agent. Species analyzed included Pacific cod, northern rock sole, Alaska plaice, Bering founder, walleye pollock, arrowtooth flounder, and Tanner crabs.

For further information, contact Dr. Frank Morado, (206) 526-6572.

E. Other Items

GIS RESOURCES

Data

NOAA's National Geophysical Data Center (NGDC) has continued building high-resolution digital elevation models (DEMs) of select U.S. coastal regions. For more information see http://www.ngdc.noaa.gov/mgg/inundation/.

ArcMap 10 has an Add Basemap button where ESRI basemaps can be added to your map. The idea is to add your data to an existing pretty basemap thereby saving you time. An ocean centric basemap is in the works.

New GIS Tools

Bathymetric attributed grid (BAG) is a non-proprietary file format for storing and exchanging bathymetric data. ArcGIS desktop 10 can now read these BAG files.

The EDC (Environmental Data Connector) extension to import data served by Thredds/OPeNDAP has now been updated to work with ArcGIS 10. The extension can be downloaded from either ERD or ASA, both websites are listed below. There is also a standalone version for use without ArcGIS. See http://www.pfeg.noaa.gov/products/EDC/ or http://www.asascience.com/software/arcgistools/edc.shtml.

Software

ArcGIS 10 came out last summer. One of the nicest improvements is a time slider that enables one to step through data. Another improvement is the centralized geoprocessing menu where you can define your environmental settings and options. You can also see your results which are a record of your geoprocessing events. Improvements are still evolving and continuing. ArcGIS server now crosses the 180° line seamlessly with the Java API. It is also being fixed for the Flex API. ArcGIS 10.1 desktop beta should start around June 2011 (https://betacommunity.esri.com).

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

APPENDIX I - Alaska Fisheries Science Center Groundfish-Related Publications and Documents In Press – January 2010 through April 2011
(AFSC authors in bold text)

Alaska Fisheries Science Center (AFSC) Peer-Reviewed Journal Reports and Technical Memoranda in 2010 (AFSC authors are in bold).
Note: Listings of 2010 Groundfish Stock Assessment Reports and AFSC Processed Reports are accessible by following the links provided below to the appropriate AFSC web page.

A'MAR, Z. T., A. E. PUNT, and **M. W. DORN**.
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APPENDIX IV - Auke Bay Laboratory Marine Ecology and Stock Assessment (MESA) Program Staff

Name	Duties
Phil Rigby	Program Manager
Dave Clausen	Rockfish, Grenadiers, Alaska Groundfish
Dave Csepp	Forage Fish, Hydroacoustics
Katy Echave	Sablefish Tag Database
Dana Hanselman	Sablefish, Rockfish, Stock Assessment
Pete Hulson	Rockfish and Shark Assessment
Jon Heifetz	Rockfish, Sablefish, Stock Assessment, Effects of Fishing
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
James Murphy	Thornyhead Assessment, Modeling of Groundfish Tagging Data
Cara Rodgveller	Sablefish, Rockfish, Longline Survey, Grenadiers
Tom Rutecki	Sablefish, Webmaster, Outreach
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
Darcie Neff	Essential Fish Habitat, Forage Fish
Christine Kondzela	Rockfish Genetics
Sharon Hawkins	Forage Fish Genetics
Ed Farley	Epipelagic Trawl Survey in Bering Sea, Age-0 Walleye Pollock

CANADA

British Columbia Groundfish Fisheries and Their Investigations in 2010

May 2011

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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, B.C., 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
Marine Ecosystems & Aquaculture	Dr. Laura Brown

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

Groundfish	Mr. Greg Workman
Invertebrates	Mr. Graham Gillespie
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 in the Groundfish Section. Groundfish specimen ageing and hydroacoustic work are conducted in the Applied Technologies Section. The Canadian Coast Guard operates DFO research vessels. These research vessels include the *W.E. Ricker, J.P. Tully, Vector,* and *Neocaligus*. A replacement vessel for the *W.E. Ricker* has been delayed until 2014 or beyond.

The Pacific Region Headquarters (RHQ) of Fisheries and Oceans Canada is located at 401 Burrard Street, in Vancouver, BC, V6C 3S4. Management of groundfish resources is the responsibility of the Pacific Region Groundfish Coordinator (Ms. Tamee Mawani) within the Fisheries and Aquaculture Management Branch (FAM). Fishery Managers receive assessment advice from MEAD through the Canadian Centre for Scientific Advice Pacific (CSAP) review committee. The Chair of CSAP (Ms. Marilyn Joyce) 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.dfo-mpo.gc.ca/science/advice-avis/index-eng.html.

The trawl, sablefish, rockfish, lingcod, dogfish, and halibut fishery sectors continue to be managed with Individual Vessel Quotas (IVQs). IVQs can be for specific areas or coastwide.

Within the general IVQ context, managers also use a suite of management tactics including time and area specific closures and bycatch limits. Details for the 2010/2011 2009/2010 integrated fisheries management plan can be viewed at http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/MPlans.htm~ #Groundfish.

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 for fishing activities are no longer possible. Larocque Relief Funding, to replace fish allocations, was provided in 2007 and will continue to fund surveys through March 2012. Details on Larocque Relief Funding can be found at http://www.dfo-mpo.gc.ca/Science/newpoli-polinouv/guidance-conseils-eng.htm.

Multispecies or ecosystem models and research

1. Ecological Risk Assessment for the Effects of Fishing (ERAEF)

In 2010, Groundfish Science staff continued to work on a pilot application of the Ecological Risk Assessment for the Effects of Fishing (ERAEF) model developed for Australian Fisheries. The pilot study is focussed on a portion of the bottom trawl fishery in Hecate Strait and includes 25 groundfish species captured by the fishery (primarily flatfish, gadids, and elasmobranchs). ERAEF assesses the impact posed by a fishing activity on the ecosystem using a hierarchical approach to risk assessment that moves from a comprehensive but qualitative analysis of risks at Level 1, through to a more focused and semi-quantitative approach at Level 2, and finally to a highly focused quantitative "model-based" approach at Level 3. Assessments only extend to the next level if risk is judged to be above a threshold, which allows the three levels to act as a series of filters to efficiently screen out low risk activities. ERAEF has the potential to serve as a basis for ecosystem-based management since risk can be assessed for ecosystem components extending beyond traditional target species (e.g., bycatch species, habitats). The goals of the pilot study are to (i) investigate how the Australian framework could be adapted to the context of BC groundfish fisheries, (ii) promote learning among groundfish scientists, manager, and stakeholders about how the method works, and (iii) explore how relative risk scores could be used to help schedule assessment activities based on ecosystem considerations.

2. Strait of Georgia Ecosystem Research Initiative Project

Groundfish Staff continued to participate in the Strait of Georgia Ecosystem Research Initiative Project in 2010. 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. 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 initiative currently comprises over thirty research projects and involves over fifty researchers. Details can be found at http://www-sci.pac.dfo-mpo.gc.ca/sogeri/default_e.htm. This 5-year project will be concluded in 2012.

3. NSERC Canadian Capture Fisheries Research Network (CCFRN)

Starting in 2010, Groundfish staff are paritcipating in the National Sciences and Engineering Research Council of Canada's (NSERC) *Canadian Capture Fisheries Research Network*. The CCFRN is a collaboration of academic researchers, the fishing industry, and government researchers and managers from across Canada. The Network includes 33 academics from 13 universities, working with collaborators in the Canadian fishing industry, DFO, and provincial governments. The Network is industry-driven and focussed on projects that have the active collaboration of each sector. The Network will link with other strategic networks and coordinate with DFO programs, where appropriate.

The vision of the Network is to re-shape fisheries research in Canada, bringing together industry, academia and government on priority research questions and linking existing research so that it is useful to industry and management. The research of the Network is aimed at increasing knowledge that will enhance the ecological sustainability, socio-economic viability and management of Canadian fisheries. Specifically, the research objectives are to:

- overcome information gaps for important commercial fisheries and improve the use of industry information in assessment and management;
- enhance ecological sustainability while achieving operational efficiency; and improve the basis for the ecosystem approach to fisheries management.

The Network will provide a forum for sharing research objectives and results that will build capacity in each sector; as well as establish a tradition of collaborative, strategic fisheries research in Canada that is expected to extend beyond its timeline. In addition, the Network will train a cohort of new researchers that will be equipped to meet the research challenges of a new fisheries management regime.

The information and technological advances gained through the research of the Network will have a significant impact on the sustainability, viability and competitiveness of Canada's capture fisheries industry, and will provide environmental and socio-economic benefits. The research will build upon and inform the development of policies and strategies for the management of capture fisheries in Canada and internationally. Details can be found at: http://www.nserc-crsng.gc.ca/Partners-Partenaires/Networks-Reseaux/CCFRN-CCRRN_eng.asp.

By species

1. Pacific cod

i Research program

Three hundred ninety dorsal fin rays from the 2009 Hecate Strait synoptic survey were analysed for aging in 2010. Age and length data are now available in the groundfish database.

ii. Stock Assessments

No new stock assessments for Pacific cod were conducted in 2010 and none is planned for 2011. Dr Robyn Forrest and Mr Rob Kronlund are preparing background materials and potential models for an assessment in 2012. Dr Forrest joined the Groundfish Section and Pacific cod/Hake program in 2010 as a Research Scientist. Among many responsibilities, it is expected that Dr Forrest will take the lead role in Pacific cod and hake, research, and stock assessment.

2a. Rockfish – slope

i. Research programs

Originally, the Slope Rockfish Program focused on the assessment of rockfish species living on the marine continental slope of British Columbia (BC). Over the past decade our group has morphed into a multi-purpose body that tackles a variety of issues: stock assessment, COSEWIC listing requirements, oceanographic exploration, software development for the R statistical platform, and scientific research in marine ecological modelling. There is a fair degree of inter-program collaboration.

The Groundfish Section at the Pacific Biological Station (PBS) conducts a mosaic of synoptic surveys that covers most of British Columbia's ocean bottom ecosystems, including those on the continental shelf and slope. The survey team gathers information on abundance and biology (lengths, weights, maturity, otoliths, etc.). The Slope Rockfish Program, headed by Dr Andrew M. Edwards (PBS research scientist) and including Rowan Haigh (PBS research biologist), focuses on the development of models and software tools for the analysis of data pertaining to groundfish and other species. We also retain the interest of two eminent scientists – Jon T. Schnute (PBS scientist emeritus) who contributes considerable time and expertise; and Paul J. Starr who works for the Canadian Groundfish Research and Conservation Society and plays an integral role in the stock assessments assigned to our program.

In 2010, work continued on maintaining and upgrading the suite of PBS packages for the R statistical platform:

PBSmodelling
- http://cran.r-project.org/web/packages/PBSmodelling/index.html
- http://code.google.com/p/pbs-modelling/

PBSmapping
- http://cran.r-project.org/web/packages/PBSmapping/index.html
- http://code.google.com/p/pbs-mapping/

PBSadmb

http://cran.r-project.org/web/packages/PBSadmb/index.html
http://code.google.com/p/pbs-admb/

PBSddesolve

http://cran.r-project.org/web/packages/PBSddesolve/index.html
http://code.google.com/p/pbs-ddesolve/

PBSfishery

http://code.google.com/p/pbs-fishery/

Contract work involving Alex Couture-Beil (M.Sc. computer science, Simon Fraser University) with the help of Jon Schnute worked towards a significant integration of PBSadmb with the products available from the AD Model Builder project (http://admb-project.org/).

Additionally, our group employed a co-op student, Stephanie Keightley (4th year biology and environmental studies, University of Victoria), to investigate the use of multivariate autoregressive (MAR) models for groundfish communities. Under the guidance of Andrew Edwards and Carrie Holt (PBS research scientist), Stephanie tested how several indices and abiotic time series might drive recruitment for three groundfish species – Pacific ocean perch (*Sebastes alutus*), canary rockfish (*S. pinniger*) and sablefish (*Anoplopoma fimbria*) – using MAR models through a MatLab toolkit called LAMBDA (http://conserver.iugo-cafe.org/user/e2holmes/LAMBDA).

ii. Stock assessment

In 2010, our group presented the first British Columbia stock assessment of Pacific ocean perch (*S. alutus*) since 2001. The assessment focused on Queen Charlotte Sound, which contains the primary habitat of this rockfish along the BC coast.

Pacific ocean perch supports the largest rockfish fishery in BC with an annual coastwide TAC (total allowable catch) of 6,148 t. The trawl fishery receives 99.98% of the coastwide TAC, with the rest allocated to the hook and line fishery. Stock status was assessed using an annual two-sex catch-at-age model tuned to three fishery-independent trawl survey series (Goose Island Gully historic, Queen Charlotte Sound synoptic and Queen Charlotte Sound shrimp), annual estimates of commercial catch since 1940, and age composition data from two of the survey series (8 years) and the commercial fishery (29 years).

Results are reported for the two accepted model runs (the first estimated natural mortality and the second kept it fixed); numeric ranges refer to the 5 to 95% credible intervals derived from Bayesian output).

Spawning biomass (mature females only) at the beginning of 2011 is estimated to be in the range of 12-43% or 8-24% of the equilibrium unexploited value. Annual exploitation rates have increased since the 1980s, and are approaching or have reached the historic high levels associated with the large catches by foreign fleets in the late 1960s. The exploitation rate for 2010 is estimated to be in the range 0.041-0.152 or 0.089-0.224.

Based on the DFO *Sustainable Fisheries Framework*, Precautionary Approach compliant limit and upper reference points of $0.4B_{MSY}$ and $0.8B_{MSY}$ were calculated (where B_{MSY} is the spawning biomass at the maximum sustainable yield). The spawning biomass at the start of 2011 has a probability of 0.96 or 0.82 of being above $0.4B_{MSY}$, and of 0.68 or 0.24 of being above $0.8B_{MSY}$.

Constant catch projections at 3,500 t/year (which is the average catch from 2006 to 2010) over 5 years predict that the spawning biomass at the start of 2016 would have a probability of 0.91 or 0.57 of remaining above $0.4B_{MSY}$, and of 0.63 or 0.15 of remaining above $0.8B_{MSY}$.

Both model runs estimate that since 1981 there have been no recruitment events as large as those observed in the early 1950s and late 1970s. There is evidence that an above average recruitment event occurred in the early 2000s, although there have been insufficient observations of this year class to be confident of its size.

iii Research activities for 2011

In 2009, COSEWIC (the Committee on the Status of Endangered Wildlife in Canada) assessed yellowmouth rockfish (*S. reedi*) as "threatened". This obliges our group to produce a Recovery Potential Assessment (RPA) document that comprises a stock assessment of yellowmouth rockfish along the BC coast, Precautionary Approach (PA) reference points, and decision tables that incorporate harvest options and their affect on the population with respect to the reference points. The RPA will look very much like PA-compliant stock assessments that DFO routinely produces. The major difference is that the population projection must extend further ahead than the typical five years. In the case of yellowmouth rockfish, the projection will be roughly ½ generation, or 15 years.

In 2011, we also plan on hiring a computer programmer to enhance the PBS suite of R packages. PBSmapping in particular needs upgrading to take advantage of the functionality in other R-packages.

2b. Rockfish – shelf

i. Research Programs in 2010

Dr. Murdoch McAllister of U.B.C. and Rick Stanley published a paper on modeling trawl survey catchability for B.C. bocaccio (*Sebastes paucispinis*): a combined expert driven – empirical approach. This paper combined fisher opinions of trawl catchability of bocaccio with a Bayesian surplus production model to conduct a stock assessment of bocaccio.

In conjunction with the Alaska Fisheries Science Centre (NMFS), work is ongoing to establish a consistent and low-priced genetics assay to distinguish between rougheye and blackspotted rockfish. U.S. and Canadian surveys are now collecting genetics samples in order to develop relative abundance indices for each of the species. It is important to note that as long as it is not possible to identify the species in the field, the survey will incur ongoing post-survey genetics assay costs.

A long delayed study of yellowtail genetics was re-initiated in conjunction with Washington State colleagues. The intent of this study was to look for stock delineation prior to the next stock assessment.

Dr Nathan Taylor joined the Groundfish Section and Shelf rockfish program in July of 2010 as a Research biologist. Dr Taylor's post-graduate and post-doctoral experience focused on stock assessment and included mathematical modelling of tuna populations.

ii. Stock assessments in 2010

A synchronous assessment of five rockfish (splitnose, sharpchin, harlequin, redstripe, and greenstriped rockfish) was initiated in 2010. The intent of this assessment to provide a cost-effective means for providing adequate assessment advice on relatively data limited species in a timely manner.

iii. Research activities planned for 2011

Genetics work on rougheye/blackspotted rockfish and yellowtail rockfish will continue in 2011.

iv. Stock assessments planned for 2011

The 5-rockfish assessment will be completed in 2011 and be reviewed in the fall of 2011. An update of the bocaccio assessment is also planned for the fall of 2011.

2c. Rockfish – inshore

i. Research programs in 2010 and planned for 2011

a) Surveys

1. Inside (PFMFC Area 4B)

A research longline survey designed for the Inside waters East of Vancouver Island and initiated in 2003, was conducted in the northern half of the study area in 2010. Survey coverage alternates between the northern and southern portions, annually. 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 and survey blocks were stratified by area and depth (41 – 70 m and 71 – 100 m) and selected for sampling at random. Twenty-one days of DFO ship time are allocated in August for this survey in 2011.

A Phantom HD2+2 remotely operated vehicle (ROV), acquired by DFO Science in 2007 has been used to develop visual survey methods for inshore rockfish. A forward looking video camera (paired lasers), DIDSON sonar unit, scanning sonar, and ultra-short baseline (USBL) underwater acoustic positioning are standard equipment used on the ROV for visual surveys. Surveys to assess inshore rockfish stocks in and adjacent to the Rockfish Conservation Areas

(RCAs) were conducted in August 2010 in the northern inside waters and in February 2011 in portions of the southern west coast of Vancouver Island. ROV surveys will continue in 2011 in northern portions of the west coast of Vancouver Island.

2. Outside (PFMFC Areas 3CD, 5ABCDE)

Since 2003, a third technician has been deployed on the annual 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). The third technician has been supported by Larocque funds since 2007 and will continue in 2011.

In collaboration with the halibut industry, a research longline survey was designed and conducted in the outside BC coastal waters in 2006. 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. The survey covers the coastwide Outside waters over two years, alternating annually between the north and the south. Three chartered fishing vessels conduct this survey between August 15 and September 15. In 2010, the northern portion of BC was surveyed and plans for a 2011 are to survey in the southern region. This survey is supported by Larocque funds.

b) Collaborative research

Three years of NSERC funding (2009 – 2011) (National Sciences and Engineering Research Council of Canada) has been awarded to Dr. Jon Shurin of the University of British Columbia (UBC), 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 began their field work on projects related to the assessment and management of RCAs for inshore rockfish in BC. MSc students will complete their projects in 2011.

Dr. Marie Etienne from the AgroParisTech in France was on sabbatical in 2010 with Dr. Murdoch McAllister at UBC and working on various projects in her field of expertise: spatial statistics. Dr. Etienne completed work, together with Dr. McAllister's PhD student Shannon Obradovich and the inshore rockfish program to develop an abundance index from research longline catch data that accounts for hook competition and the return of empty hooks (Etienne et al. *in review*). The catch data from the Inside longline surveys as well as directed hook-timer experiments are being used to test various models and help differentiate between competing scenarios.

ii. 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 was also reviewed by COSEWIC in the fall of 2009 and COSEWIC has recommended a Threatened status. http://www.cosewic.gc.ca/eng/sct1/searchform_e.cfm

An inside yelloweye rockfish stock assessment was presented to the Canadian Science Advisory Process (CSAP) in April 2011. A coastwide quillback rockfish assessment will be presented to CSAP in May 2011.

iii. Management

In 2007, the RCA strategy was completed with 20% of rockfish habitat closed in Outside waters and 30% of rockfish habitat closed in Inside waters. 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

i. Research activities in 2010 and planned for 2011

The Sablefish Research and Assessment Survey Program includes the following program components:

a) A **Traditional Standardized Program** (1990-2010)

This program includes standardized sets at nine (9) offshore fishing localities and biological sampling. Starting in 1990, one set was made in each of five (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 over time. Catch rates from these core sets extend a stock abundance index series and sablefish are sampled for data on size and growth.

b) A **Traditional Tagging Program** (1991-2007, hiatus in 2008-2010)

This program captures sablefish for tagging and release at historical tagging locations. Sets are made in the 9 traditional standardized program localities as well as five (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.

c) A **Randomized Tagging Program** (2003-2010)

This program 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.

d) An **Inlets Program** (1995-2010)

This program includes standardized sets at four (4) mainland inlet localities. Sablefish are tagged and released from inlet sets and are sampled for biological data.

The annual Research and Stock Assessment Survey Program will be conducted in the fall of 2011, but will include only the randomized program (c) and the inlets program (d).

ii. Stock assessment activities in 2010 and planned for 2011

A sablefish assessment was conducted in 2010 (Cox et al. 2011, in revision). Sablefish stock assessment and management in British Columbia is conducted collaboratively by DFO and the Canadian Sablefish Association. The collaboration is formalized as a Joint Project Agreement 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.

Fishery reference points are based on a target spawning biomass at maximum sustained yield, B_{MSY}, with limit and upper stock reference points at $0.4B_{\mathrm{MSY}}$ and $0.8B_{\mathrm{MSY}}$, respectively. Conservation objectives relate to (*i*) maintaining the spawning biomass above the limit reference point of $0.4B_{\mathrm{MSY}}$ in 95% of years projected over two sablefish generations (~36 years), and (*ii*) implementing an acceptable probability of stock decline over 10 years that scaled from 0.5 at the target biomass to 0.05 at the limit reference point. A multi-gear, age-structured, catch-at-age model was fitted to historical data to create stock scenarios that captured uncertainty in natural mortality, growth, and future recruitment variability. Stock reconstructions suggest stock status is currently below B_{MSY} for all scenarios. A closed-loop feedback simulation approach was used to evaluate the relative performance of candidate management procedures that are distinguished by the choice of survey data, assessment model assumptions, harvest control rule specifications, and future regulations related to at-sea release of sub-legal sablefish. Candidate management procedures were robust to the uncertainties considered as indicated by a consistently low probability ($p < 5\%$) of breaching the limit reference point over two sablefish generations (~36 years) regardless of the management procedure or stock scenario. Expectations for stock growth toward the target reference point over two sablefish generations range from B_{MSY} or greater to levels near, but not above B_{MSY} under the more pessimistic scenarios.

Performance of management procedures based on the stratified random trap survey alone suggested the legacy standardized trap survey could be discontinued without creating a conservation concern, and could also achieve reduced catch variability relative to the use of both surveys. Increases in expected conservation and catch performance due to adopting an avoidance option for sub-legal sablefish, or a full retention option, were small relative to the performance attained by the existing size limit tactic, but these effects are likely underestimated due to suspected violations of assumptions related to trawl gear selectivity. The coast-wide quota was set at 2,300 t for 2011/12 fishing year, unchanged from the 2010/11 fishing year. Sablefish is next scheduled for a stock assessment in 2012.

Development of the management strategy evaluation for BC sablefish in 2010 added modeling of retained and released catches to the age-structured operating model. A 55 cm fork length minimum legal size limit in British Columbia means that sub-legal fish are released by regulation. Work in 2011 will focus on improvements to the modeling of releases by gear sector and simulation evaluation of the B_{MSY}-based reference points. The longline trap and longline hook sectors of the sablefish fishery in BC received Marine Stewardship Council certification on July 29, 2010. Certification was award upon conditions related to (*i*) assessment of stock status relative to fishery reference points and in particular whether the stock is fluctuating around the target reference point, (*ii*) evaluation of the impacts of bycatch of the rougheye/blackspotted rockfish complex, (*iii*) evaluation of existing sea-bird bycatch data and improvement of seabird bycatch monitoring data collection.

4. Flatfish

i. Research program in 2010

Jeff Fargo retired from DFO at the end of 2010 after 32 years conducting research on flatfish biology, ecology and stock assessment. Kendra Holt joins DFO as the new program head for flatfish research and will lead the flatfish program in 2011.

Ongoing data collection in support of the flatfish research program continued in 2010 with samples being collected during two Groundfish synoptic bottom trawl surveys, the first off the west coast of Vancouver Island in June and the second off the west coast Haida Gwaii (Queen Charlotte Islands) in August – September. Additional samples were collected by port samplers in Vancouver and Prince Rupert as well as by At Sea Observers (ASOP) deployed on bottom trawl vessels. During surveys biological data were collected from all flatfish species encountered, including non-commercial species. Sampling included collecting aging structures and determining maturity stage.

Two technical reports were prepared during 2010:

Fargo, J.J. In press. Dynamics of marine fish assemblages in Hecate Strait, British Columbia. Can. Tech. Rep. Fish Aquat. Sci. xxxx: xx + 69p.

Fargo, J.J. and S.J. Westrheim. In press. Tagging mortality, recovery rate and mortality rate of English sole (*Parophrys vetulus*) tagged in Hecate Strait, June 9-18, 1983, and records of other migrations elsewhere. Can. Tech. Rep. Fish Aquat. Sci. xxxx: xx + xxxp.

ii Stock assessments in 2010

No flatfish stock assessments were prepared in 2010.

iii. Research programs planned for 2011

Biological data collection for all flatfish species will continue in 2011 with fishery independent samples coming from two synoptic surveys the first in Hecate Strait in June and the second in Queen Charlotte Sound in July.

Seventeen flatfish species in British Columbia have been included in a pilot study implementation of an Ecological Risk Assessment for the Effects of Fishing to a portion of the BC bottom trawl fishery in Hecate Strait (see section D – ERAEF Pilot). A productivity susceptibility analysis (PSA) will be applied to each of these species in 2011 to estimate potential risk from bottom trawl fishing in this area. PSA methods have been taken from methodology developed by NOAA (http://nft.nefsc.noaa.gov/PSA_pgm.htm). Flatfish species included in the analysis include a wide range of directed (e.g., dover sole, petrale sole) and non-directed (e.g., speckled sanddab, deepsea sole) species.

In preparation for future stock assessments, Jeff Fargo (Retired - alumnus biologist) will complete a technical report in 2011 summarizing life history characteristics, biomass estimates, and fisheries reference points for several BC flatfish species.

5. Pacific hake

i. Research program

Triennial (until 2001), then biennial acoustic surveys, covering the known extent of the Pacific hake stock have been done since 1995. 2010 was an intra-survey year during which the survey team responded to questions raised by the Stock Assessment Review (STAR) panel in 2010. The first issue was potential bias due to the protocol for sampling schools of hake. One reviewer had felt that schools would likely be stratified by size and age and that the conventional approach of taking a “dip” from the top or side of a school to verify the lengths of fish estimated in the acoustic signal would likely be biased. Survey teams onboard the US vessel *Miller Freeman* and Canadian *W.E. Ricker* fished several hake aggregations where they were able to tow the net through the top, middle and bottom and across the length and width of a school and found no obvious pattern of size stratification. Scientists also intended to test the acoustic target strength of Humboldt squid (*Dosidicus gigas*) which were abundant during the 2009 survey, contaminating 39% of the acoustic transects with an unknown quantity of squid backscatter. This problem could not be resolved in the 2010 field season due to the absence of Humboldt Squid during the 2010 survey.

ii. Stock Assessment in 2011

The majority of the Hake catch for the 2010 season was taken from the LaPerouse area in the third quarter (July-Sept), however the shift in temporal and spatial distribution of Pacific hake was still apparent with much of the catch being taken from Queen Charlotte Sound (PMFC 5A and 5B). The increased fishing in the Strait of Juan de Fuca seen in the 2009 fishery was not apparent in 2010; word has spread amongst the fishing community that the fish caught there in 2009 were too small for processors to handle.

The 2011 harvest advice was prepared jointly by Canadian and US scientists, with considerable efforts by the two teams to align data and assumptions in the two assessment models. The models were SS and TINSS, respectively prepared by the US and Canadian assessment teams. Results from the two assessments were combined within a single document that was reviewed by the Pacific Hake Stock assessment review (STAR) panel. Notably, for the first time, decision tables incorporated results from both models, thus presenting uncertainty arising from model-choice to be presented in a consistent format. The review panel accepted both models as equally plausible and recognised the large step forward that had been taken in US-Canadian collaboration on the hake assessment.

Note that in 2009 survey results were badly contaminated by huge numbers of Humboldt squid that occurred all along the Pacific coast. It had not been possible to distinguish squid from hake acoustically and the STAR panel had recommended that the 2009 survey abundance index be removed from the assessment entirely. Re-analysis of the acoustic survey data by NOAA's acoustic team during 2010 enabled confidence intervals to be placed on the 2009 estimate of hake abundance. The acoustic team also re-analysed all the raw acoustic data since 1995 and applied a kriging methodology to recalculate indices of abundance with confidence intervals. Addition of confidence intervals that could be attributed to the presence of Humboldt squid to the 2009 index led to the decision to re-instate this data point (with CV) into the assessment. All survey data prior to 1995 were removed from the analysis, as these were known to contain bias due to subjective inflation factors that had been applied to account for the fact that these surveys did not cover the same extent (spatially or depth-wise) as surveys since 1995. Furthermore, raw data were no longer available for the earlier surveys and it was therefore impossible to apply the same kriging methodology to recalculate the index of abundance. The review panel supported the removal of pre-1995 survey data and re-instatement of the 2009 data.

A notable feature of both assessments was the appearance of an apparent strong 2008 year class in the 2010 commercial catch data. This apparent above-average recruitment event, along with evidence for relatively large 2005 and 2006 year classes, was strongly influential on model results. The strength of the 2008 year class was highly uncertain in the assessments, as it had only been seen once in commercial catch data. This year class has not yet been seen in survey data, as there was no survey in 2010 and the survey does not sample one year old fish, precluding its appearance in the 2009 survey. The uncertainty in the size of the 2008 year class led to extreme uncertainty in model results and was treated as the major axis of uncertainty in the decision tables. The assessment authors noted that a change in fishing practices could also lead to a greater proportion of two-year olds in the catch but were unable to evaluate this hypothesis without fishery-independent information (i.e., survey data). Survey data from 2011 and future years will hopefully confirm whether or not the high proportion of two year old fish in the 2010 catch was indeed the result of a very large recruitment event.

Scientists from Canada were invited to attend the Pacific Fisheries Management Council’s (PFMC) meeting in Vancouver, WA, in March, 2011 to jointly present the assessment results (with US scientists) to the Science and Statistics Committee (SSC) of the PFMC. Dr Robyn

Forrest presented the TINSS results, while Dr Ian Stewart (NOAA) presented the SS and combined SS-TINSS decision tables. The SSC forwarded both sets of results to the PFMC as equally plausible and recommended an overfishing limit (OFL) based on the mean of the combined posterior results from both models. Drs Stewart and Forrest also presented the results to the PFMC's Groundfish Management Team (GMT) and Groundfish Advisory Panel (GAP). They re-iterated their concerns that the size of the 2008 cohort is extremely uncertain and age-composition data could be partly a result of an unknown change in fishing practices. After hearing the testimony of the SSC, GMT, GAP and several stakeholders, the PFMC came to a consensus on a TAC of 393,750 mt. This was based on a previous environmental impact assessment that recommended the TAC should not be more than 1.5 times the previous year's TAC (262,500 mt).

6. Elasmobranchs

i. Research programs in 2010

Two shark tagging surveys were undertaken in 2010. In late July 2010, a pelagic longline survey was conducted offshore of Barkley Sound on the west coast of Vancouver Island. Four blue sharks (*Prionace glauca*) were tagged with archival satellite tags all providing real-time data; approximately 200 were tagged with conventional tags. Two tope sharks (*Galeorhinus galeus*) were tagged with archival satellite tags, with pop-up dates for July 2011. A bottom longline survey was conducted in March 2011 in the Strait of Georgia. Eight sixgill sharks (*Hexanchus griseus*) were tagged with satellite tags, with pop-up dates set for March 2012.

Aerial surveys for basking sharks (*Cetorhinus maximus*) were conducted monthly May to September in 2010 in two areas of historic high abundance: Barkley and Clayoquot Sounds; and Rivers Inlet. No sharks were sighted. Two basking shark sightings were received through the basking shark Sightings Network (toll-free number or online form). Tri-national collaboration between Canada, US and Mexico on critical habitat modeling and tagging programs was implemented in 2010.

ii. Stock assessment(s) in 2010

A stock assessment of the spiny dogfish (*Squalus acanthias*) for both the inside stock (Strait of Georgia, PMFC 4B) and outside stock (PMFC 3C through 5E) of spiny dogfish was reviewed and accepted by the CSAP.

iii. Management

There are no directed fisheries allowed for sharks (excluding spiny dogfish, *Squalus acanthias*) in BC waters; therefore sharks are bycatch only. For the upcoming groundfish commercial fishing season, retention of shark bycatch in the hook and line fishery is not permitted and the sale of shark products is not permitted by the trawl sector. To aid in fisher and on-board observer identification of sharks, an identification guide “Sharks of British Columbia” was produced and distributed to all licence holders.

New management measures will be put in place in the recreational fishery in 2011, with non-retention of all shark species other than spiny dogfish and salmon shark (*Lamna dirtopis*). A daily limit of 4 and an annual possession limit of 8 will be implemented for spiny dogfish. A daily limit of 1 and an annual possession limit of 2 will be implemented for salmon shark. Previously the daily limit for all shark species was 20 per species, with an annual possession limit of 40 per species.

Basking shark was formally listed as Endangered under the Species At Risk Act, affording this species complete protection within Canadian waters. The Recovery Management Strategy has been completed. It is currently in the final 30 day comment period with the public SARA Registry, and will likely be accepted by summer 2011. The tope shark and sixgill shark were listed as Special Concern. A combined Management Plan has been drafted and is currently in the DFO regional and national review process.

iv. Research activities for 2011.

In collaboration with the Alaska Fisheries Science Center and Moss Landing Marine Labs, a collaborative project on bomb dating for age validation of big skate (*Raja binoculata*) and longnose skate (*R. rhina*) will be initiated. A population genetics study for blue shark and salmon shark in the North Pacific is underway with collaborators from California, Alaska, Hawaii and Japan. A population genetics study of sixgill sharks in BC will be conducted, and is to include the investigation of polyandry.

7. Lingcod

Kendra Holt began work on the lingcod program in 2010, and will continue working with Dr. Jackie King on the program in 2011.

i. Research programs in 2010

A lingcod (*Ophidodon elongatus*) egg mass survey was conducted by DFO SCUBA divers at Snake Island Reef and Entrance Island Reef in the Strait of Georgia between February 15th and February 25th, 2010. This survey was undertaken to add to the existing time series from Snake Island Reef, one of the primary index sites, and to provide an ongoing source of biological and relative abundance information for Strait of Georgia lingcod.

ii. Stock assessment(s) in 2010

Stock assessments for four different management units of outside lingcod (southern west coast Vancouver Island, northern west coast Vancouver Island, Queen Charlotte Sound, and Hecate Strait & the west coast of Haida Gwaii [Queen Charlotte Islands]) were undertaken in 2010 using a Bayesian surplus production model. The assessments were approved at an April 2011 meeting of the CSAP, and an assessment document will be published in the CSAS series with a 2011 publication date.

iii. Research activities for 2011

Lingcod research activities in 2011 will focus on Strait of Georgia lingcod, including updating the stock assessment methodology and management framework developed as part of the 2005 *Management Framework for Strait of Georgia Lingcod.* This work will be undertaken in preparation for a stock assessment in 2012 or 2013. An update of the 2005 framework will require the reference points, management objectives, and harvest control rule identified in the 2005 framework to be re-evaluated in light of DFO's 2009 *Decision-making Framework*

Incorporating the Precautionary Approach. A management strategy evaluation approach (MSE) to providing management advice has been identified as a useful tool for evaluating trade-offs among these choices. The feasibility of developing a management strategy evaluation for Strait of Georgia lingcod will be evaluated in 2011.

Other related studies

1. Statistics and Sampling

i. Biological sampling and database work in 2010

Principal Statistics and Sampling activities in 2010 included the ongoing population of the groundfish biological database (GFBio). This database now includes almost 9 million 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 218 length/sex/age samples and 169 length samples in 2010. Port samplers provided an additional 101 samples, 91 samples with ageing structures (length/sex/age/weight) and 10 without structures (length/sex/weight). The focus of their sampling efforts was from those fisheries not covered by at-sea observers.

ii. Catch monitoring in 2010

Staff continued to play a key role in development a new Regional Catch Monitoring information system as well being actively involved in the Groundfish Hook and Line Catch Monitoring Program and a Recreational catch monitoring working group. The Region is considering a more formal approach to identifying accountabilities for catch monitoring in the Region. The outcome of this review may lead to the Science/Groundfish Section assuming a much greeter role and workload with respect to the collection and management catch monitoring data.

In September 2010, staff co-authored a presentation at the ICES annual symposium on the use of an audit opposed to census approach for review of catch video imagery. This paper has been accepted for publication in the ICES journal with a 2011 publication date.

Related to the above issue, one staff member was invited to give a presentation and participate in the discussions at a European Fisheries Commission workshop in Copenhagen. This workshop focussed on uses, applications, and operational elements involved in the collection and analysis of video imagery from catch monitoring.

iii. Field work in 2010

Staff participated on various bottom trawl surveys including the West Coast Vancouver Island and West Coast Haida Gwaii groundfish trawl surveys, the West Coast Vancouver Island and Queen Charlotte Sound shrimp trawl surveys, as well as the Pacific hake hydroacoustic surveys, and lingcod dive survey. This group also included the port sampling activity (1.8 person-years) in the Vancouver and Prince Rupert areas. Staff continued to enhance GFBioField, the integrated (paper-less) data capture system for surveys.

iv. Proposed field and database work for 2011

Port sampling will continue in 2011, as will staff participation in the bottom trawl surveys to Hecate Strait and Queen Charlotte Sound as well as the shrimp trawl surveys in Queen Charlotte Sound and lingcod dive survey in the Strait of Georgia.

Starting in 2011 staff will begin to develop "GFCatchAll" as comprehensive database that will include all known sources of groundfish catch (1900-present). This project is expected to be 90% complete but usable by the end of 2013.

APPENDIX 1. REVIEW OF CANADIAN GROUNDFISH FISHERIES

1. Commercial fisheries

All catch figures for the 2010 calendar year are preliminary. Canadian domestic trawl landings of groundfish (excluding halibut) in 2010 were 77,198 t, a decrease of 10% from the 2009 catch. The major species in the trawl landings were Pacific hake (62%), Pacific ocean perch (7%), yellowtail rockfish (6%), and walleye pollock (5%). Trawl production was distributed amongst areas 3C (45%), 3D (20%), 5B (12%), 5D (6%), 5A (5%), 5E (4%), 4B (3%), and 5C (2%).

Canadian landings of groundfish caught by gear other than trawl in 2010 totalled 7,380 t. Landings of sablefish by trap and longline gear accounted for 2,834 t, approximately 29% by trap gear, 70% by longline gear and 1% by unspecified. Landings of species other than sablefish by trap, longline, handline and troll gear accounted for 4,546 t (36% rockfish, 34% dogfish, 17% lingcod and 12% skates) (see IPHC-TSC submission for estimates of halibut catches).

2. Recreational fisheries

Each year, Fisheries Management Branch of DFO conducts creel surveys of the recreational angling fishery in the four south coast regions. For the Strait of Georgia, in 2010, these surveys covered the months of March to October. Provisional estimates of 2010 catches, landings and releases, for this 8-month period were 22,551 fish for lingcod, 22,750 fish for all rockfish species, 126 fish for halibut, 5,066 fish for rock sole, 1,198 fish for starry flounder, 4,896 fish for dogfish, 2,784 fish for greenlings, 2,262 fish for Pacific cod and 1,793 fish for other groundfish species.

For the Strait of Juan de Fuca, catch estimates have been generated from creel surveys and fishing lodge reports for the months of March to September. Provisional estimates for this 7-month period are 21,642 fish for lingcod, 14,521 for all rockfish species, 5,614 fish for halibut, 2,155 fish for rock sole, 1,041 fish for other flatfish species, 14,006 fish for dogfish, 4,536 fish for greenlings, and 2,225 fish for other groundfish species.

Along the West coast of Vancouver Island, catch estimates have been generated from creel surveys and fishing lodge reports. Data are available for June to September. Provisional estimates of 2010 catches were 16,787 fish for lingcod, 21,364 fish for all rockfish species, 16,428 fish for halibut, 2,347 fish for dogfish, 452 fish for greenlings, and 1,137 fish for other groundfish species.

In Johnstone Strait, catch estimates have been generated from creel surveys and fishing lodge reports for June to August. Provisional estimates of 2010 catches were 4,040 fish for lingcod, 11,613 fish for all rockfish species, 4,852 fish for halibut, 1,287 fish for flatfish species, 1,006 fish for greenlings, 662 fish for dogfish and 1,511 fish for other groundfish species.

3. Joint-venture fisheries

In 2010, 13 Canadian catcher vessels delivered Pacific hake and incidental species to a single processing vessel in a co-operative fishing arrangement. This fishery took place mainly off the southwest portion of Vancouver Island (area 3C). A total of 8,243 t of Pacific hake was processed by the one American vessel. The estimated catch breakdown by area was 78% from area 3C, 19% from area 5B, and 3% from area 3D. The quotas and catches are outlined below:

Nation	Species	Quota (t)	Catch (t)
Poland	Hake	8,500	8,243
	Pollock	incidental	3
	Rockfish	incidental	185
	Other	incidental	11

4. Foreign fisheries

There were no national or supplemental fisheries for Pacific hake off British Columbia in 2010.

APPENDIX 3. GROUNDFISH STAFF IN 2010

Greg Workman	Section Head
Schon Acheson	Technician, Groundfish port sampling
Bill Andrews	Technician, Flatfish
Kristina Anderson	Technician, Groundfish port sampling
Karina Cooke	Technician, Database and Surveys, Inshore and Shelf Rockfish
Andrew Edwards	Program Head Slope Rockfish, Statistical and mathematical modelling, stock assessment
Jeff Fargo	Program Head Flatfish stock assessment and biology
Rob Flemming	Biologist, GIS specialist, Inshore rockfish
Robyn Forrest	Research Scientist, Stock assessment, Hake, Pacific Cod
Chris Grandin	Program Head Hake
Rowan Haigh	Biologist, Statistical and exploratory data analysis, Slope Rockfish
Kendra Holt	Biologist, Stock assessment, ERAEF
Gail Jewsbury	Technician, Data, Health and Safety
Jackie King	Research Scientist, Lingcod, Elasmobranchs, Climate studies
Brian Krishka	Biologist, database support and analysis, Flatfish
Rob Kronlund	Program Head Sablefish, analytical programs
Lisa Lacko	Biologist, GIS specialist and database manager
Romney McPhie	Biologist, Lingcod, Elasmobranchs
Brock Medlar	Technician, Sablefish
Wendy Mitton	Technician, Sablefish
Norm Olsen	Biologist, programmer/GIS, groundfish statistics, Shelf rockfish
Kate Rutherford	Biologist, database manager, groundfish statistics, Shelf rockfish
Rick Stanley	Program Head Shelf rockfish assessment and biology, statistics.
Nathan Taylor	Biologist, Stock assessment
Malcolm Wyeth	Biologist, Groundfish surveys and Port sampling
Lynne Yamanaka	Program Head Inshore rockfish research and stock assessment

APPENDIX 4. PARTIAL LIST OF GROUNDFISH RELATED REPORTS WITH 2010 PUBLICATION DATES.

PRIMARY

Dulvy, N.K. and R.E. Forrest. 2010. Life histories, population dynamics and extinction risks in chondrichthyans. Ch. 17 In Sharks and their Relatives II. Biodiversity, Adaptive Physiology and Conservation. Edited by J. Carrier, J. Musick and M. Heithaus. CRC Press, Boca Raton. pp.639-679.

Forrest, R.E., McAllister, M.K., Dorn, M.W., Martell, S.J.D., and Stanley, R.D. 2010. Hierarchical Bayesian estimation of recruitment parameters and reference points for Pacific rockfishes (*Sebastes* spp.) under alternative assumptions about the stock–recruit function. Can. J. Fish. Aquat. Sci. 67: 1611–1634.

McAllister, M.K. R.D. Stanley and P. Starr. 2010. Modeling trawl survey catchability for B.C. bocaccio (*Sebastes paucispinis*): a combined expert driven – empirical approach. Fishery Bulletin 108:282-304.

Taylor, S., Sardell, R., Reid, J., Bucher, T., Taylor, N.G., Arcese, P., Keller, L. 2010. Inbreeding coefficient and heterozygosity–fitness correlations in unhatched and hatched song sparrow nestmates. Molecular Ecology. doi: 10.1111/j.1365-294X.2010.04824.x

Taylor, N. and Walters, C. 2010. Estimation of Bioenergetics Parameters for a Stunted Northern Pikeminnow Population of South Central British Columbia. The Open Fish Science Journal. 3:110-121

Yamanaka, K.L., Logan G. 2010. Developing British Columbia's Inshore Rockfish Conservation Strategy. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 2:28–46.

OTHER PUBLICATIONS

Edwards, A.M., Starr, P.J., and R. Haigh. 2010. Stock assessment for Pacific ocean perch (*Sebastes alutus*) in Queen Charlotte Sound, British Columbia. Canadian Science Advisory Secretariat, Research Document 2010/xxx.

Grandin, C., K. Cooke, and J. Holmes. 2010. Pacific Hake (*Merluccius productus*) distribution and abundance along west coast of Canada and the United States. Pg 92-96 in Crawford, W.R., and J.R. Irvine (eds) State of physical, biological, and selected fishery resources of Pacific Canadian marine ecosystems in 2009. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/053.

IPHC Research Program

Review of 2010 Projects and Proposals for 2011

International Pacific Halibut Commission Staff

Introduction

This report reviews research conducted by the IPHC staff in the past year as well as research proposed for the upcoming year. The report is divided into two sections, with the first section briefly reviewing the status of research conducted in 2010. The second section presents the preliminary staff research proposals for 2011. 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 $4.1 million (as of FY2010) 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 appropriations funding or carryover from 2010;

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 through staff time alone or if sufficient funds are available 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 2010

Research conducted by the IPHC staff during 2010 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.

Overview

Genetics and population structure

Research on population structure through genetics research (#621) continued in 2010 with additional sample analysis under the supervision of Dr. Lorenz Hauser at the University of Washington's Marine Molecular Biology Laboratory (MMBL). The work, initiated with Dr, Hauser in 2002, has not detected significant genetic structure and the present results support the hypothesis that a genetically well-mixed population exists from at least the Queen Charlotte Islands through the southeast Bering Sea and eastern Aleutian Islands. Dr. Heather Galindo, a post-doctoral researcher in the MMBL, has been screening samples from several winter collections for neutral microsatellite markers and more powerful markers derived from coding genes (expressed sequence tags, or ESTs) for further tests of population structure. During the course of the microsatellite screenings, she "chanced" upon three markers that appear to be strongly correlated with sex, despite the fact that no genetic test for sex has even been published for Pacific halibut and the species' sex-determining mechanism is unknown. While the use of these three markers does not result in fool-proof identification of sex, a preliminary test suggests that using these markers to assess sex is, on average, >90% accurate. It can also be used on individual fish compared with the sample-based mathematical estimates presently used to estimate sex-ratios in the commercial catch for the stock assessment. A manuscript describing these alleles is presently undergoing peer-review, and in order to more fully test this possibility, a 2010 student internship was designed to collect commercial samples amenable to conducting a formal comparison of methods (see below).

PAT tagging

PAT tag studies in 2010 involved further analysis of recoveries from past deployments. The most recent set of Area 4 PAT tag releases in 2008 were deployed to investigate the low recovery rates of PIT tags from Area 4 and the possibility that eastward migration is higher south of Unimak Pass than north of it. The tags released from the fish after one year. Dispersal patterns of the tag pop ups varied by area: no fish tagged in Area 4B produced an out-of-area endpoint location, whereas six fish tagged in Area 4A reported from Areas 3B and 3A, and a seventh fish from Area 2A. From the fish tagged in Area 4A, no fish tagged north of Unimak Pass reported from the Gulf of Alaska; all movement into Areas 2 and 3 was observed from fish that had been tagged south of the Aleutians. No fish tagged in the Bering Sea reported from outside the Bering Sea, whereas movement was observed from the Gulf of Alaska (southern 4A) northward into the Bering Sea (n = 3). Although there was no evidence of fish departing the Bering Sea, three of the fish tagged in Areas 4C & D moved along the contiguous northern shelf to Russian waters. Additionally, three of the summer pop-ups occurred in the Bristol Bay Closed Area, as did another nine of the premature releases.

Archival tags

Research continued on several fronts in 2010 on the use of archival tags (Project #650), which began in 2006. In one study, approximately 900 fish (> 32 in) were wire tagged and released at four distinct locations in Area 4B from the 2010 assessment survey, with the goal of locating a high recovery rate site for future deployment of archival tagged halibut. A single tag has been recovered to date. A second study is being conducted at the Oregon Coast Aquarium (Newport, OR), where halibut held in tanks have been tagged with a variety of both internally-implanted and externally-affixed tags. External mounts included through-body, opercular, and dart-and-tether. The fish will be regularly monitored for growth and behavioral effects over a period of at least one full year post-tagging. Other longer term studies include (1) the tagging of 162 halibut in Area 2B in 2008 with external cradle-mount tags and an additional four fish with internal implants, (2) double-tagging in 2009 of 200 fish near Kodiak with an external wire tag plus either an internal or external dummy archival in order to compare tag recovery rates. To date, 20 of the 2008 external tags have been recovered, in addition to one of the internal implants. Twenty-nine of the 2009 double-tagged fish have been recovered, represented by 22 internally-tagged and seven externally-tagged individuals.

Pacific Ocean Shelf Tracking (POST)

The multi-agency POST (Pacific Ocean Shelf Tracking) collaboration continued in 2010. This work began in 2009, with IPHC partnering with NMFS Auke Bay and ADF&G in the deployment of four sets of receiver-transmitter systems in Area 2C. The receiver-transmitter systems were deployed in depths of approximately 160, 300, 500, and 560 m, slightly different than originally planned. During a May, 2010 cruise to deploy the remaining stations off Cape Ommaney and recover the receivers deployed in 2009, we experienced 100% failure of the release assemblies at each station and were unable to retrieve any of the receivers. However, we were able to confirm that the acoustic releases had, in fact, tripped. We hypothesized that the receivers failed to surface because the chains attaching the receivers to the releases had become bound, although this design was recommended by the manufacturer. The receivers from one inshore station were recovered after 12 hours of dragging with a grappling hook during a 4-day follow-up cruise, using ADF&G funds. We did not have time to attempt recovery of the other receivers, but depth sounder returns from the submerged trawl floats indicated that at least one of the moorings was still in place in June. We hope that the receiver moorings from both "stranded" stations will eventually release and will be recovered and returned. All mooring equipment is labeled with contact information and an indication of reward for return of the equipment. Analysis of the data from the recovered receivers is ongoing by ADF&G.

Estimation of discard mortality with reflex action mortality predictors (RAMP)

IPHC staff participated for a second year in a study conducted by the North Pacific Fisheries Foundation (NPFF) to collect data from trawl-caught halibut for evaluating the effects of fishing practices on estimated discard mortality. The reflex action mortality predictors (RAMP) method uses reflex actions (six in this study) to produce a numerical condition score. The RAMP procedure is similar in concept to the existing IPHC condition factor scoring used by NMFS observers for estimation of discard mortality rates, but there are no survival correlates for the RAMP indices, as there are for the IPHC scoring. An initial cruise in 2009 was unable to catch a sufficient number of fish for analysis, so a follow-up took place in May, 2010. This latter cruise also was unable to meet the experimental goals; tow sizes were sufficiently large enough that few halibut were lively enough to provide the full range of typical physical conditions. The IPHC sampler on board also had doubts about the practical application of this approach, which involves placing the fish in s small restraint and rotating the fish to monitor eye movement. The results are being analyzed by NPFF but initial results suggest that halibut may not be suitable for the RAMP methodology.

Bering Sea radiocarbon curve for age validation

Work continued in 2010 on a collaborative aging study with NMFS, using the samples from IPHC's historical otolith collection to form a Bering Sea radiocarbon, or ^{14}C, curve to validate the ageing techniques used by both agencies. In 2009, the staff was approached by staff from the fish aging unit at NMFS with a proposal to construct a Bering Sea bomb radiocarbon curve. Several agencies have used the halibut radiocarbon curve created in 2003 by IPHC staff to successfully validate their age determination methodologies. Those comparisons have been made between fish caught in the Gulf of Alaska (GOA) and a halibut radiocarbon curve which was constructed with samples from the GOA. However, NMFS has been unsuccessful in using the GOA halibut radiocarbon curve to validate age determination methodologies for several Bering Sea flatfish. NMFS proposed several possible explanations for this difference, and offered to share the costs of constructing a Bering Sea curve. In mid 2009, we selected otoliths from ages 1-6 halibut caught during 1954-1981 from the Bering Sea and a set of older halibut also from the Bering Sea. Upon completion, both the GOA curve and the Bering Sea curve will be compared to determine the initial onset of ^{14}C into both systems.

Water column profilers

Water column profilers were deployed in 2010 on all IPHC survey vessels. This is the result of the grant from NOAA for the purchase of profilers in 2008. The profilers collect data on salinity, temperature, dissolved oxygen, ocean acidity (pH), and fluorescence (chlorophyll) throughout the water column, which will provide a unique and valuable annual snapshot of oceanic conditions above the continental shelf over most of the northeast Pacific Ocean. Over 1,200 casts were made in 2010.

Cooperative data collection of bycatch species on IPHC surveys

Cooperative data collection continued on the assessment surveys in 2010. On the Area 2A surveys, cooperative studies continued with Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) to collect rockfish (*Sebastes* spp.) bycatch data. In addition, this year we worked with WDFW to fish supplemental stations designed to further enhance the understanding of rockfish status in these areas. On the Area 2B survey, IPHC worked with the Canadian Department of Fisheries and Oceans (DFO) to provide a third biologist on our survey vessels to collect hook by hook occupancy information for all species, and otoliths, maturities, and lengths for rockfish (except thornyheads). Cooperative work with the Alaska Department of Fish and Game (ADF&G) resulted in the collection of whole-haul catch data for yelloweye rockfish from survey vessels operating in the Fairweather survey region of Area 3A and in the Sitka, Ommaney and Ketchikan charter regions of Area 2C.

Whale interactions on stock assessment surveys

Additional data collection was undertaken on the 2010 assessment surveys in an effort to increase our understanding of the scope and impact of whale interactions with longline gear, and in particular the impact on setline surveys. Gear damage was noted on every set, and additional data were collected when marine mammals were in the area. The protocols for this data collection were developed in concert with other agencies, in particular the NMFS Auke Bay sablefish survey team, who are struggling with quantifying the impact of sperm whale depredation on their surveys.

Genetic techniques for determining male vs female within commercial catch

As noted in the summary of the UW genetics work, IPHC hired an intern (Project 618) in 2010 to collect tissue and otolith samples aboard commercial fishing vessels engaged in IQ trips. These samples will be used to test whether genetic techniques can be used to aid in segregating commercial catch into male and female components in the context of the sex-specific stock assessment. During the course of our genetics program, a suite of alleles was identified that show strong sex-linkage. We wish to conduct a formal comparison of the accuracy of genetics relative to the numerical method present used to partition catches, but this cannot be conducted using survey-collected samples because survey data provide the primary input for the numerical method. This year's intern, an undergraduate student from Simon Fraser University (Burnaby, B.C.), was deployed on two vessels (the *Ashley Erin* and *Kruzof*) conducting fishing in Areas 2B and 3A, and successfully sampled 254 and 225 fish in each area, respectively. In addition, she was deployed to Area 4C, but bad weather and her need to return to university prevented full sampling from that area; still, 34 fish were sampled. She presented the data to IPHC staff at the end of her internship, and her samples will be combined with additional samples expected to be collected in 2011 in order to yield a robust future analysis.

Ongoing programs

Other field activities in 2010 included: (1) placing staff aboard the NMFS trawl surveys in the Bering Sea to collect otoliths and data on the relative abundance of juveniles, (2) continued collection of halibut tissue samples on the surveys for studies on mercury and other contaminants by the Alaska Department of Environmental Conservation, and (3) collection of seabird occurrence data on the surveys.

Every year, the quantitative staff of the Assessment Program produces a stock assessment which forms the basis for the annual staff catch limit recommendations. The data that go into the assessment, the assessment itself, and the harvest policy used to determine sustainable catch levels are all continually reviewed and refined. A few of this year's more influential and substantive analyses included:

(1) U32 mortality. For years, the under-32 inch (U32) halibut bycatch and wastage mortality (BAWM) have been accounted for through harvest rate adjustment. Options have been developed whereby U32 BAWM can now be factored directly into catch limit recommendations;

(2) Apportionment. The apportionment of the coastwide estimates of Exploitable Biomass (ebio) is based on survey catch rate, adjusted for catchability differences among areas, weighted by bottom area, and averaged over time. Standard procedure has been to equally

weight the three most recent years. Statistical analysis of within-region and among-year variance has shown that an optimal weighting scheme places much more emphasis on the most recent year's value and substantially less weight on previous years.

(3) Migration. The single most important result from the years-long PIT tag program was the unequivocal demonstration that halibut migrate much more extensively than previously believed. This finding has implications for the harvest policy and determination of the impact of U32 bycatch. Quantifying these losses has been the subject of ongoing research and has helped to frame the discussion about out-of-area impacts.

2010 contracts and grants

NMFS Auke Bay Lab (ABL) has had a sablefish data collection program for several years and IPHC has been contracted by NMFS to assist 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 (Project 617.00) 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 2010.

IPHC also received several grants in 2010. NMFS provided a grant for the incremental increase in port sampling costs due to the IFQ program (Project 300.00-81). We also were in the final year of a grant from NPRB to partially cover our costs associated with the study examining the use of electronic monitoring (video) of the halibut fishery off Alaska (#654.11-84).

2010 Research Publications

IPHC staff noted in **Bold** type.

Cahalan, J. A., **B. M. Leaman, G. H. Williams,** B. H. Mason, and W. A. Karp. 2010. Bycatch characterization in the Pacific halibut fishery: A field test of electronic monitoring technology. U.S. Dept. Commer., NOAA Tech Memo. NMFS-AFSC-211, 66 p.

Loher, T., and Rensmeyer, R. *In Press*. Physiological responses by Pacific halibut, *Hippoglossus stenolepis*, to intracoelomic implantation of archival tags, with a review of tag implantation techniques employed in flatfishes. *Reviews in Fish Biology and Fisheries*. DOI: 10.1007/s11160-10-9192-4.

SECTION II

RESEARCH PROPOSED FOR 2011 -- OVERVIEW

Projects to be carried out in 2011 consist of a continuation of several projects currently underway. Selected continuing projects include:

1. **Water column profilers (Projects 610.11, 610.12, 610.13)** – The first profiler was deployed on an IPHC survey vessel in 2003, and a second went out in 2007. Coastwide deployment began in 2009. The profilers measure temperature, salinity, dissolved oxygen,

pH, and florescence and will be deployed at each station during the 2011 summer assessment survey.

2. **Archival tagging (Project 650.13)** – Staff proposes to continue with the holding experiment at the Oregon Coast Aquarium in Newport, to monitor the response to several different archival mounting configurations. The results will support the anticipated future use of this type of technology.

Staff will also continue with other long-standing projects in 2011. These include the collaborative work on contaminants in halibut with ADEC (#642.00), placement of IPHC staff on the NMFS summer trawl surveys (#604.00), and the undergraduate internship program (#618.00). Cooperative projects with WDFW and ODFW to provide data on bycatch species on the setline surveys in Area 2A will continue, as will efforts with DFO in Area 2B, in Areas 2C/3A with ADF&G. Additionally, we will resume collecting Pacific cod information for NMFS in predetermined areas within the Bering Sea.

In addition, projects conducted under contract to other agencies or through research grants will be continued in 2011. IPHC port sampling activities in Alaska will continue being augmented by a grant from NMFS (Project 300.00-81), and IPHC port samplers in Alaska will collect sablefish logbook data for the NMFS Auke Bay lab (Project 617.00).

Four new funded projects are proposed for 2011:

1. **Area 2A assessment survey pilot expansion.** Improving the precision of the estimates of catch rates (WPUE) in the Area 2A assessment survey, as well as examining the requirements and ramifications of fishing in depths not currently included in the survey design (< 20f and >275f), are the objectives of this study.

2. **Comparison of alternative baits for use in assessment survey.** The increasingly high cost of chum salmon is having us look for a suitable alternative for future survey work. In this pilot study, two different designs will be fished and evaluated for a broader, more comprehensive comparison.

3. **Pilot study to test geomagnetic tag performance in the Gulf of Alaska.** Geomagnetic tags have the potential for providing better information on fish location, as they are not dependent upon light levels as with the current PAT tags. We wish to begin an evaluation of this new tag technology with a small pilot study in the Gulf of Alaska.

4. **Use of genetic techniques for partitioning commercial catch by gender.** We began initial work on this approach in 2010, with limited sample collections from two areas. A full evaluation requires samples from additional areas, which we propose conducting in 2011.

CONTINUING RESEARCH IN 2011

1. PIT tagging study: Double tag experiment
Start Date: 2003
Anticipated ending: Continuing
Personnel: J. Forsberg, G. Williams, S. Hare, A. Ranta

In September 2003, over 2,600 halibut were double tagged with PIT and external wire tags to provide data for estimating PIT tag shedding. Double-tagged fish continue to be recovered, and this section accounts for the premium rewards paid for the recovered tags. No rewards were paid in 2010.

2. NMFS trawl survey: At-sea data collection
Start Date: 1996
Anticipated ending: Continuing
Personnel: L. Sadorus, A. Ranta, S. Hare

The series of NMFS trawl survey data on halibut, parallel to our assessment survey data, is extremely valuable 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 IPHC's database 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 2011, samplers will be deployed on the NMFS Gulf of Alaska and Bering Sea surveys.

3. Water column profiler project
General survey: Start date: 2000
Oregon: Start date: 2007
Coastwide: Start date: 2009
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). In 2009, a NOAA grant provided for the complete outfitting of all chartered survey vessels, resulting in a complete coastwide deployment. Annual costs are directed towards maintenance and calibration of the profilers, and data preparation necessary for submission to the National Ocean Data Center.

4. 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.

5. 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

Additional work by researchers at the University of Washington's Marine Molecular Biology Laboratory (MMBL) and College of Ocean and Fishery Sciences (COFS) is scheduled for this coming year. This work will complete the work which began in late 2009. The MMBL lead, Dr. Heather Galindo, unexpectedly left for another position at the end of September, but other technicians were available to complete the remaining microsatellite work. Work on sequencing mitochondrial DNA (mtDNA), which are maternally-inherited and have proven useful in other species for investigating sex-biased migration and demographics in relation to climate change, will be conducted by another UW COFS graduate student under the supervision of Dr. Vince Galluci.

6. Histology: Analysis of gonad staging
Start: 2004
Anticipated Ending: Continuing
Personnel: K. MacTavish, other staff as needed

The staff believes it is necessary to re-evaluate our classification criteria for female gonad maturity stage. The method currently used on the assessment surveys is based on visual criteria established in the early 1990s 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 question this assumption. Gonad samples were collected in 2004 from which to base this study. In 2010, proposed work entails looking for a size gradient for oocytes dependent on their location within the gonad, determine the maximum precision for oocyte diameter measurements by oocyte maturation stage, determine a sampling protocol for measurement of oocyte diameters, and contract slide preparation for gonads. We will also begin assessment of archived gonads from a set of previously-prepared slides.

7. Assessment of mercury and contaminants in Pacific halibut
Start Date: 2002
Anticipated ending: Continuing
Personnel: C. Dykstra, Alaska Department of Environmental Conservation (ADEC)

The staff plans on continuing our collaboration with the Alaska Department of Environmental Conservation (ADEC) in 2010, collecting halibut tissue samples for analysis of heavy metal and organic pollutant loading. This work has been ongoing since 2002. Results from a 2002 collection of halibut samples led the Alaska Division of Public Health in 2003 to conclude that the concentrations of heavy metals in Alaskan Pacific halibut were not a public health concern. In 2004, the first results regarding organic pollutants (PCB's, pesticides) were released demonstrating that halibut had the lowest concentrations of the five species (including salmon and sablefish) examined. The 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. Since 2002, the IPHC has submitted 1,293 samples for testing by ADEC. 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.

8. Archival tagging: Pilot studies (2008 Area 2B releases)
Start Date: 2006
Anticipated ending: Continuing
Personnel: T. Loher

This study, involving PAT tag releases in Area 2B in 2008, 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 earlier PAT 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 2011 are for the anticipated recoveries. Premium rewards are being offered to encourage recoveries.

9. Archival tags: Holding tank experiments examining mounting protocols
Start Date: 2009
Anticipated ending: 2011
Personnel: T. Loher

For 2010, the staff intends to continue holding halibut in tanks at the Oregon Coast Aquarium (OCA) in Newport, OR to 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 were captured via hook-and-line and transported live to the OCA. The fish are treated 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 will support the anticipated use of this type of technology in subsequent years. Expenses for 2010 involve the care and feeding of the fish at OCA.

10. Archival tags: 2009 releases of dummy test tags
Start Date: 2009
Anticipated ending: 2010
Personnel: T. Loher

External and internal tag recovery rates are being tested in the field release of archival test tags. In August-September 2009, 200 fish were tagged off southern Kodiak Island (in Areas 3A and 3B), half with external tags and half with internal implants. Fish were also tagged with a bright pink cheek tag, and rewards of $100 will be given for all tags recovered. To date, a single tagged fish has been recaptured; it had received an internal implant, and both of its tags were recovered. FY11 expenses consist of tag rewards.

11. Archival tags: Preparation for coastwide release
Start Date: 2012
Anticipated ending: Continuing
Personnel: T. Loher, B. Leaman, R. Webster, J. Forsberg

In preparation for a coastwide release of archival tags in 2012, the staff has been working with Lotek Wireless (St. John's, NL) on a specific tag design and configuration for IPHC use. Although no field activity is planned for 2011, Lotek is continuing their work on our requirements and construction. Results from the 2009 release of dummy archival tags in Area 3A and the examination of several mounting protocols on fish being held at the Oregon Coast Aquarium will feed into the design of the tag and its attachment to the fish.

12. Archival tags: Site selection in Area 4B
Start date: 2010
Anticipated ending: 2010 for tag releases; 2012 for tag recoveries
Personnel: T. Loher, J. Forsberg, survey team

In 2009, we tagged approximately 900 fish in Area 4B to evaluate tag recovery rates of Area 4B releases in preparation of a future release of archival tags in the area. Recovery rates of PIT tags released in the Aleutians were quite low, without evidence of recovery hotspots. This suggests that if archival tags were deployed in the Aleutians, we would likely recover relatively few of those tags. This would result in either too few data to draw any conclusions or require that a very large number of tags be initially deployed. Given that archival tags cost $500-1200 each, resorting to a very large deployment would be financially prohibitive and problematic. Our goal is to locate at least two release sites which will yield a sufficient number of recoveries. To date, only a single wire tag has been recovered, which his low but not completely unexpected for the period immediately following release. In 2010, additional recoveries are expected and the budget is to pay for the necessary rewards.

PROPOSED NEW RESEARCH

1. Area 2A assessment survey pilot expansion

Start Date: 2011
Anticipated ending: 2011
Personnel: R. Webster, C. Dykstra, S. Hare, survey team

The setline weight per unit effort (WPUE) in Area 2A is estimated with much poorer relative precision than in other regulatory areas, with coefficients of variation (CV) averaging over 30% in recent years. The CV in all other areas has been consistently under 20% with the present survey design. The poor precision of the Area 2A estimate means that it is more likely to differ by a large amount from the true WPUE than is the case in other areas. While this is not important for the coastwide stock assessment, the use of WPUE as an abundance index for apportionment means there is valid concern that Area 2A's share of coastwide biomass could be quite different from that estimated using the survey data.

Further, parts of Area 2A are not included in the current survey, meaning that WPUE estimates may be biased. Inside waters have never been surveyed, although they do include areas within the current survey's 20-275 fm depth range and the survey catch rate from the sampled areas is applied to these unsampled areas (as is the case for all regulatory areas). Some potential stations on the 10 nm grid are also excluded for logistical reasons; were they to be included in the survey, they would improve the estimates of mean WPUE for Area 2A.

Finally, given evidence from commercial catches that many halibut are found in significant numbers at depths outside the survey range, staff is considering expanding the survey down to depths of 400 fm, and into shallower waters to 10 fm. In all regulatory areas, this expansion will increase the proportion of the halibut population covered by the survey, and thereby improve survey WPUE as an index of area halibut density. In Area 2A in particular, a significant number of new stations would be added, and we would achieve a greater increase in the precision of WPUE estimates in that area. Thus, we are proposing piloting the survey expansion first in this area.

2. Comparison of alternative baits for use in assessment survey
Start Date: 2011
Anticipated ending: 2011
Personnel: R. Webster, S. Kaimmer, C. Dykstra, survey team

Chum salmon (*Onchorynchus keta*) is the bait currently used for the annual setline assessment survey. With the price of chum increasing and availability decreasing, we wish to consider alternative baits. Before replacing the current bait, it is important that we compare it with possible alternatives to ensure that the survey index will not be affected by the change, or to estimate a correction factor to apply if there is an effect on the index. This study will be a small-scale pilot study with the goal of estimating variability and determining required sample sizes for a larger-scale bait comparison experiment. We are currently planning on conducting this test in eastern Area 3A and in Area 3B, using chum salmon, pollock (*Theragra chalcogramma),* herring (*Clupea pallasii*), and pink salmon (*Onchorynchus gorbuscha*) in late summer, depending on vessel availability.

3. Pilot study to test geomagnetic tag performance in the Gulf of Alaska
Start Date: 2011
Anticipated ending: 2011
Personnel: T. Loher, J. Nielsen (UAF Juneau)

We are proposing a pilot study to tag a small number of halibut with three tag-mount configurations (tethered, external hard-mount, surgical implantation) of geomagnetic archival tags in two regions (2B, western 3A) where magnetic field lines are oriented differently relative to the coastline and where our prior pilot releases have experienced relatively high fishery recovery rates, as well as in a captive setting (n=2) at Oregon Coast Aquarium. Data will be used to assess suitability of mounting protocols and relative data quality between tag manufacturers and in varying geomagnetic environments.

4. Use of genetic techniques for partitioning commercial catch by gender
Start Date: 2011
Anticipated ending: 2011
Personnel: T. Loher, L. Hauser (UW)

For 2011, we are proposing to continue collecting samples of commercially-caught fish, which began in 2010, for the purposes of comparing genetic sex identification to the survey length-at-age method presently employed in the stock assessment. In 2010, sufficient samples were only collected from Areas 2B and 3A; hence, we wish to expand this effort to an additional area to further investigate the potential of this approach.

OTHER 2011 RESEARCH – CONTRACTS AND GRANTS

1. Alaska port sampling
Granting agency: NMFS
Start Date: 2002
Anticipated ending: Continuing
Personnel: H. Gilroy, M. Larsen, L. Erikson

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.

2. Water column profiler project (Coastwide)
Start date: 2009
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). In 2009, a NOAA grant provided for the complete outfitting of all chartered survey vessels, resulting in a complete coastwide deployment. Annual costs are directed towards maintenance and calibration of the profilers, and data preparation necessary for submission to the National Ocean Data Center.

3. Alaska catcher vessel logbook and sablefish data collection
Contracting agency: NMFS
Start Date: 1999
Anticipated ending: Continuing
Personnel: L. Erikson, 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.

ASSESSMENT AND HARVEST POLICY STUDIES

1. The stock assessment
Budget: Staff salaries
Personnel: S. Hare, J. Valero, R. Webster

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. The IPHC setline stock assessment survey
Budget: Staff salaries, costs of enhancing survey differ by region
Personnel: S. Hare, J. Valero, R. Webster, C. Dykstra

The current IPHC setline stock assessment survey (SSA) was designed in the late 1990s and has remained essentially unchanged since that time. The survey assesses stock status in waters between 20 and 275 fathoms. Recent data indicate that commercial fishing operations now take place in deeper and shallower regions. The apportionment procedure currently extends density estimates for the surveyed depths to the broader depths (0-20 and 275-400 fathoms). There is potential bias in extending these densities to non-surveyed depths, and we anticipate expanding the survey accordingly. Numerous statistical and logistical questions arise and we will work with industry and other staff to tailor the survey expansion. In 2011, a pilot project will investigate expansion of the survey in 2A; other regions should follow in subsequent years.

3. Development of IPHC harvest policy
Budget: Staff salaries
Personnel: J. Valero, S. Hare

Since 2004, the IPHC harvest policy has been based on maintaining coastwide spawning biomass above a reference level, with options in place to reduce the harvest rate should that level be crossed. Work is continuous, with refinements to calculation of the optimum harvest rate itself in light of our present understanding of stock dynamics, fish movement, new information on commercial length-specific selectivity coming from the PIT tag experiment, and impacts of bycatch mortality when accounting for migration. In a broader sense, our harvest policy should also be robust to the many uncertainties inherent in the assessment and management of a broadly distributed and continually migrating stock, particularly one with individual regulatory area catch limits. A formal approach to evaluate such harvest policy is thru Management Strategy Evaluation (MSE). An explicit aim of our MSE 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 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. In addition, we will examine potential effects of fishing on life history traits.

4. Ongoing analytical and statistical studies in support of halibut management
Budget: Staff salaries
Personnel: S. Hare, J. Valero, R. Webster

Every year, the analytical staff engages in a broad range of studies, many unanticipated at the onset of each year, to support halibut management. Examples of recent work include spatio-temporal modeling of setline WPUE, adjustments to the "Slow Up Fast Down" catch quotas, methods of accounting for U32 bycatch and wastage mortality, estimation of bycatch impacts on lost yield, surplus production trends, participation and preparation of materials for workshops (apportionment, bycatch, commissioner retreats, etc.), improvements to port sampling programs, among many others. We fully anticipate these side projects to continue to increase in number and scope. For example, in 2011, reworking of bycatch estimation is anticipated to receive a full review.

OTHER RESEARCH

1. Seabird occurrence project
Budget: Staff salaries
Start Date: 2002
Anticipated ending: Continuing
Personnel: T. Geernaert, Washington State Sea Grant

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 IPHC seabird occurrence data and the collection project is ongoing.

2. Bering Sea age validation study utilizing 14C radiocarbon (Project 624.12)
Budget: Staff salaries
Start Date: 2009
Anticipated ending: 2011
Personnel: S. Wischniowski, 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 is 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. Work began in late 2009 with otolith selection, and the mass spectrometry work occurred in early 2010. During 2011, analyses of the results and report preparation are planned.

3. Species identification of amphipods frequenting Pacific halibut (Project 653.00)
Budget: Staff salaries
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., whether there are 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 last year of data collection for this stage of the project was 2006. The 2007 summer intern performed initial analysis of interannual occurrence and virulence. Additional work will be directed at correlated variables.

4. Estimates of bycatch on the assessment surveys
Budget: Staff Salaries
Revenue: To be determined
Start Date: 2003
Anticipated ending: Continuing
Personnel: C. Dykstra, T. Geernaert, E. Soderlund, E. White, sea samplers, agency staff

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 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 skate of capture (since 2006) information. All marked fish are retained so state biologists can collect additional data shore-side. Marketable fish are sold. The IPHC then provides each agency with the effort information collected as part of the normal survey data collection.

Area 2B
In 2011, IPHC will continue to work 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. Otoliths, maturities, round weights, and lengths were collected for all rockfish except thornyheads. This is the eighth year of this cooperative program and continued collaboration is anticipated.

Area 2C and eastern 3A
Collection of whole-haul catch data for yelloweye rockfish capture is expected to continue in

2011, at the request of the Alaska Department of Fish and Game (ADFG), for survey vessels operating in the Fairweather, Sitka, Ommaney, and Ketchikan charter regions. The 2009 work was scaled back from what was done in 2008, which required an additional sampler to collect hook-by-hook occupancy information for all species, plus otoliths, sex, and lengths for all yelloweye rockfish. This project built upon cooperative work started with ADFG in 2007 and future collaboration is anticipated.

Area 4

Length frequency data on incidentally-caught Pacific cod were collected in 2009 in the 4A Edge and 4D Edge charter regions. This project was initiated at the request of NMFS-AFSC Pacific cod assessment team and is 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. The work was discontinued in 2010 at NMFS' request but is expected to resume in 2011.

5. Electronic reporting project for commercial landings in Alaska

Budget: $ 27,000 (covered under Catch Statistics budget: A30-7131-30)
Start Date: 2002
Anticipated ending: Continuing
Personnel: H. Gilroy, L. Erikson, 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 and 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. The application is continuously being modified, including the incorporation of additional fisheries and tender landings. Agency staffs attend annual workshops and provide training to processors. Costs represent system maintenance costs, software purchase and development, steering committee meetings, and travel costs.

6. Electronic logbooks and technology

Budget: $ 50,000 (Covered under Catch Statistics budget: A10-7131-30)
Start: 2010 (postponed from 2008)
End Date: Pilot project
Personnel: H. Gilroy, L. Erikson, K. MacTavish

In 2010, the staff started to work on a technology plan for data collection within the port sampling program but no funds were spent. The project will continue and collaborating with other agencies will occur to determine the feasibility of an electronic logbook, which geographic location would work best, and to establish the specifications needed f

Northwest Fisheries Science Center

National Marine Fisheries Service

NOAA Fisheries

Agency Report to the Technical Subcommittee

of the Canada-U.S. Groundfish Committee

April 2011

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. At the current time, the Environmental Conservation and Resource Enhancement and Utilization Technologies Divisions are being restructured to form a single new division. 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, 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; and employ advanced technologies for new assessments.

During 2010, FRAMD continued to: implement a West Coast observer program; conduct a coast wide survey program that includes West Coast groundfish acoustic and trawl surveys; develop new technologies for surveying fish populations, particularly in untrawlable areas; and expand its stock assessment, economics, and habitat research. Significant progress continues in all programs.

For more information on FRAMD and groundfish investigations, contact the Division Director, Dr. Michelle McClure at Michelle.McClure@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 acting Center Director, Dr. John Stein at John.Stein@noaa.gov, (206) 860-3200.

B. Groundfish Studies

1. Research

a) Video evidence of flatfish herding by NWFSC groundfish survey trawl sweeps – **Investigators:** K.L. Bosley, D. Bryan, A. Hicks, W.W. Wakefield and M. Haltuch.

The Northwest Fisheries Science Center (NWFSC) combined shelf-slope trawl survey has occurred annually since 2003 and data from the survey have been used in 2007 and 2009 stock assessments. The estimate of *q* (the scalar that relates the magnitude of a survey index to the predicted size of a population) was high in the 2009 petrale sole stock assessment because the magnitude of the relative index of abundance from the NWFSC survey was larger than the population estimates from the stock assessment model. One factor contributing to the high estimate of *q* could be that the area-swept calculation was an underestimate of the actual area swept by the trawl because of the herding of petrale sole by the gear in front of the net. It is widely known that flatfish are commonly herded by trawl nets, but the extent of herding of flatfish by the NWFSC survey trawl was unknown. To address this, in August 2009 we undertook a pilot project using an underwater video camera to determine if the sweeps, or the cable gear running between the trawl doors and the footrope, on survey trawls were herding fish towards the net, resulting in a larger effective area swept than what was calculated using the distance between the wings. Over 91 % of flatfish showed an orientation relative to the gear that was indicative of herding at first view; this rose to over 93% at final view. Those that were not herded either escaped over or under the mud gear (1%) or were stationary during the time observed. Taken together, these results show direct evidence of herding of flatfish by the NWFSC survey trawl.

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

b) Research on U.S. West Coast temporal and regional summer groundfish assemblages
Investigators: J. Cope and M. Haltuch

Multispecies interactions are increasingly being considered by U.S. management councils during decision making, highlighting the need for the identification of fish assemblages across varying spatial and temporal resolutions. On the U.S. West coast, previous groundfish assemblage analyses have focused either on particular species groups (i.e. *Sebastes*) or over limited geographic regions within the groundfish fishery and have not used the most recently available fishery independent data. This study expands those previous studies to identify groundfish assemblages across the full spatial extent of the west coast groundfish fishery during 1977-2009 by using two fishery-independent trawl surveys. Species assemblages were identified using two clustering methods (partitioning analysis and hierarchical analysis) and two alternative types of data (presence-absence and log+1 transformed CPUE). The analysis using presence-absence data provides information on species that co-occur while the CPUE data provides information on species that occur at similar magnitudes. Temporally and spatially persistent assemblages were detected by both clustering approaches through most years. Assemblages identified using CPUE were often subsets of those identified using presence-absence, indicating that the members of an assemblage may occur together, but not necessarily at the same magnitude. Identification of species assemblages is applicable to bycatch models and informative when evaluating the implementation of spatial management measures, thus germane to challenges faced by marine resource managers.

For more information, contact Jason Cope at Jason.Cope@noaa.gov or Melissa Haltuch at Melissa.Haltuch@noaa.gov

c) Estimating biomass from in situ counts of demersal fishes—the challenge in creating a random sample from data collected nonrandomly
Investigators: J.E.R. Clemons, Dr. W. Waldo Wakefield, Dr. I.J. Stewart, and C.E. Whitmire.

This project provides a detailed description of the methodology for a statistically sound and organized approach for combining nonrandomly collected in situ direct count fish observation data with a habitat map to estimate fish biomass. Specifically, we address how to treat a nonrandom data set that was collected with potentially different objectives in mind, in this case, fixed station and geological reconnaissance. For this study we used an existing and previously published upon data set from Heceta Bank, Oregon. Heceta Bank is one of the largest rocky banks along the U.S. west coast containing a wide range of habitats supporting numerous species of commercially important groundfish, including a diverse assemblage of rockfishes (*Sebastes* spp.). We used high resolution bathymetry and backscatter imagery of the bank collected with a Simrad EM 300 multibeam echo sounder, and strip transect video surveys of habitat and demersal fishes, using a remotely-operated vehicle. We examined fish observations relative to the habitat variables of depth, sediment type, backscatter intensity and relative elevation (i.e. topographic position index). We post-stratified the data to address sampling bias toward shallower water (along the top of the bank) and present abundance estimates for select species of groundfish to illustrate the method. This type of approach could be evaluated for nonrandomly collected data wherever the most important habitat information dictating fish abundance is available.

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

d) Co-occurrence of demersal fish species in the US west coast bottom trawl fishery.
Investigators: E. Heery and J. Cope

This study presents a more comprehensive and current view of species co-occurrence onboard commercial vessels in the bottom trawl fishery using data from a mandatory at-sea observer program conducted yearly from 2002. Three major questions were explored: (1) Are there identifiable associations between species caught in the bottom trawl fishery? (2) Do overfished species cluster with certain target groups in a consistent and predictable way? (3) Do overfished species cluster at particular spatial scales or are relationships spatially consistent across the whole data set? Results indicate two particularly significant assemblages when evaluating data from the entire geographic range of the fishery: a deepwater/slope group that included Dover sole, sablefish, and shortspine thornyhead, and a shallower shelf group dominated by English sole and petrale sole. Results also indicate that our ability to predict bycatch events of rare overfished species based on the catch of target species is extremely limited. Associations between overfished rockfish and other groundfish species simply are not evident over large spatial scales.

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

e) Demersal fish species composition and biomass in relation to the oxygen minimum zone along the U.S. West Coast
Investigators: A. A. Keller, V. Simon, K. Bosley. M. Bradburn, D. Kamikawa, J. Buchanan, W.W. Wakefield, J.A. Barth, and S. Pierce

Understanding the relationship between environmental variables and fish distribution and abundance has long been a goal of fisheries biologists. Since 2002, hypoxic conditions have been observed on the continental shelf off the coast of the Pacific Northwest in a region not previously characterized by low oxygen conditions. In addition, major declines in dissolved oxygen have been observed in the oxygen minimum zone (OMZ) within the California Current as well as a shoaling of the OMZ. Despite these recent increases in frequency, duration, and spatial extent of hypoxia and the recognition of hypoxia as a threat to worldwide fish production, little is known about its effects on upper trophic levels. In 2007, the Northwest Fisheries Science Center (NWFSC) initiated studies on the extent of hypoxic conditions on the continental shelf and slope along the west coast and the influence of hypoxia on demersal fishes and invertebrates, including commercially important groundfish. This project was developed as an extension of the NWFSC West Coast Groundfish Bottom Trawl Survey. In 2009 and 2010, working with oceanographers at Oregon State University, the NWFSC expanded its hypoxia research coast-wide by deploying an oceanographic sensor package for monitoring oxygen on ~1,100 tows of the NMFS bottom trawl survey. Total catch per unit effort (ln CPUE, kg hectare^{-1}) and species diversity (number of species, n) were significantly ($P<0.05$) and positively related to oxygen concentration within hypoxic zones offshore Oregon (2007 – 2009) and southern California (2008). Coast wide the relationship between CPUE and near-bottom oxygen was highly significant ($P<0.0001$) within hypoxic waters (DO<1.43 ml l^{-1}) although the relationship with species richness was significant only at depths <100 m.

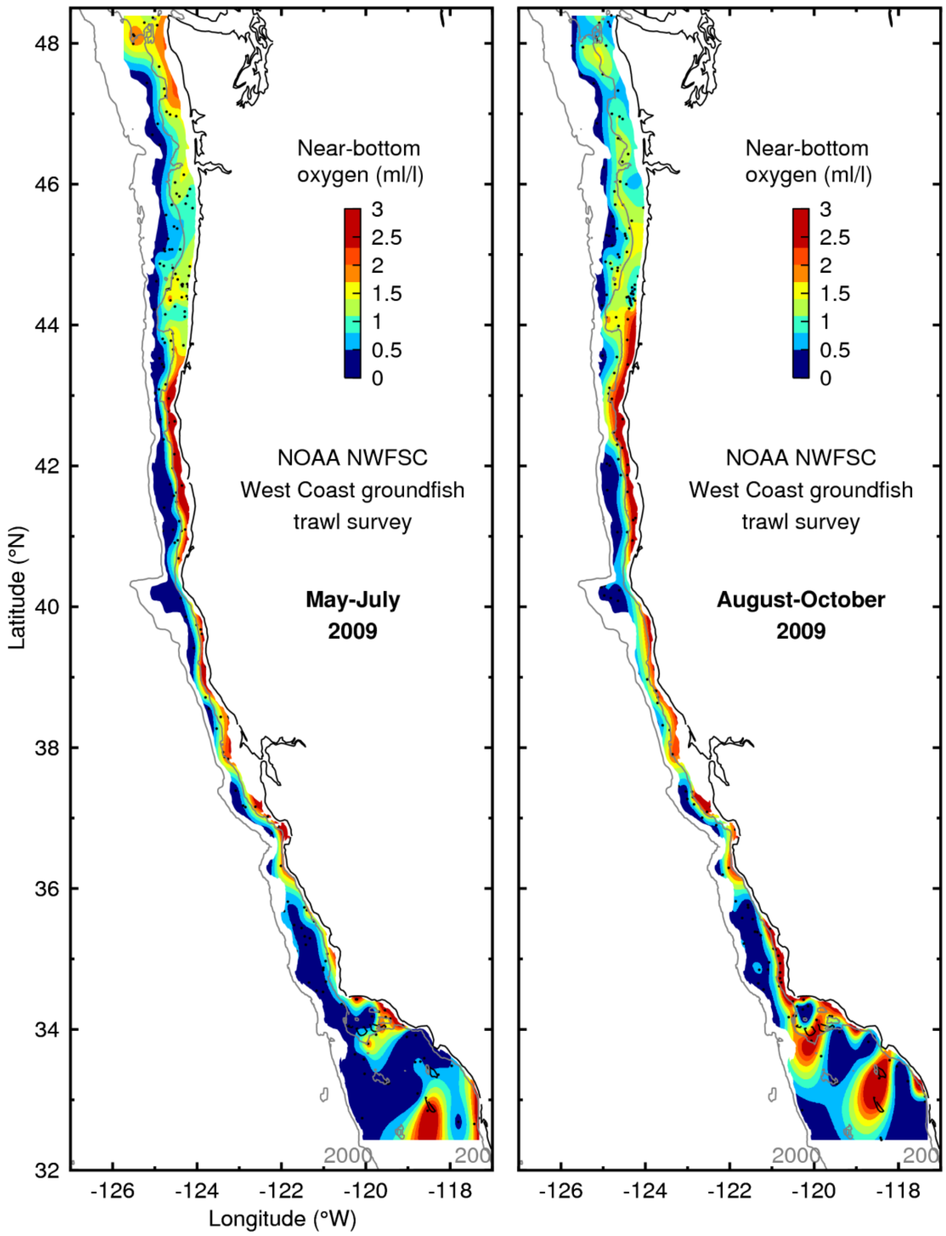

Figure 1. Sampling during the 2009 groundfish survey indicates low DO in deep water within the OMZ during both passes of the survey. Low DO appeared to move shoreward as the summer progressed and later in the season occurred in shallower water offshore of both Washington and Oregon. In the southern California, Current low DO was more widespread in July (pass 1) than Oct. (pass 2) with the geographic distribution of low DO waters variable between passes.

For more information, contact Aimee Keller at Aimee.Keller@noaa.gov.

f) Development of a Quantitative Optic Trawl Analysis System (QUOTAS)

Investigators: V. Simon, S. Tomich, W.W. Wakefield, D. Chu and A. Keller

The goal of this research is to improve accuracy and reduce uncertainty of fish stock assessments by developing a non-lethal, efficient method of gathering data on important management species over wide areas via a deployed integrated optical camera system (Figure 2). In 2010, FRAM scientists successfully completed development and building of a six-camera ring to be used in providing multi-species density estimates and species population characteristics in a non-extractive manner. Six images per second are taken by the system and analyzed. The intent of the system is to be able to identify and enumerate fish in a non-lethal manner and to ultimately automate the processing of images.

The prototype has been built and tested. We next propose to scale out development for underwater deployment. This includes the fabrication of pressure housings, camera upgrades, and a modified ring to facilitate image analysis. This NWFSC effort supports the national Advanced Sampling Technology Working Group initiative to improve NMFS's ability to monitor protected marine resources without using conventional, lethal trawling methods.

Figure 2. Figure illustrates the configuration of the QUOTAS prototype. A total of 6 camera units are activated in a group of 3 to sequentially illuminate the sample volume bounded by the ring frame. The laser pair on each camera is used to size the illuminated targets. The figure also illustrates one cycle of six images obtained from the prototype.

For more information, please contact Victor Simon at: Victor.Simon@noaa.gov

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

In August 2010, as part of the West Coast Groundfish Bottom 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 a groundfish 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 August 2010, 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 2010 hypoxic zone. A Seabird SBE19-plus was attached to the trawl gear to monitor oxygen concentration during each tow. We sampled 15 stations along 2 depth contours (70 and 80 m) and additionally measured bottom DO via 11 CTD casts within the sampling area off OR. 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 ranged from 0.85 to 1.93 ml l^{-1} and was hypoxic along 14 tow tracks. Preliminary results indicate that total catch (kg) and bottom dissolved oxygen (DO, ml l^{-1}) levels for 2010 were significantly related as seen for all depths combined and that the relationship was similar to that observed in 2009 (Figure 3).

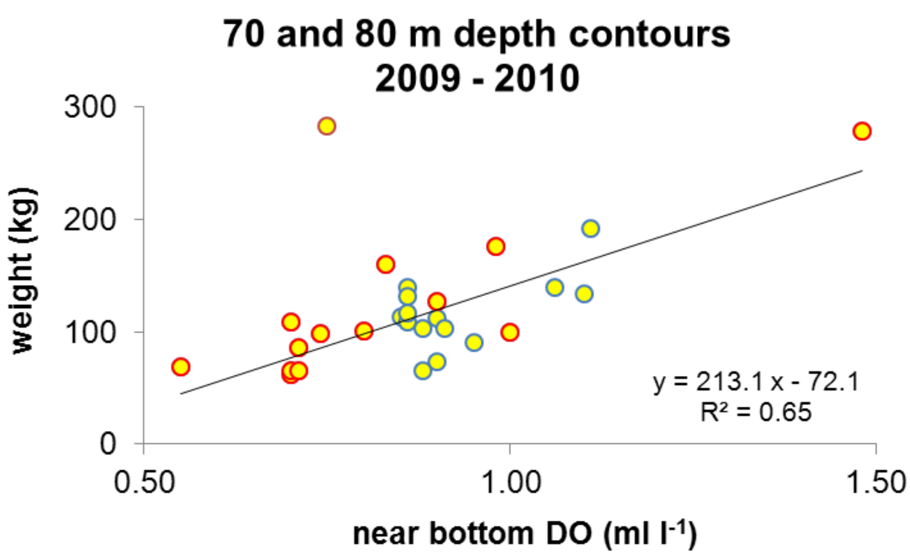

Figure 3. Relationship between catch (kg) and mean near bottom oxygen concentration (DO, ml l^{-1}) along the tow track within the hypoxic zone (1=2009 red outline; 2010 green outline).

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h) Using meso-habitat information to improve abundance estimates for West Coast groundfish: a test case at Heceta Bank, OR

Investigators: W.W. Wakefield, J.E.R. Clemons1, I.J. Stewart, and C.E. Whitmire

Historical *in situ* observations of benthic fishes and invertebrates represent an opportunity for establishing fishery-independent benchmark estimates of abundance from specific time points and in both trawlable and untrawlable habitats. Depending on the original intended purpose of a given study, the direct count data may be nonrandom in nature. The objective of this research is to show how a new method for treating such data was used by combining *in situ* fish observation data and a habitat map to estimate fish abundance. We evaluated whether increased resolution of habitat information could improve the precision of population estimates. For this study, we used an existing and previously published data set from Heceta Bank, OR. Heceta Bank is one of the largest rocky banks along the U.S. West coast containing a diverse array of habitats supporting numerous species of commercially important groundfish, including a diverse assemblage of rockfishes (*Sebastes* spp.). We looked at fish observations relative to the variables of habitat type, depth, backscatter intensity and relative elevation (i.e. topographic position index) and post-stratified the data according to levels of sampling effort. We also looked at two levels of habitat detail: four habitat types, and 'hard' vs. 'soft' substrate. We then calculated the density and variance of fish species for each habitat type and then estimated fish abundance for a select group of groundfish species. Based on these results it appears that improved precision of more geographically comprehensive abundance estimates may be achieved through presurvey stratification based on currently available habitat information.

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For more information, please contact Waldo Wakefield at Waldo.Wakefield@NOAA.gov

i) Investigating rapid age determination methods using otolith morphometrics for four groundfish species

Investigators: J. Cope, P. McDonald, O. Rodriguez, and K. Munk

Age-at-length information is one of the most informative types of data available for stock assessment modeling. Ageing structures, typically otoliths, record individual fish age by growing with the fish through time. Counting of incremental rings laid annually is the most widely recognized otolith characteristic used to define fish age. But while this approach has proven very useful, the application of this method requires a mix of both skill and art. Even with highly trained age readers, ageing error can remain significant. In addition, the technique can be time intensive. The Northwest Fisheries Science Center Groundfish Trawl survey has collected thousands of otoliths, many of which remain to be aged. The need to collect age data from these structures for stock assessment is a high priority, but resource limitation reduces the numbers obtainable. Previous studies in other fishes have explored the potential of alternative measures of otolith morphometrics such as weight, length, width, and thickness to more rapidly age fish. Attributes of these methods should include faster ageing with no reduction in accuracy, but a possible increase in precision, thus decreasing subjective analysis. Four species with very different otolith morphologies (Pacific hake, petrale sole, sablefish, and splitnose rockfish) were chosen to demonstrate how useful these measures may be as predicators of fish age. Samples sizes of 100-125 previously aged otoliths per sex per species were analyzed. The preliminary results here demonstrate how useful otolith weight is as a predicator of age.

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

j) Habitat Associations in Demersal Fishes Inhabiting a Deep-Water Rocky Bank off Oregon
Investigators: W.W. Wakefield, J.R. Clemons, B.N. Tissot, C.E. Whitmire, S.R. Merle, R.W. Embley

Heceta Bank, a 50 km-long rocky shoal on the outer shelf of central Oregon was the focus of pioneering fish habitat studies in the 1980s, and is today and was historically, a major fishing ground. The bank is representative of a series of offshore topographic features that create a variety of benthic habitats on Oregon's continental margin. In 2006, the banks of offshore Oregon were designated as Habitat Areas of Particular Concern and Essential Fish Habitat Conservation Areas, a form of marine protected area closed to bottom trawling. A survey of Heceta Bank, using a high-resolution multibeam echosounder, was completed in 1998 providing a basis for a number of new geophysical, geochemical, and biological studies. During the summers of 2000 and 2001, 28 dives were completed with an advanced scientific remotely operated vehicle (ROV), resulting in comprehensive observations of the bank in water depths from 54 to 686 m. The current study integrates the 1998 high-resolution geophysical seafloor mapping data with detailed in situ direct observation and sampling with the ROV, yielding a new interpretation of the Heceta Bank megahabitat. The abundance and habitat associations of commercially important groundfishes and other non-commercial demersal fishes were quantified. Habitats along the bank were categorized into four major mesohabitat types: (1) steep ridge, (2) low relief ridge and mixed substrata, (3) cobble and boulder, and (4) unconsolidated sediment. The most abundant fishes on Heceta Bank included a number of species that attain smaller sizes as adults and also a category of small/juvenile rockfishes (*Sebastes* spp.), the latter category was the most common taxa, representing 22.5% of the total observed. Rockfishes were a dominant feature on the bank, including a complex of Pygmy / Puget Sound, *S. wilsoni*, and *S. emphaeus*, sharpchin, *S. zacentrus*, rosethorn, *S. helvomaculatus*, yellowtail, *S. flavidus*, greenstriped, *S. elongatus*, and redstriped, *S. proriger* . Other demersal fish taxa included unidentified sculpins, Cottidae, and Dover sole, *Microstomus pacificus*. The assemblages of fishes that characterize the four mesohabitats identified in the current study and the associations on a smaller macrohabitat scale, parallel the historical studies on Heceta Bank as well as other studies along the West coast of North America from California to Alaska. A comparison of fish abundances at Heceta Bank after approximately a decade revealed no clear trends for a group of strategic taxa of groundfishes. Thus, the data from this study establish a baseline from which the effects of the 2006 closure may be measured.

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k) Variations in Eastern North Pacific Demersal Fish Biomass Based on the U.S. West Coast Groundfish Bottom Trawl Survey (2003 – 2008)
Investigators: A.A. Keller, J. Wallace, B. Horness, O. Hamel and I. Stewart

Coast-wide groundfish biomass is described from a series of six annual fishery-independent surveys using standardized techniques along the U.S. West coast from the U.S.-Canada to U.S.-

Mexico borders at depths of 55-1,280 m. Despite increasing or variable biomass trends in many individual groundfish species, the overall tendency is towards declining biomass for 62 dominant taxa combined and six major subgroups (including flatfishes, rockfishes and thornyheads) from 2003-2008. These decreases occurred during a period of reduced fishing pressure for demersal species along the shelf and upper slope region relative to historical rates. The synchronicity and coherence of these trends among major subgroups of demersal fish suggested that climate variability and/or declining biomass after an anomalously large 1999 recruitment event may be contributing factors. Biomass (for major taxonomic or depth-based groups) and species richness (for two depth strata and overall) were highly correlated with the Pacific Decadal Oscillation (PDO). Both measures decreased as ocean conditions shifted from a warm to a cool phase. Changes in minimum, maximum or mean depth for 13 of 62 individual species were significantly related to annual changes in PDO values as were similar changes in latitude for 14 of 62 species examined. Because of the relatively short time series, we also examined the relationship between the PDO and biomass indices for ten abundant groundfish (individually and aggregated) collected from the slope region (183-1,280 m) over a more restricted geographic range (U.S.-Canada border to Pt. Conception, California) but longer time frame (1999-2008). We found similar correlations among species well-represented in the longer time-series. Our results suggest climate could be a factor in explaining the observed patterns in biomass and distribution (movement within, into and out of the survey area) of groundfish along the West coast, although we have yet to rule out natural demographic decline.

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l) Development of the marine fisheries habitat assessment improvement plan: a national plan to advance marine habitat science

In spring 2010, a team of NMFS scientists completed a national Habitat Assessment Improvement Plan (HAIP) for the U.S. This is the first nationally coordinated plan to focus on the marine fisheries aspects of habitat science. It addresses the lack of knowledge regarding the association of marine species and their habitats, which impedes effective fisheries and habitat management, protection, restoration, and stock assessment. Questionnaire responses from National Marine Fisheries Service (NMFS) managers and scientists indicated a lack of habitat-specific data, staff to collect such data, and knowledge of interactions within the ecosystem. The HAIP establishes the framework for NMFS to coordinate habitat research, monitoring, and assessments and to increase support for habitat science. The goals of the HAIP are to: (1) Assist NOAA in developing habitat science; (2) Improve our ability to identify essential fish habitat and habitat areas of particular concern; (3) Provide information needed to assess impacts to essential fish habitat; (4) Reduce habitat-related uncertainty in stock assessments; (5) Facilitate a greater number of stock assessments that explicitly incorporate ecosystem considerations and spatial analyses; (6) Contribute to assessments of ecosystem services (i.e., the things people need and care about that are provided by marine systems); and (7) Contribute to ecosystem-based fishery management, integrated ecosystem assessments, and coastal and marine spatial planning. The first joint NMFS National Habitat Assessment Workshop (NHAW) occurred in May 2010 and coincided with the biennial NMFS National Stock Assessment Workshop (NSAW). A portion of these two workshops was devoted to a 1 ½ day joint session. The purpose of the joint session was to advance the integration of habitat information into stock assessments, improve collaboration between NMFS stock assessment and habitat assessment scientists, and identify pilot projects to integrate stock and habitat assessments.

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m) Pleurocercoids of the trypanorhynch cestode *Nybelinia surmenicola* in Pacific hake (*Merluccius productus*) caught off Oregon and Washington

Investigators: K. Jacobson, D. Bryan, J. Buchanan, M. B. Rew

The trypanorhynch cestode *Nybelinia surmenicola* uses a broad spectrum of marine fishes as paratenic hosts prior to maturing in salmon sharks (*Lamna ditropsis*). A total of 834 Pacific hake (*Merluccius productus*) stomachs collected from 341 trawl stations along the United States west coast during the summers of 2008 and 2009 were examined for pleurocercoids of this marine cestode. Pleurocercoids were recovered from 75.2% of Pacific hake in 2008 and in 88.0% in 2009. In an examination of 131 Pacific hake stomachs collected along the United States west coast in 1999, *N. surmenicola* prevalence was 35.1%. The results from a general linear model suggested that prevalence is influenced by year and latitude of collection site, Pacific hake length and sex. Mean intensity of *N. surmenicola* 2008-2009 was 20.22 (± 1.13 SE) and was positively related to Pacific hake length and the latitude of collection site. Year one Pacific hake (< 27 cm length) had significantly lower prevalence and intensity of *N. surmenicola* compared to older and larger fish. Pacific hake collected south of Point Conception, California (32.5º N to 35º N) had lower prevalence and intensity of *N. surmenicola* compared to those collected in northern latitudes (35.1º N to 48.4º N). Higher *N. surmenicola* prevalence in Pacific hake in recent years suggests a dynamic food web in the Northern California Current ecosystem potentially caused by changes in ocean transport of zooplankton or distributions of pelagic fishes. The observed increase in the abundance of this larval cestode warrants future monitoring in Pacific hake.

For more information, please contact John Buchanan, at John.Buchanan@noaa.gov

n) Light availability during bottom trawls affects catchability of Eastern Pacific groundfish species

The relationship between near-bottom light levels and catch per unit effort (CPUE) was examined for multiple groundfish species encountered during the NWFSC annual bottom trawl survey. Depth explained 22% of the variation in CPUE for hauls < 200 meters and 54% for hauls < 400 and, respectively. Based on linear models conditioning for depth, there was a significant negative relationship between near-bottom light and CPUE for three species: spotted ratfish, arrowtooth flounder, and Dover sole for hauls < 400 m and < 200 m ($p < 0.05$). Controlling for the effect of depth, significant negative partial correlation coefficients were estimated for spotted ratfish, arrowtooth flounder, and Dover sole at both depths ($p < 0.05$). There was a significant positive partial correlation between greenstriped rockfish CPUE and near-bottom light ($p < 0.05$).

Growth

For more information, please contact Mark Bradburn, at Mark.Bradburn@noaa.gov

2. Stock Assessment

a) Stock assessment model development

Stock Synthesis (SS) is an assessment model in the class termed integrated analysis and is the basis for west coast groundfish assessments and many other assessments around the world. SS is built with a population sub-model that simulates a stock's growth and mortality processes, 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 over time or 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 included in the NOAA Fisheries Assessment Toolbox (http://nft.nefsc.noaa.gov/) incorporating a graphical user interface developed by Alan Seaver (NEFSC). In 2010, SS was augmented to better deal with time-varying growth and to produce forecasts that better conform to the needs for determining annual catch limits. It is now at version 3.20d in March 2011. SS was one of the featured models at the ICES workshop, WKADSAM, in Sept 2010 at Nantes, France.

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

b) Research on using climate data in fish stock assessment

Investigators: Melissa A. Haltuch, André E. Punt

Concurrent declines in demersal fish stock abundances and shifts in long-term average environmental conditions have been well documented in the Pacific. Management advice ignoring environmental forcing of recruitment may cause stocks to be over- or under-harvested so it is important to consider including environmental forcing on recruitment in stock assessment models. 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 and the ability to estimate management reference points when the duration of the fisheries time series is equal to or less than the period of the environmental cycle. Assessment methods most commonly used in practice tend to lead to lower total type I and type II error rates. The promise of integrating environmental data with decadal scale variability directly into stock assessments via the stock-recruitment relationship is outweighed by the pitfall of high type I error rates. High type I failure rates are often due to fishing producing declines in spawning biomass and recruitment that coincide with directional environmental change. However, the impact of type I errors while estimating reference points can be minimized by choosing an appropriate combination of assessment method and reference point estimators. The estimation of reference points is improved in the absence of type II errors.

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

c) Growth variability of the splitnose rockfish (*Sebastes diploproa*) in the Northeast Pacific Ocean: pattern revisited

Investigators: V. Gertseva, J. Cope and S. E. Matson

Understanding patterns of somatic growth within populations greatly contributes to fisheries stock assessment. Splitnose rockfish, *Sebastes diploproa*, was reported as having a striking pattern of latitudinal growth variability from studies conducted in the 1980s. We investigated variation in growth parameters of splitnose rockfish by latitude using recent data from the NOAA Fisheries Groundfish Survey (2003–2008), current ageing techniques, and advanced modeling and statistical methods to provide an updated understanding of growth along this species' latitudinal range. Sex-specific age data were fit to a von Bertalanffy growth parameter (k) incorporating ageing error, and growth parameters were estimated for 5 areas along the U.S. West Coast, specified based on biogeographic boundaries. Resampled values of each growth parameter were then fit to linear models, and Akaike's information criterion (AIC) was used to evaluate hypotheses for growth parameter relationship with latitude. We found that splitnose rockfish exhibited a cline in asymptotic length ($L\infty$), with $L\infty$ increasing with rising latitude. We also found that although k was smallest in the most southern area, there was no apparent cline along the coast; a northward cline in k has previously been reported in the literature. We propose that differences in fishing intensity could be responsible for the cline in $L\infty$, as higher fishing pressure in the south could skew the size distribution of the population in that region and reduce southern $L\infty$ estimates. We also attribute slower growth in the southern area to oceanographic characteristics and low productivity of the area south of Point Conception.

For more information, contact Vladlena Gertseva at Vladlena.Gertseva@noaa.gov

d) Analysis of fishery-independent hook and line-based data for use in the stock assessment of bocaccio rockfish (*Sebastes paucispinis*)

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 paper introduces a standardized hook and line survey for rockfish conducted by NOAA Fisheries'Northwest Fisheries Science Center in the Southern California Bight. The survey uses fishing gear similar to that used in many recreational fisheries to sample approximately 120 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 2004–2008 using a Bayesian Generalized Linear Model to account for site, fishing time, survey vessel, angler, and other statistically significant effects. Results indicate that the bocaccio stock vulnerable to this survey 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 future stock assessments of bocaccio for use in U.S. West Coast groundfish management. This survey is the only available tuning index for the adult portion of the bocaccio population in recent years as historically used recreational catch per unit effort indices have been compromised due to changes in bag limits and other management restrictions.

Using the aforementioned methods:

Data analysis methods put forth in the bocaccio methods paper were applied to five other species and one complex that occur in the Southern California Hook & Line Survey.

In addition:

A document to find the FSPR of 30% for Dover sole from Dave Sampson's 2005 Dover sole assessment was submitted to the council process.

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

e) An approach to defining stock complexes for U.S. west coast groundfishes using vulnerabilities and ecological distributions
Investigators: J. Cope and members of the Groundfish Management Team

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires active management for all stocks at risk of overfishing or otherwise in need of conservation and management. In the Pacific Fishery Management Council groundfish fishery management plan, about two-thirds of the 90+ managed stocks are currently without traditional assessments to help define stock status in relation to management targets. Stock complexes are often employed for management purposes in such situations. Guidelines issued in response to the 2006 MSA amendments defined a complex as a group of stocks with similar geographic distributions, life histories, and vulnerabilities to fisheries. This work uses the Productivity-Susceptibility Analysis (PSA) to measure the vulnerabilities of 90 managed groundfish stocks, 64 that are currently managed within stock complexes. These stock complexes are re-evaluated by first using a partitioning cluster analysis to group stocks by depth and latitude. Vulnerability reference points are then established based on the above PSA results to determine vulnerability groups of low, medium, high, and major concern within each ecological group. This method is a simple and flexible approach to incorporating vulnerability measures into stock complex designations while also providing information to prioritize stock- and complex-specific management.

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

f) Reconciling stock assessment and management scales under conditions of spatially-varying catch histories
Investigators: J. Cope and A. Punt

Spatial homogeneity is the exception, not the rule, for many marine populations. Data limitations or biological knowledge gaps, though, often drive the assumption of limited stock structuring; the subsequent mismatch of model spatial scale and biological stock structure may compromise management goals. Spatial considerations thus remain a major challenge in providing managers with the best information for responsible and responsive management. This study uses simulation testing to offer a quantitative evaluation of spatial stock structure assumptions on the performance of stock assessments relative to management scales. Catch histories, not biological differences, are used to create stock structure. Simulation testing is based on an operating model of 'true' population states of nature that vary only in catch history across 9 regions. Stock assessments under various data scenarios are then performed on regions either as one aggregated assessment, or at finer area scales defined by zonal catch differences. The median absolute relative error of the terminal spawning biomass depletion is used as a performance statistic. One area stock assessments demonstrated low bias and high precision under all catch scenarios when stock structure is ignored, but perform poorly when applied to areas with differing regional catch histories. Separate area assessments grouped by zonal catch differences performed best under these circumstances, despite lower data quality, indicating the importance of identifying stock structure for management purposes. We suggest a focus on explicitly defining management units prior to conducting stock assessments with a concomitant resolve to increase data provisions at the resolution of management needs.

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

g) A fishery-independent multi-species examination of recent population trends for key species of shelf rockfish (Genus: *Sebastes*) in Southern California (in prep)
Investigators: J.R. Wallace, I.J. Stewart, and J.H. Harms

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 research was undertaken during a standardized hook and line survey for rockfish conducted by NOAA Fisheries' Northwest Fisheries Science Center (NWFSC) in the Southern California Bight. The survey uses fishing gear similar to that used in many recreational fisheries to sample approximately 120 locations covering a wide range of depths and habitats. This paper applies the methods described in Harms et al. (2010) to hook and line survey data for six important species of shelf rockfish to generate fishery-independent abundance indices, including the first unique indices for vermilion rockfish (*S. miniatus*) and its cryptic pair, sunset rockfish (*S. crocotulus*). This survey is the only available ongoing tuning index for the adult portion of many structure-associated shelf rockfish species in the region, as historically-used recreational catch per unit effort indices have been compromised due to changes in bag limits and other management restrictions.

For more information, please contact John Harms at John.Harms@noaa.gov

h) Distribution and life history characteristics for vermilion rockfish (*Sebastes miniatus*) and sunset rockfish (*S. crocotulus*) in Southern California (in prep) –
Investigators: J.H. Harms, J. Hempelmann, P. McDonald, R.M. Barnhart, O. Rodriguez, J.A. Benante, A.A. Keller

Recent genetic research by Hyde et al. (2008) at NOAA Fisheries' Southwest Fisheries Science Center identified a cryptic pair of the vermilion rockfish from specimens collected along the U.S. West Coast and suggested some depth and biogeographic partitioning between the two species.

Using specimens and catch data collected during the hook and line survey, NWFSC researchers analyze depth and latitudinal differences and similarities between vermilion and sunset rockfish as well as develop unique life history characteristics for the two species. These include age at length, annual growth estimates, length-weight relationships, and age at maturity. This information can be combined with the unique indices of abundance outlined in the previous paper to support separate stock assessments for vermilion and sunset rockfish.

For more information, please contact John Harms at John.Harms@noaa.gov

i) Reconciling uncertain and conflicting trends in petrale sole abundance
Investigators: M.A. Haltuch, J.D. Hastie, A. Hicks, and C.E. Whitmire

Petrale sole are a commercially important flatfish that migrate seasonally between feeding and spawning grounds, and have recently been declared overfished. The summer trawl survey shows a decline in petrale sole abundance since 2005 similar to the unstandardized summer catch per unit of effort (CPUE) from the fishery. However, many stakeholders disagree that petrale sole abundance has been declining, instead choosing to focus on the unstandardized winter CPUE that shows a strong increase beginning in 2000. The assessment attributes the increasing trend in winter CPUE to management actions that forced the fleet to: 1) increase fishing effort during the winter; and 2) conduct winter fishing in locations with high historical catch rates. Standardized fishery CPUE was not used in the assessment due to changing management regulations beginning in the late 1990s and the high likelihood of a winter CPUE index showing hyper-stability due to the fishery focusing on the aggregated spawning stock. Given the potential discrepancy between the assessment results and the experience of the groundfish fleet, particularly during the winter fishing season, and the limited conclusions that can be drawn from unstandardized CPUE, this work explores the utility of the summer and winter fishery CPUE series as indices of abundance for the petrale sole stock assessment. The ultimate goals are to determine if an adequate index of abundance can be created using fishery CPUE, and to address the uncertainty due to the discrepancy between the fishery-independent and fishery-dependent data sources and therefore the perceived stock assessment uncertainty.

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

j) Population dynamics of splitnose rockfish (*Sebastes diploproa*) in the Northeast Pacific Ocean
Investigators: V. Gertseva and J. Cope

We developed an age-structured population model of splitnose rockfish, *Sebastes diploproa*, in the Northeast Pacific Ocean. Splitnose rockfish is a bycatch species that co-occurs with several commercially important species that are currently declared overfished. Bycatch species are typically not the focus of stock assessment efforts because of their limited economic importance, but they may suffer the same population declines as species with which they co-occur. To examine the dynamics of splitnose rockfish for the first time, we analyzed data from three groundfish fisheries and four research surveys conducted in the Northeast Pacific Ocean. To develop a model, we used Stock Synthesis software, a statistical framework for the construction of a population dynamics models utilizing both fishery-dependent and fishery-independent data.

In the model, we reconstructed the total catch of the species back to 1900, estimated the dynamics of the stock spawning output and recruitment and evaluated biomass depletion relative to the stock's unfished state, as well as sources of uncertainty in model outputs. The results indicate that the splitnose rockfish is currently not overfished even though it has experienced several periods of abrupt decline in its biomass. Revisiting age data from earlier years, monitoring fishery discard, and investigating the spatial dynamics of splitnose rockfish is important to further improve the understanding of this species' population dynamics, and decrease uncertainty in model results.

For more information, contact Vladlena Gertseva at Vladlena.Gertseva@noaa.gov

k) The relationship between MSY fishing rates (F_{MSY}) and productivity indices
Investigators: J. Cope, W. Patrick, and R. Methot

The 2009 revision of the National Standard 1 Guidelines describe a hierarchal approach to prescribing precautionary catch recommendations (i.e., Overfishing Limit (OFL) ≥ Acceptable Biological Catch (ABC) ≥ Annual Catch Limit). This research focuses on the specification of the ABC, which is the scientific recommendation for a level of catch that would prevent overfishing. To do this, it must take into account any scientific knowledge about the stock, and uncertainty in the estimate of OFL (where OFL = F_{MSY} * current biomass). The F_{MSY} is typically based on proxies and incompletely accounts for all biological factors that could influence the true F_{MSY}. It has been proposed that indices of stock productivity, which potentially consider more factors than are directly accounted for in F_{MSY} proxy calculations, could contribute to the scaling of the buffer between OFL and ABC. In extreme data-poor situations, it is possible that a productivity measure could be the sole source of information with which to set ABC relative to historical catch levels. As a first step, we investigated the strength of the relationship between productivity indices and commonly used measures of F_{MSY}. The goal is to determine if productivity measures could serve as a proxy for F_{MSY} in data-poor situations and could provide useful supplementary information for scaling ABC relative to OFL even in more data-rich situations.

For more information, please contact 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 2011, is shown in Table 1. Updates are also shown.

Table 1. 2011 Review Schedule for Full Groundfish Assessments.

STAR PANEL	STOCK	AUTHOR(S)	STAR PANEL DATES	STAR PANEL LOCATION
Whiting	Pacific hake/ whiting	Ian Stewart Robin Forrest Chris Grandin Owen Hamel Allan Hicks Steve Martell Ian Taylor	February 7 - 11	Seattle, WA
1	Data Poor Methods/ Examples	Jason Cope	April 25-29	Santa Cruz, CA
Updates	Bocaccio Canary Cowcod Darkblotched Yelloweye	E. J. Dick Owen Hamel John Field Andi Stevens John Wallace	June 6	Spokane, WA
2	Pacific Ocean Perch Petrale sole	Owen Hamel Melissa Haltuch	June 20-24	Seattle, WA
3	Widow Spiny dogfish	Xi He Vlada Gertseva	July 11 - 15	Seattle, WA
4	Sablefish Dover sole	Ian Stewart Allan Hicks Chantel Wetzel	July25 -29	Hatfield Marine Science Center Barry Fisher Bldg., Room 101, 2032 SE Oregon State University Drive, Newport, OR 97365
5	Greenspotted Blackgill	John Field E.J. Dick	August 8-12	Southwest Fisheries Science Center 110 Shaffer Road Santa Cruz, CA 95060

1. Shelf Rockfish - West Coast

a) Stock Assessments

No shelf rockfish assessments were conducted during 2010. Full assessments of widow rockfish, and greenspotted rockfish rockfish will be conducted in 2011. Updates of the 2009 bocaccio, canary rockfish, cowcod rockfish and yelloweye rockfish assessments will also be conducted in 2011.

Yelloweye rockfish: The complete version of: Status of the U.S. yelloweye rockfish resource in 2009 can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/2009_yelloweye_assessment_SAFE_version.pdf

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

Widow rockfish: The 2011 widow rockfish assessment will be conducted by the SWFSC. The complete version of: Status of the widow rockfish resource in 2009 can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/He_et_al_WidowStockAssessment_2009_PostSTAR_8_26_2009_Council_BriefingBook.pdf

Bocaccio: The 2011 bocaccio assessment will be conducted by the SWFSC. The complete version of: Status of bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas for 2009 can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/Bocaccio_Final_Jan15_2010.pdf

Greenstriped rockfish: The complete version of: Status of greenstriped rockfish (*Sebastes elongatus*) along the outer coast of California, Oregon, and Washington can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/GreenstripedSAFE.pdf

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 2009 (Update of 2007 assessment model) can be viewed online at:
content/uploads/2009_canary_updated_assessment_SAFE_version.pdf

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

Cowcod: The complete version of: Updated status of cowcod, *Sebastes levis*, in the Southern California Bight can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/cowcod_update_assessment_2009.pdf

Greenspotted rockfish**:** Greenspotted rockfish will be assessed by the SWFSC in 2011.

2. Slope Rockfish

a) Stock assessments

No slope rockfish assessments were conducted during 2010. Full assessments of Pacific ocean perch and blackgill rockfish and an update of the darkblotched rockfish assessment will be conducted in 2011.

Blackgill rockfish: Blackgill rockfish will be assessed by the SWFSC in 2011. The complete version of: Stock Assessment of the Blackgill Rockfish (*Sebastes melanostomus*) Population off the West Coast of the United States in 2005 can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/BLACKGILL_ASSESSMENT_Complete_Final_8-31-05.pdf

For more information on blackgill rockfish, please contact Dr. Andi Stevens at Andi.Stevens@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 Updated in 2009 can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/Darkblotched_2009_Final-SAFE_ver.29_Oct_2009.pdf

For more information on darkblotched rockfish, please contact Andi Stevens at Andi.Stevens@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 2009 can be viewed online at:
http://www.pcouncil.org/wp-content/uploads/POP_Assessment_2009_Final_SAFE_version.pdf

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

3. Thornyheads

a) Stock Assessments

No thornyhead assessments were conducted during 2010, and none are scheduled for 2011.

4. Sablefish

a) Stock Assessments

No sablefish assessment was conducted in 2010. A full assessment of sablefish is planned for 2011.

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/wp-content/uploads/Sable07v3_0.pdf

For more information on sablefish, contact Dr. Ian Stewart at Ian.Stewartl@noaa.gov.

5. Flatfish

a) Stock Assessments

No assessments for flatfish were conducted during 2010. A full assessment of Dover sole and petrale sole are planned for 2011.

Dover sole: The complete version of the 2005 assessment of Dover sole: The Status of Dover Sole off the U.S. West Coast in 2005 can be viewed online at:

http://www.pcouncil.org/wp-content/uploads/Dover05_Final-corrected.pdf

For more information, please contact Dr. Allen Hicks at Allen.Hicks@noaa.gov

Petrale sole: The complete version of the 2008 assessment of petrale sole: Status of the U.S. petrale sole resource in 2008 can be viewed online at:

http://www.pcouncil.org/wp-content/uploads/pet_SAFE_2009_11_17_09.pdf

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

6. Pacific hake

a) Stock assessments

Pending formal implementation of the Joint US-Canada treaty on Pacific Hake governing both scientific and management actions for Pacific hake, the 2011 stock assessment represented the collaborative efforts of a joint team comprised of both U.S. and Canadian scientists operating in the spirit of the treaty agreement. Both stock assessment models indicated that the Pacific hake female spawning biomass was well below equilibrium at the start of the fishery and during the 1970s. The stock increased rapidly after two or more large recruitment events in the early 1980s and then declined rapidly after a peak in the mid- to late 1980s to a low in 2000. This long period of decline was followed by a brief increase to a peak in 2003 as the exceptionally large 1999 year class matured. In 2011 (beginning of year), spawning biomass is estimated to be rebounding rapidly based on the strength of recent year classes (2005, 2006 and particularly 2008, in both the SS and TINSS models), however this estimate is quite uncertain, with 95% posterior credibility intervals ranging from historical lows to well above equilibrium levels. Current median posterior spawning biomass estimates are well above the $SB_{40\%}$ target and the $SB_{25\%}$ overfished threshold at approximately 91% (SS model) or 175% (TINSS model) of the unfished level (SB_0). The primary source of uncertainty that is relevant to management decision-making for the 2011 fishing season is the strength of the 2008 year-class. The estimate for this cohort is very uncertain, and the stock trajectory is entirely dependent on its value. The vast uncertainty in this year class will likely persist until the next acoustic survey has been conducted, providing a fishery independent estimate of its magnitude.

At the request of the SSC, the posterior distributions for management-related quantities from the SS and TINSS models were combined with equal weight in order to provide model-averaged estimates. Based on the SSC's recommendations, the Pacific Council adopted an allowable biological catch (ABC, the overfishing limit) of 973,727 mt. The Pacific Council adopted a coast-wide OY (target harvest level) for 2011 of 393,750 mt. The Pacific hake treaty was signed by the president in 2010 and therefore, the committees required by the treaty are being formed and the assessment process will likely no longer be conducted by the Pacific Council for the 2012 fishing season.

Pacific hake: The 2011 hake stock assessment can be viewed online at:
http://www.pcouncil.org/groundfish/stock-assessments/current-stock-assessments/

For more information on the Pacific hake assessment, please contact Dr. Ian Stewart at Ian.Stewart@noaa.gov.

7. Other species

a) Stock assessments

Cabezon: The complete version of: Status of Cabezon (*Scorpaenichthys marmoratus*) in California and Oregon Waters as Assessed in 2009 is available online at:
http://www.pcouncil.org/wp-content/uploads/Cabezon09_FINAL.pdf

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

Lingcod: The complete version of: Status and Future Prospects for Lingcod in Waters off Washington, Oregon, and California as Assessed in 2009 is available online at:
http://www.pcouncil.org/wp-content/uploads/Lingcod_Assessment_2009_Final_SAFE_version.pdf

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

Spiny dogfish: Spiny dogfish will be assessed in 2011.

For more information, please contact Dr. Vlada Gerseva at Vlada.Gertseva@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. This year updates to survey information have been added and habitat information has been updated.

For more information, contact Elizabeth.Clarke@noaa.gov (206-860-3381) or Chris Goldfinger at gold@coas.oregonstate.edu (541-737-5214)

2. Bycatch Reduction Research

Gear Technician and Bycatch Reduction Gear Research

In 2010, the NWFSC sought funding from the NOAA NMFS National Bycatch Reduction Engineering Program for continuation of a fishing gear technician to work with the NWFSC Habitat and Conservation Engineering (HCE) group. Since December 2008, with BREP funding, the NWFSC was able to hire and maintain a Pacific States Marine Fisheries Commission (PSMFC) fishing gear technician to focus on gear research, assist the HCE group coordinator in the continued development of the NWFSC bycatch reduction research, and collaborate with other NMFS and regional gear researchers and the fishing industry. Through contracting of a PSMFC staff member and ongoing collaborations with the conservation engineering group at Oregon Department of Fish and Wildlife (ODFW), the NWFSC has been able to pursue a wide-ranging array of conservation engineering projects relevant to reducing bycatch and habitat impacts from mobile fishing gear in the groundfish trawl fishery.

With continued support for a fishing gear technician, several developments have been achieved. The NWFSC has tested an open escape window bycatch reduction device (BRD) to reduce bycatch of Endangered Species Act (ESA)-listed Chinook salmon and overfished rockfish species (e.g., darkblotched, canary, and widow) in the Pacific hake fishery. During this study, a promising BRD has been developed that has shown to reduce salmon bycatch on the order of 50 to 81% and widow rockfish bycatch by 26%. Results from this work are currently being drafted into a manuscript (see below).

The NWFSC also has tested footrope and rigid grate modifications designed to reduce the bycatch of groundfishes (including juveniles of overfished species), megafaunal invertebrates, and ESA-listed Pacific eulachon (an anadromous smelt), as well as reduce physical impacts on benthic communities in the ocean shrimp trawl fishery. An experimental footrope, modified by removing the central one-third of the trawl groundline, reduced eulachon bycatch by 16.6%, by weight. The footrope also reduced bycatch of slender sole, other small flatfish, and juvenile darkblotched rockfish by 95.9%, 96.5% and 79.6%, respectively. However, the experimental groundline also reduced the catch of ocean shrimp by 22.2%. Reducing bar spacing in a rigid-grate BRD from 25.4 mm to19.1 mm (1" to ¾") reduced eulachon bycatch by 16.6% by weight, with no reduction in ocean shrimp catch. It also reduced bycatch of slender sole, other small flatfish, and juvenile darkblotched rockfish by 36.8%, 71.8% and 76.3%, respectively. Results from this work are currently being drafted into a manuscript.

The gear technician funded under this project helped provide direct observation video camera systems to fishermen for their use in evaluating industry-designed BRDs. These camera systems were scheduled for use by the fishing industry starting in November 2010. Project details appear on page 62.

Finally, the NWFSC has conducted planning and development for a Pacific halibut excluder to be used in the groundfish trawl fishery. This work is in response to the fishing industry's increasing concerns about an individual bycatch quota of Pacific halibut allocated in the Groundfish Trawl Rationalization Catch Share Program.

Developing, Testing, and Demonstrating Bycatch Reduction Devices in West Coast Trawl Fisheries

Bycatch limits for Chinook salmon and several rockfish species (e.g., darkblotched, canary, and widow) have been established in the Pacific hake fishery. These limits have reduced the overall harvest of Pacific hake and have the potential to stop the fishery if bycatch exceeds hard caps on some species.

Beginning in 2009, the Pacific States Marine Fisheries Commission (PSMFC) and the NMFS Northwest Fisheries Science Center developed and began field testing a bycatch reduction device (BRD) to reduce bycatch of Chinook salmon and overfished rockfish species (e.g., darkblotched, canary, and widow) in the Pacific hake fishery. The basic design of this BRD consists of two mesh panels that direct actively swimming fish towards open escape windows on each side of the net (Figure 4). The concept is that fish displaying strong swimming abilities (e.g., salmon and rockfishes) can escape through the open windows, whereas fish exhibiting weak swimming abilities (e.g., Pacific hake) will pass into the codend.

Since 2009, three versions (A, B, and C) of the open escape window BRD have been field tested. Fish behavior and gear performance were observed using autonomous high-resolution low-light color video camera systems. The BRD has been shown to reduce Chinook salmon bycatch on the order of 50 to 81% and widow rockfish bycatch by 26% (Table 2, Figure 5). Further, this study noted a significant result as far as which escape window salmon utilized. Over 82% of the Chinook salmon that escaped exited out the escape window illuminated by the autonomous video system's light. A significant difference in the mean escape time of salmon between gear designs A and C also was observed, with the quickest mean escape time noted in gear design C (Figure 6). Too few Chinook salmon were observed in gear design B; therefore, data from this gear design were not used in the analysis of mean time to escape.

Table 2. Summary of Chinook salmon and widow rockfish bycatch reduction by gear design examined.

	Chinook salmon			Widow rockfish		
Gear design	# encountered	# escaped	% reduction	# encountered	# escaped	% reduction
A	16	8	50.0	53	0	0.0
B	2	1	50.0	0	-	-
C	11	9	81.8	45	12	26.7

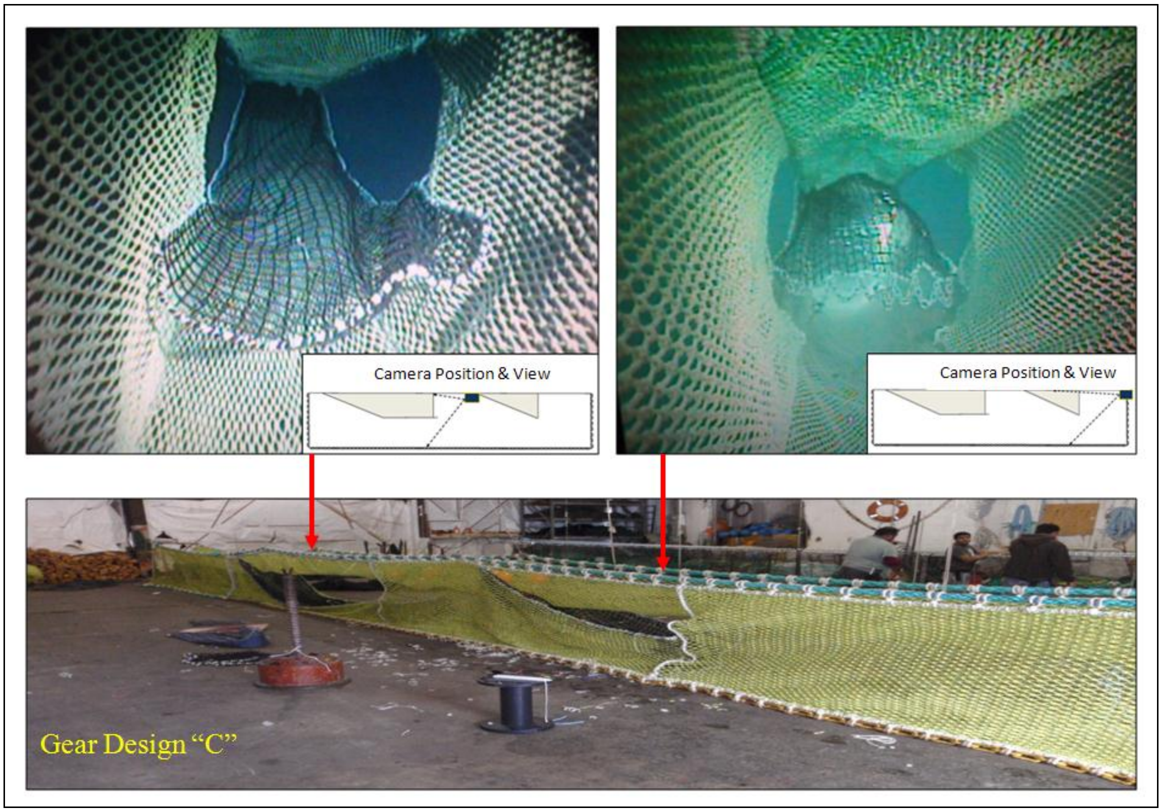

Figure 4. Most recent BRD (gear design C) tested during 2010. The upper images depict both the port and starboard side escape windows, whereas the bottom image only depicts the port-side escape windows.

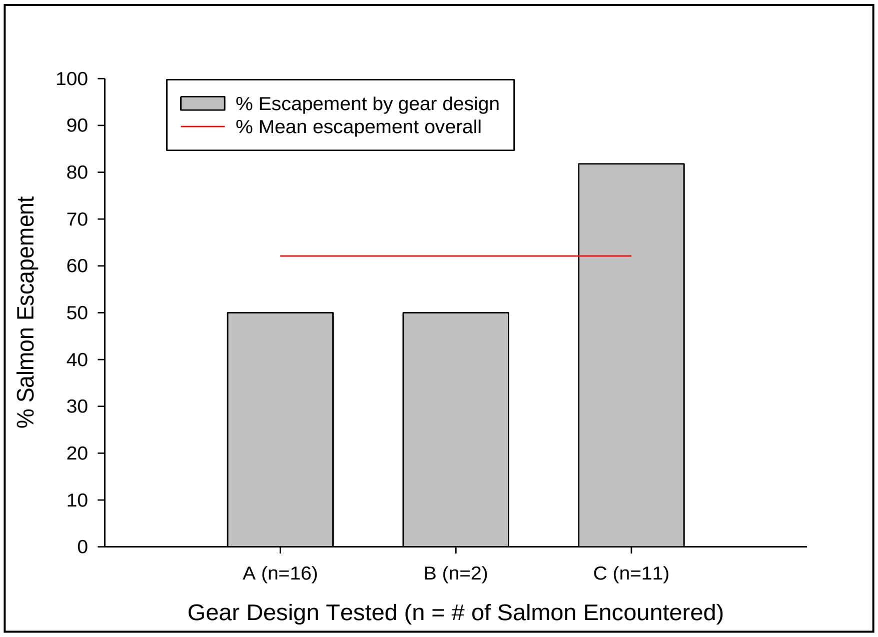

Figure 5. Chinook salmon escapement rates by gear design tested

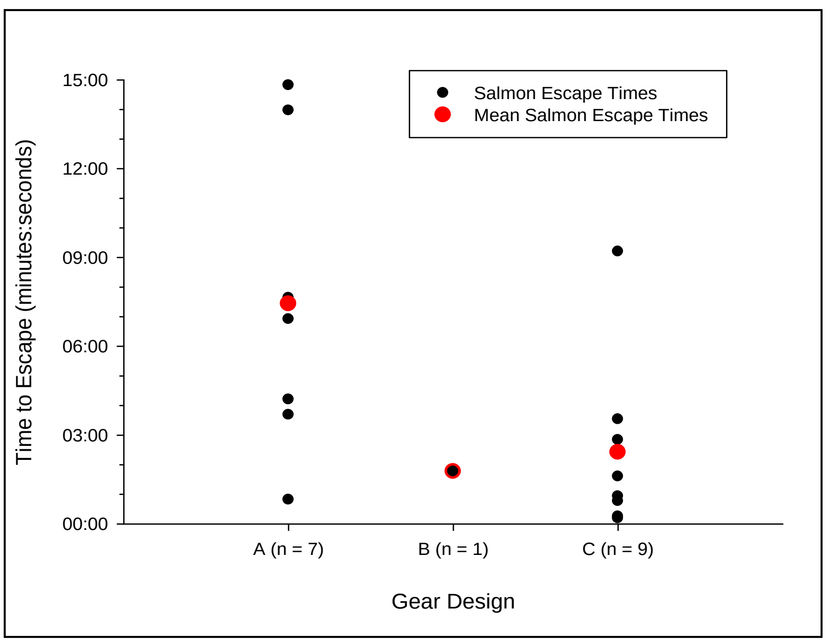

Figure 6. Chinook salmon escape times by gear design tested.

In addition to the encouraging results in bycatch reduction from the current study, interactions between researchers and the fishing industry have resulted in a technology transfer whereby variations of this BRD design have been used as a salmon excluder in both the Pacific hake and

Bering Sea walleye pollock trawl fishery. Results from these tests and lessons learned are continuously being exchanged and are stimulating discussions within the industry that have expanded out into other fisheries (e.g., applying BRDs to reduce Pacific halibut bycatch in bottom trawls). Collaborations with conservation engineers at the NMFS Alaska Fisheries Science Center (notably Dr. Craig Rose) have provided NWFSC and PSMFC researchers with valuable information that has helped with the success of this project.

Providing Direct Observation Video Camera Systems to Fishermen for Use in Evaluating Industry-Designed Approaches to Reducing Bycatch and Impacts to Benthic Habitats

The NMFS Northwest Fisheries Science Center (NWFSC) received funding from the NMFS National Bycatch Reduction Engineering Program to build two video imaging systems and make these systems available to commercial fishers and other sectors of the industry for their use in evaluating industry-designed bycatch reduction devices. The NWFSC has completed the video systems (Figure 7) and is in the process of implementing the video loaner program (for further details see: http://www.nwfsc.noaa.gov/research/divisions/fram/habitat.cfm). As part of an outreach effort surrounding the loaner program, the NWFSC and Pacific States Marine Fisheries Commission (PSMFC) met with fishing industry representatives from California, Oregon and Washington at an October 2010 workshop. Attendees included 15 from the fishing industry and 6 agency scientists. At this successful workshop and a subsequent meeting, the NWFSC developed a dialogue focusing on how the NWFSC's Conservation Engineering Program, working in collaboration with PSMFC and other agencies, might assist the fishing industry with bycatch reduction solutions under the new annual catch shares program.

Figure 7. One of two autonomous direct observation video camera systems developed at the NWFSC with 2010 BREP funding.

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

3. 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 2010, CAP aged the following species: Dover sole, petrale sole, canary rockfish, Pacific ocean perch, darkblotched rockfish, Pacific hake, and sablefish. Double –reads were made for widow rockfish and the following species were sent to other laboratories for aging: widow rockfish, spiny dogfish, blackgill rockfish, big skate, chilipepper rockfish and lingcod.

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

4. Resource Surveys

a) U.S. West Coast Groundfish Bottom Trawl Survey

The NWFSC conducted its thirteenth annual bottom trawl resource survey for groundfish off the coasts of Washington, Oregon, and California. The objective of the 2010 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 October. Each vessel was chartered for 11-12 weeks with the *Ms Julie* and *Noah's Ark* surveying the coast during the initial survey period from May to July. The *Excalibur,* and *Raven* operating in tandem, surveyed the coast during a 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 2010, 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) Sculpin phylogenetics and adaptive radiation – Stanford University; 3) Collect all specimens of eulachon (*Thaleichthys pacificus*) encountered during the groundfish survey – Conservation Biology Division, NWFSC, NMFS, NOAA; 4) Age, growth, and reproductive biology of the starry skate, *Raja stellulata* - Moss Landing Marine Laboratories; 5) Collection of any white-finned catsharks encountered - Moss Landing Marine Laboratories; 6) Collection of all unusual or unidentifiable skates, Deepsea skate, *Bathyraja abyssicola*, Pacific white skate, *Bathyraja spinossisima*, fine-spined skate, *Bathyraja microtrachys*, Aleutian skate, *Bathyraja aleutica*, and Broad skate, *Amblyraja badia*, - Moss Landing Marine Laboratories; 7) Collection of all unusual or unidentifiable sharks including: Pacific black dogfish, *Centroscyllium nigrum*, and small sleeper sharks, *Somniosus pacificus* -

Moss Landing Marine Laboratories; 8) Collection of any chimaera that is not *Hydrolagus colliei*, including: *Harriotta raleighana*, *Hydrolagus* spp. and *Hydrolagus trolli* - Moss Landing Marine Laboratories.

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 and various rockfish; 4) Collection and identification of cold water corals; 5) Fish distribution in relation to bottom dissolved oxygen concentration in the oxygen minimum zone; 6) Fish distribution in relation to bottom dissolved oxygen concentrations in a known hypoxic area off OR; 7) Composition and abundance of benthic marine debris collected during the 2010 West Coast Groundfish Trawl Survey from May to October 2010; and 8) Collection of ovaries from sablefish and canary rockfish to assess maturity.

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

b) Autonomous Underwater Vehicle (AUV) for monitoring fish and their habitat on the U.S. West coast

M. Elizabeth Clarke, Erica Fruh, Curt E. Whitmire, and Hanumant Singh

The Northwest and Pacific Islands Fisheries Science Centers have worked with researchers at Woods Hole Oceanographic Institution (WHOI) to redesign the Seabed AUV to overcome the difficulty of monitoring fish populations and habitat in rocky areas. Traditional fish monitoring techniques such as bottom trawl surveys have some limitations for assessing groundfish populations and their habitat throughout their range because of the abundance of rugged terrain. Hover-capable bottom tracking AUVs, on the other hand, offer a unique tool that is appropriate for work in such areas.

The Seabed AUV developed by Hanumant Singh at WHOI is a multihull hover-capable vehicle that unlike traditional torpedo shaped AUVs is capable of working extremely close to the seafloor while maintaining very precise altitude and navigation control. Its small footprint coupled with its 2000 meter depth rating makes it an ideal platform for conducting surveys off the continental shelf on ships ranging from standard oceanographic vessels to smaller fishing vessels.

Key modifications have been made to the AUV to simultaneously obtain forward- and downward-looking bottom imagery. In addition, a multibeam echosounder is mounted on the AUV to collect very high resolution bathymetry that is coregistered with digital photographs. Use of the Seabed AUV will allow the development of nonextractive surveys to monitor groundfish and their habitats in previously unassessed rocky habitats. The Seabed AUV is expected to provide better monitoring of groundfish communities in untrawlable habitats and increased resolution and positional accuracy of seafloor imagery, while simultaneously reducing ship time requirements.

In 2010, the NWFSC conducted Autonomous Underwater Vehicle (AUV) operations in support of and funded by NOAA's Deep Sea Coral Program. In June 2010, operations focused on potential deep-sea coral and sponge habitats in and around Olympic Coast and Channel Islands National Marine Sanctuaries. Research in the Olympic Coast National Marine Sanctuary focused on areas that are being reviewed for protection as part of Essential Fish Habitat (EFH) by the Pacific Fishery Management Council. The bottom tracking AUV, *Lucille* operated by the NWFSC in collaboration with the PIFSC and the *Kraken 2* Remotely Operated Vehicle (ROV) operated by the University of Connecticut were used to survey these areas aboard the NOAA Ship *McArthur II*. Both video and digital still images of the seabed and associated fauna were collected. Because of poor weather, only three sites were visually surveyed. However, in Channel Islands National Marine Sanctuary five days of surveys were completed for deep-sea corals and sponges at depths of 280-900 meters on Piggy Bank, an underwater mountain off Southern California. Scientists collected approximately 45 hours of continuous high-definition video and several thousand still images using the ROV. Eight nighttime missions were conducted by the AUV at depths of 284-888 meters and over 16,000 digital images were collected.

In September 2010, on board the *Pacific Storm*, scientists from the NWFSC and PIFSC conducted seven AUV missions with NMFS' AUV *Lucille* in the glass sponge areas offshore of Gray's Harbor, Washington. Multibeam surveys were conducted by Oregon State University in this area in July 2010 in order to describe the survey area and inform sample design of AUV collections. Over 24,000 georeferenced still images were collected. Detailed multibeam information was also collected by the AUV at specific sites thought to have particularly dense populations of sponges. All data collected are currently being analyzed and will be used to understand of distribution patterns of sponges and corals and associated fishes and provide the PFMC with information needed to manage EFH.

For more information, contact Dr. Elizabeth Clarke at Elizabeth.Clarke@noaa.gov

c) Southern California shelf rockfish hook-and-line survey

In early Fall 2010, FRAM personnel conducted the seventh 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) and the southern California sportfishing industry 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 of at-sea research, with nine biologists participating during 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 2,500 lengths, weights, fin clips, and otolith pairs were taken representing 37 different species of fish.

Several ancillary projects were also conducted during the course of the survey. An underwater video system was deployed opportunistically at sites to gather imagery of the seafloor for future analyses correlating catch rates of key species with specific habitat types. This camera system has also been deployed in other applications including direct visual observations of pelagic fish schools to be compared with contemporaneous acoustic backscatter data. Ovaries and stomachs were collected from key species to estimate mortality and investigate feeding habits. Several dozen individual fish were retained for use in species identification training for West coast groundfish observers and for a genetic voucher program conducted by the University of Washington.

For more information, please contact John Harms at John.Harms@noaa.gov

d) 2010 inter-vessel comparison (IVC) of the EK60 scientific echosounder between two NOAA ships, the *Miller Freeman* and *Bell M. Shimada*

The Acoustics Team of the Resource Analysis and Monitoring Division (FRAM) conducted an inter-vessel comparison (IVC) of the EK60 scientific echosounder using two NOAA ships, the *Miller Freeman* and *Bell M. Shimada* in June-July 2010. The *Miller Freeman* has previously been used by FRAM for the Joint US/Canada Integrated Acoustic and Trawl Hake Survey and was compared to the *Bell M. Shimada*, a noise-reduced vessel. The IVC was conducted to examine if results from FRAM's ongoing acoustic survey onboard the *Miller Freeman* are comparable to results obtained using NOAA's new noise-reduced fisheries survey vessels (FSV), the *Bell M. Shimada*, and/or to document any differences due to either the vessels' equipment or to fish behavior in response to noise-reduction. The IVC consisted of both vessels surveying an area in tandem, running either follow-the-leader or parallel transects with random selection of the lead, or north/south, vessel. Most vessel operations were identical to the normal FRAM hake acoustic survey operations, with additional time devoted to the follow-the-leader transects.

The 2010 Inter-Vessel Calibration (IVC) between the NOAA Ships *Miller Freeman* and *Bell M. Shimada* for the Pacific hake (*Merluccius productus*) acoustic survey was completed on July 26, 2010. The original plan was to conduct a hake IVC and to study the acoustic signatures of Humboldt squid (*Dosidicus gigas*). Since Humboldt squids were not sighted or collected during the IVC, effort focused solely on hake. During the IVC, four sets of 50 nm mini-grids were completed using both ships, with 1 to 1.5 nm spacing between transects. For the IVC, there were two operating modes: follow-the-leader and side-by-side. In the follow-the-leader mode, one ship followed the other along the same transect separated by about 0.5 nm. In the side-by-side mode, the two ships were horizontally separated by 0.5 - 1.0 nm. For mini-grid IVC operations, two sets were follow-the-leader mode (*Bell M. Shimada* led once and the *Miller Freeman* led once), and two sets were side-by-side mode.

In addition, 3 sets of trials were also completed to examine haul representativeness (i.e. the statistics of biological catches made at different portions of each hake aggregation upper, mid, and lower layers in vertical direction, and front, center, and back portions along the transect were compare). A total of 37 successful trawls were conducted on the *Bell M. Shimada* and 26 trawls were completed on the *Miller Freeman*.

The IVC cruise was originally scheduled for 30 days from June 25 to July 26, 2010 but was hampered from the start due to a mechanical issue on the NOAA Ship *Miller Freeman*. This resulted in a loss of 10 survey days. The NOAA Ship *Bell M. Shimada* departed on June 26, 2010 to begin scouting for hake in hopes that the *Miller Freeman* would be repaired quickly and the IVC could start with a minimal delay. The IVC officially began on July 6, 2010 when the *Miller Freeman* joined the *Bell M. Shimada* at sea. On July 8, 2010, the 2 ships made a scheduled port call in Eureka, CA with departure delayed 1 day due to a personnel issue. Both ships sailed on July 12, 2010 to continue the IVC. Forty knot winds in the Eureka, CA area resulted in a decision to return to the north where fish had been found prior to the port call so that the weather would not have a negative impact on the schedule. The IVC continued conducting follow-the-leader and side-by-side IVC transects and fishing operations, until July 22, 2010 when the generator on the *Miller Freeman* failed again and the ship headed in to Port Angeles, WA for repairs. Once repairs were made and the ship arrived in Seattle, WA, a sphere calibration was conducted on the *Miller Freeman* on July 26, 2010. Sphere calibration on the *Bell M. Shimada* took place on July 23, 2010. Overall, the IVC lost 15 days of sea time and only completed a fraction of the IVC planned work. Additional work will be required to complete the IVC.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

e) Joint PWCC-NMFS hake pre-recruit survey

A joint Pacific Whiting Conservation Cooperative and FRAMD hake pre-recruit survey was not conducted in 2010.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

5. NOAA Program: Fisheries And The Environment (FATE)

Project Title: Modeling Pacific hake (*Merluccius productus*) summer distribution

Investigators: Dr. Melissa Haltuch (NWFSC), Dr. Carrie Holt (DFO, Nanaimo), Dr. Elizabeth Clarke (NWFSC), and Dr. André E. Punt (NWFSC)

Recent funding via the NOAA Fisheries and the Environment (FATE) Program as well as funding via the Department of Fisheries and Oceans (DFO) Canada, International Governance Strategy Funds has lead to a joint project between the Northwest Fisheries Science Center (NWFSC) and DFO, Nanaimo focusing on building a model to describe hake distribution during the summer migratory season, with the long term goal of being able to both hind-cast and forecast hake distribution. The motivation for this work is that Pacific hake exhibits strong environmentally-driven inter-annual variation during the stock's annual summer northerly migration that impact monitoring, assessment, and management of hake. Being able to describe and forecast hake distribution could impact management via optimized survey design and planning, resulting in improved estimates of hake distribution and density. Specifically, survey effort could be distributed to minimize (expected) variance given the ability to predict hake distribution and density prior to a survey, resulting in more precise estimates of abundance that form the basis for stock assessment and management advice. Hind-casting hake distribution could also be useful for investigating hake selectivity and availability in the stock assessment model. Essentially, the ability to model hake selectivity as a function of a covariate(s) would reduce the number of parameters in the stock assessment model. Finally, understanding and forecasting of hake distribution during migration is important for both short-term management decisions and long-term planning under future climate scenarios.

This project is using the depth aggregated hake acoustics survey data (1992-2007) to investigate space (latitude and longitude), population age composition, and environmental drivers of the north-south and cross-shelf distribution of hake along the west coast of North America. A set of hypothesis have been proposed in order to investigate potential mechanisms underlying the hake summertime distribution. The null hypothesis is that the north-south summertime distribution of hake is determined by latitude and the population age structure; and that the cross-shelf distribution of hake is determined by bathymetry. Three hypotheses have been developed that address possible climate mechanisms forcing hake summer distribution. Hypothesis 1 proposes that the intensity and location of the poleward undercurrent impacts the period of active migration, with stronger poleward flow leading to the population moving farther north. Hypothesis 2 suggests that formation and distribution of mesoscale structure in the CCE, e.g. eddies, is different between warm and cool years, impacting the distribution of hake's main prey resource, euphausiids. The hake distribution then tracks the changes in the distribution of euphausiids. Hypothesis 3 concerns the timing of the spring transition and in turn the intensification of upwelling, which impacts the timing and distribution of euphausiid availability and therefore hake distribution. A suite of environmental data from both satellite data on surface ocean conditions (e.g. SST) and regional ocean model (ROMS) outputs (e.g. poleward flow) are being assembled to test these hypotheses. Preliminary data exploration and modeling efforts are ongoing.

Current funding for this project extends through September 2011. However, we are currently pursuing alternative sources of funding via NASA, FATE and DFO to extend the project. Proposed activities include a reanalysis of historical hake survey data to extract hake backscatter at depth, analysis of the in situ physical oceanography data collected during the hake survey, further investigations using the satellite data and ROMs outputs, and refining the ongoing modeling effort that is utilizing the depth aggregated hake acoustics survey data.

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6. Ecosystem Studies

a) Fish Ecology Division Summary Report

The Fish Ecology Division completed four monthly field surveys in 2010 for larval fishes using plankton nets and juvenile fishes using trawls. Field surveys are used to assess spawning success of a variety of groundfish species in relation to oceanographic conditions and climate variability, with the intent of establishing recruitment success indices to enhance stock assessment. We did not conduct our usual May cruise this year due to unavailability of any fishing vessels to charter. Our June cruise was conducted aboard the NOAA ship *Miller Freeman* and the July, August and September cruises were done aboard the chartered fishing vessel *Miss Sue*. All larval and juvenile fish have been sorted and identified for 2010. Preliminary results have shown a substantial increase in the abundance of rockfishes in our plankton nets and trawls in the last few years such that they dominate the ichthyoplankton composition presently. Due to the fact that there are potentially so many (>60) rockfish species present off our coast and that they are so difficult to visually differentiate at early stages, we have been using genetic techniques to identify several thousand rockfish juveniles from 2005-2010. We have identified at least 24 species and several species groups in this analysis. We will soon apply these techniques to larvae which we have begun to preserve in alcohol. There have also been moderate increases in flatfish larvae/juveniles of several commercially important species. We have been examining diets of four of the most common rockfish species using direct stomach and stable isotope analysis and have a manuscript ready to submit on this. Perhaps the most striking change in our sampling for 2010 was the complete lack of the major predator in our trawls, the Humboldt squid that had occurred in our sampling area every year since we started in 2004 but were particularly abundant in 2009. We have completed a manuscript which documents the occurrences of this voracious predator.

Products*:*

- Oral presentation at the 2011 annual Ocean Ecology Meeting in Seattle entitled, "Winter Ichthyoplankton abundance: predictor of summer prey fields and ultimate survival of juvenile salmon?" Elizabeth A. Daly, Richard D. Brodeur Toby D. Auth, William T. Peterson and Edmundo Casillas.
- Oral presentation at the CalCOFI Annual Meeting in La Jolla, CA entitled, "Larval and juvenile recruitment dynamics of rockfishes in the Northern California Current." R.D. Brodeur, T.D. Auth, E.A. Daly, T.A. Britt, M.C.C. Litz, and R.L. Emmett.
- Auth, T.D. MS. Analysis of the spring-fall epipelagic ichthyoplankton community in the northern California Current in 2004-2009 in relation to environmental forcing factors. Submitted to *CalCOFI Rep.*
- Toole, C.L., R.D. Brodeur, C.J. Donohoe, and D.F. Markle. 2011. Seasonal and interannual variability in the community structure of small demersal fishes off the central Oregon coast. In press in *Mar. Ecol. Prog. Ser.*
- Auth, T.D., R.D. Brodeur, H.L. Soulen, L. Ciannelli, And W.T. Peterson. In press. The response of fish larvae to decadal changes in environmental forcing factors off the Oregon coast. *Fish. Oceanogr.*
- Litz, M.N.C., T. A. Britt, A.J. Phillips, R.L. Emmett, and R.D. Brodeur. MS. Episodic range expansions of Humboldt squid (*Dosidicus gigas*) off Oregon and Washington. Submitted to *CalCOFI Rep.*
- Bosley, K.L, T.W. Miller, R.D. Brodeur, K. Bosley, A. Van Gaest and A. Elz. MS. Feeding ecology of juvenile rockfishes off Oregon and Washington: insights into life history patterns based on stomach content and stable isotope analyses. To be submitted to *Mar. Biol.*
- Contributed multiyear data on juvenile fishes to a section of the North Pacific Marine Science Organization Ecosystem Status Report that was published in 2010.

For more information, contact Dr. Rick Brodeur or Dr. R. Emmett at Rick.Brodeur@noaa.gov and Robert.Emmett@noaa.gov

b) Integrated Ecosystem Assessment of the California Current: Ecosystem health, Salmon, Groundfish and Green Sturgeon

Editors: Phil Levin and Frank Schwing

An Integrated Ecosystem Assessment (IEA) is formal synthesis and quantitative analysis of information on relevant natural and socio-economic factors in relation to specified ecosystem management goals. In this first iteration of the California Current IEA, we focus on a series of ecosystem components and ecosystem pressures that are of keen interest to resource managers, policy makers and the public: ecosystem health, salmon, groundfish and green sturgeon. Our goal is to provide the technical underpinnings of future IEA documents that will target stakeholders and managers. We report on 1) a process to develop a limited set of scientifically credible indicators; and 2) the status and trends of these indicators. We then develop a new method for conducting ecosystem risk assessment, and report on pilot evaluations of management scenarios. This report is the first in a series of efforts to complete a full IEA of the California Current. The next iteration of the IEA will improve analytical techniques and models, fill data gaps, will include more ecosystem components and pressures.

A 30 page summary of IEA findings, as well as the full Technical Memorandum, will be available this spring at http://www.nwfsc.noaa.gov/publications/scientificpubs.cfm

For more information, please contact Dr. Phil Levin at NOAA's NW Fisheries Science Center, Phil.Levin@noaa.gov

c) Fishing catch shares in the face of global change: a framework for integrating cumulative impacts and single species management

Investigators: I.C. Kaplan, M. Burden, P.S. Levin, and E.A. Fulton

Any fishery management scheme, such as individual fishing quotas (IFQs) or marine protected areas, should be designed to be robust to potential shifts in the biophysical system. Here we couple possible catch scenarios under an IFQ scheme with ocean acidification impacts on shelled benthos and plankton, using an Atlantis ecosystem model for the US West Coast. IFQ harvest scenarios alone in most cases did not have strong impacts on the food web, beyond the direct effects on harvested species. However, when we added impacts of ocean acidification, the abundance of commercially important groundfish such as English sole (*Pleuronectes vetulus*), arrowtooth flounder (*Atheresthes stomias*), and yellowtail rockfish (*Sebastes flavidus*) declined up to 20-80% due to the loss of shelled prey items from their diet. English sole exhibited a tenfold decline in potential catch and economic yield when confronted with strong acidification impacts on shelled benthos. Therefore, it seems prudent to complement IFQs with careful consideration of potential global change effects such as acidification. Our analysis provides an example of how new ecosystem modeling tools that evaluate cumulative impacts can be integrated with established management reference points and decision mechanisms.

For more information, please contact Dr. Isaac Kaplin at NOAA's NW Fisheries Science Center, Isaac.Kaplan@noaa.gov

d) Genetic evaluation of stock structure and population bottlenecks in the severely depleted cowcod

Investigators: J. Hess, P. Chittaro, A. Elz, L. Gilbert-Horvath, J. Carlos Garza , V. Simon

Cowcod (*Sebastes levis*) range from Oregon to Baja California and are currently assumed to be one continuous population. Since 2004, it has been on the National Marine Fisheries Service "Species of Concern" list due to its dramatic decline in abundance (<3.4% - 16.3% of historical biomass). The following questions were addressed: 1) Are there population subdivisions within the species, specifically, between two marine biogeographic regions separated by Point Conception, and 2) Have cowcod populations experienced loss of genetic variation due to a reduction in population size? Sixteen variable microsatellite loci were genotyped and ~500 bp of the mitochondrial control region were sequenced for 294 fish distributed throughout the species range. We observed significant structure when fish were grouped into two regions separated by Point Conception (FST=0.066). However, upon further inspection, an individual-based spatial analysis using Bayesian cluster assignment of the microsatellite genotypes localized this genetic break further south (FST=0.092), corresponding to separation between a Channel Islands region versus the mainland. These results indicate a minimum of two management units in this species. In general, cowcod show low genetic diversity compared to other rockfishes. However, cowcod stocks do not appear to exhibit detectable loss in genetic variation, despite declines in abundance.

For more information please contact Paul Chittaro at Paul.Chittaro@noaa.gov e)

e) Differential somatic growth rates and population subdivision of regions separated by Point Conception, CA, in a depleted rockfish, cowcod (*Sebastes levis*)

Investigators: P. Chittaro, J. E. Hess, J. Carlos Garza, and V. Simon

Cowcod rockfish (*Sebastes levis*), a once commonly harvested (commercially and recreationally) species within Californian waters, was declared overfished in 2000, and added to the National Marine Fisheries Service Species of Concern list in 2004. To assist in the conservation of this species, we used otolith microchemistry and microstructure to obtain information related to population structure and the spatial variability of juvenile somatic growth. We hypothesized that a location of large upwelling near Point Conception, CA may act as a dispersal barrier for cowcod rockfish, resulting in population structure (currently, fisheries managers assume a single continuous population). If population structure is detected, we hypothesized that juvenile somatic growth rates would differ among populations owing to the different environments each population resides. To address these objectives, we used archived collections of otoliths that were obtained throughout the species range. Using trace element concentrations from whole otoliths we identified two populations of cowcod rockfish that were separated at Point Conception. Further, based on otolith microstructural analyses we detected significant differences in juvenile somatic growth rates between these two populations. These results suggest that a management approach, which considers two populations with differential growth rates, may better assist the rebuilding of this species.

For more information, please contact Paul Chittaro at Paul.Chittaro@noaa.gov

f) Mapping and exploring the underwater San Andreas fault, 2010

The Northern San Andreas Fault (NSAF) stretches from the Mendocino Triple Junction, an area in northern California where three tectonic plates meet, south through the San Francisco Bay area. The NSAF ruptured over 100 years ago in the great San Francisco earthquake of 1906. The rupture was thought to have caused rifts and scarps in the seafloor, but in the time that has passed since the earthquake, the underwater portion of the fault has remained largely unexplored until this past September when an interdisciplinary expedition team completed an investigation of the fault offshore of northern California. The team included scientists from NOAA's Fisheries Service, Oregon State University, and the U.S. Geological Survey. The expedition utilized two vessels, the Sailing Research Vessel *Derek M. Baylis* and the Research Vessel *Pacific Storm* as well as the SeaBED AUV *Lucille* from NOAA Fisheries Northwest and Pacific Fisheries Science Centers. Multibeam mapping operations and seismic profiling were conducted onboard the *Baylis* while AUV and fisheries sonar operations were conducted onboard the *Pacific Storm*.

For multibeam operations, the expedition used a Reson 8101 multibeam sonar aboard the *Derek M. Baylis* to study the expression of the fault at the surface of the seafloor. The multibeam was mounted on a specially designed pole below the depth of the sailboat's keel. Between data collected during this expedition, which mapped the majority of the fault offshore in Federal Waters and work done by the California State Waters mapping program, the entire length of the fault between Point Arena and Point Delgada has now been mapped. Complete coverage of the fault has an average resolution of ~2 m. The data collected also include backscatter data over the same area, with an average resolution of 50 cm.

The new mapping coverage revealed the fault to be a dramatic escarpment on the continental shelf and exhibits classic strike-slip features, with pop-up and pull-apart basins along its length related to gentle strike changes of the fault. The fault is well expressed where it captures and offsets the head of Noyo Canyon. Multibeam data also revealed several fault splays that are related to uplifted banks along the fault. It was observed that the fault does come ashore at Point Delgada.

In the next part of the expedition, the seismic operations, data on the layers of sediment and rock, deep under the surface of the seafloor, were collected using a system called a seismic reflection "mini-sparker" deployed from *Baylis.* The OSU and USGS teams collected 58 seismic profiles in a grid across the fault at a spacing of 1 km. The lines, combined with 51 lines previously collected by USGS earlier in the summer comprise the most dense seismic grid ever collected across the San Andreas Fault, and possibly any plate boundary fault. Seismic profiling revealed highly variable structure along the fault. In some places, the fault was a simple structure, and remarkably constrained to a very narrow zone of hundreds of meters width. In other areas, the fault zone was kilometers wide, had multiple main traces and was highly diverse in structural expression. The mini sparker profiles were of excellent quality, and will provide a very high-resolution 3D model of the fault system when the data are processed and assembled into a 3D grid.

Researchers and engineers from the NOAA Fisheries and Woods Hole Oceanographic Institution aboard the research vessel *Pacific Storm* used the AUV *Lucille* and a multi-frequency quantitative sonar system to survey the seafloor and water column around the NASF, previously mapped by the team on the *Baylis*. The AUV's advanced optical cameras were used to image surface features of the seabed and characterize habitats with their associated fauna. The multi-frequency Simrad EK60 sonar system was used to image animals living in the water column—the "nekton" and "zooplankton", especially aggregations of individuals such as fish schools, and those that often appear as layers comprised of smaller fishes, squid, and crustaceans such as shrimp and krill.

During the eight days that AUV and sonar operations were conducted on board, the *Pacific Storm*, 14 AUV missions were completed and AUV *Lucille* returned tens of thousands of photos of the seafloor. At three of the AUV dive sites, the fisheries sonar system was used to conduct surveys of scattering layers in the overlying water column at three frequencies.

The photos taken by the AUV provided researchers with information about the composition of the seafloor, along with associated fish and invertebrate communities. Shoreward and seaward of the fault the sedimentary environments were inhabited by the fishes and invertebrates commonly known for this area of the California Current, including commercial and non-commercial flatfishes and skates, as well as, sculpins and poachers. Where the NSAF outcropped, the AUV's images revealed a rich invertebrate fauna characteristic of high-current areas with dense aggregations of feather stars or crinoids, anemones, basket stars, and in some areas sponges. Feather stars and basket stars are known to inhabit rocky habitats in areas of strong currents that deliver food to these filter feeding organisms. Once complete, analysis of seafloor will be used to document distributional patterns in fish and invertebrate assemblages associated with the NSAF.

The research group also focused on making their research as "green" as possible. The *Baylis*, a San Francisco-based sailboat owned by Sea Life Conservation, is powered by a combination of wind and diesel. The *Baylis* runs quietly, and emits little pollution. Due to its hull construction and design, the *Baylis*'s average fuel consumption was 1.6 gallons per hour. Comparatively, the more standard research vessel, the *Pacific Storm*, used anywhere from 12 – 22 gallons of fuel per hour, depending on the mode of operations.

During this exploration, the exploration team completed the first comprehensive high-resolution multibeam sonar and seismic reflection survey of the NSAF. When combined, data from these two complementary geophysical surveys will provide an unprecedented high-resolution 3D visualization of the fault system. In addition, digital photographs and photomosaics obtained with a hovering autonomous AUV will provide the collaborative team of geologists and biologists with direct observation of the seafloor and associated biological communities at selected sites. Mapping and imaging the NSAF at georeferenced spatial scales from kilometers to meters will support ongoing studies and discoveries on the nature of the NSAF and contribute to the assessment of marine habitats in the California Current Ecosystem. Finally, the exploration provided a case study and outreach opportunity for conducting a "green" oceanographic research project.

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7. Acoustic Modeling and Research

a) Development of a new EchoPro software package to process the Integrated Acoustic and Trawl Survey (IATS) data

To address the 2010 hake STAR Panel's and the Stock Assessment Team's concerns, a new software package EchoPro was developed over the past year. This is a Matlab code program package that can significantly enhance the capability of acoustic data processing: (1) the data processing is now independent of Oracle database; (2) it is more efficient since all data reading and loading are done automatically; and (3) it is more flexible in terms of how to process data. The STAR Panel and the Stock Assessment Team asked the Acoustics Team to provide sex-specific biomass estimate, which would require much more involved man power to modify the source code within Oracle. With EchoPro, the sex-specific biomass estimate is relatively easy.

The historical hake biomass data from 1995 to 2009 were re-processed using EchoPro. The outputs are length, age, and sex structured abundance and biomass estimates that are acoustically weighted. The comparison of the total biomass estimates using EchoPro with those using conventional method from 1995 to 2009 are listed in Table 3. The small differences are from: (1) bottom intrusion using conventional method has been removed; (2) region drawing ambiguity (start and end times); (3) missing pings in ek500 logger data files; and (4) ambiguity in vessel log interval.

Table 3. Comparison of acoustic biomass estimates (mmt) from 1995 to 2009.

Year	Historical	EchoPro	Difference (%)
1995	1.39	1.36	-1.8
1998	1.19	1.10	-6.9
2001	0.74	0.69	-5.8
2003	1.84	1.82	-1.1
2005	1.27	1.23	-2.9
2007	0.88	0.83	-6.0
2009	1.46	1.47	0.7
Average	**1.25**	**1.21**	**-3.4**

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

b) Application of a geo-statistical technique (kriging) to hake biomass estimate

Historically, hake biomass (age 2+) and variability were estimated from the survey data using a stratified random transect design. These design-based estimates did not account for spatial correlation of the data or patchiness of hake distributions and assumed that there was no hake biomass beyond the ends of each transect. In addition, estimates of variability were uncertain and likely biased because some sources of uncertainty could not be accounted for in the adopted approach.

Geostatistical methods were originally developed for spatially structured mining data and are a collection of numerical and mathematical techniques used to analyze observations that are correlated in space. Kriging is a geostatistical method and a local estimator used to interpolate a spatially distributed quantity in an unobserved location and was considered to be suitable to estimate fish abundance and precision by an ICES Study Group.

Methods of estimating fish abundance that are based on random sampling theory do not make any assumptions about spatial correlation, and assume that the observations are independent samples. However, due to its nature, hake biomass distribution is believed and has been verified to follow the intrinsic hypothesis, thus is correlated, and the survey may deviate from a random sampling design to explore the distribution of the stock being surveyed. The spatial correlation must therefore be accounted for to appropriately estimate the biomass and the variance. In FY2010, a kriging technique was developed and applied to the hake biomass estimate.

There are several advantages of applying geostatistical techniques (i.e., kriging) to the biomass estimate of Pacific hake from the IATS:

1) It provides the hake biomass and associated sample variance estimates simultaneously and properly accounts for spatial correlation along and between transects.
2) It provides biomass estimates in the area beyond transect lines but within correlation distance; assuming an **Intrinsic Model**.
3) It provides maps of hake biomass and variance that take into account the inhomogeneous and patchy hake distribution.
4) It provides more flexibility in survey transect design, such as allowing transects to remain more or less perpendicular to the coastline or to zigzag up the coast, which is likely a more efficient sampling scheme.

The semi-variograms for 2001, 2007, and 2009 are given in Figure 8. The agreement between data and model is similar with the data for other years.

Biomass density data estimated directly from the IATS conducted in 1995, 1998, 2001, 2003, 2005, 2007, and 2009 are processed using the kriging software are given in Figure 9.

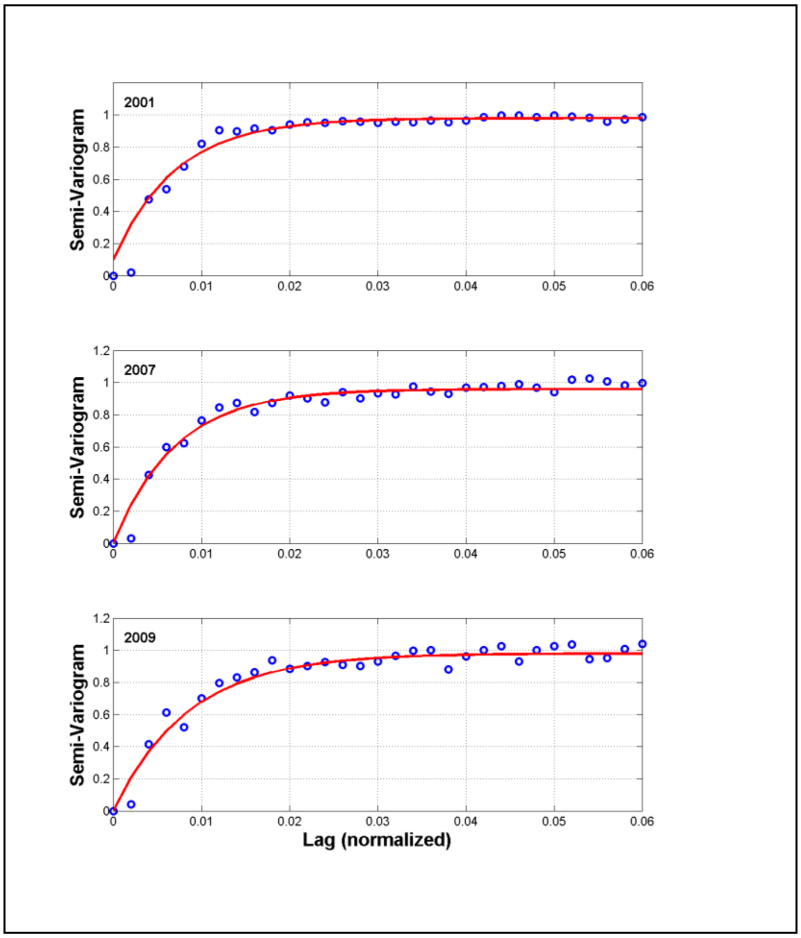

Figure 8. Semi-variograms of the IATS conducted in 2001, 2007, and 2009. Note that the lag is a normalized quantity, approximately 200 nm for a lag of unity.

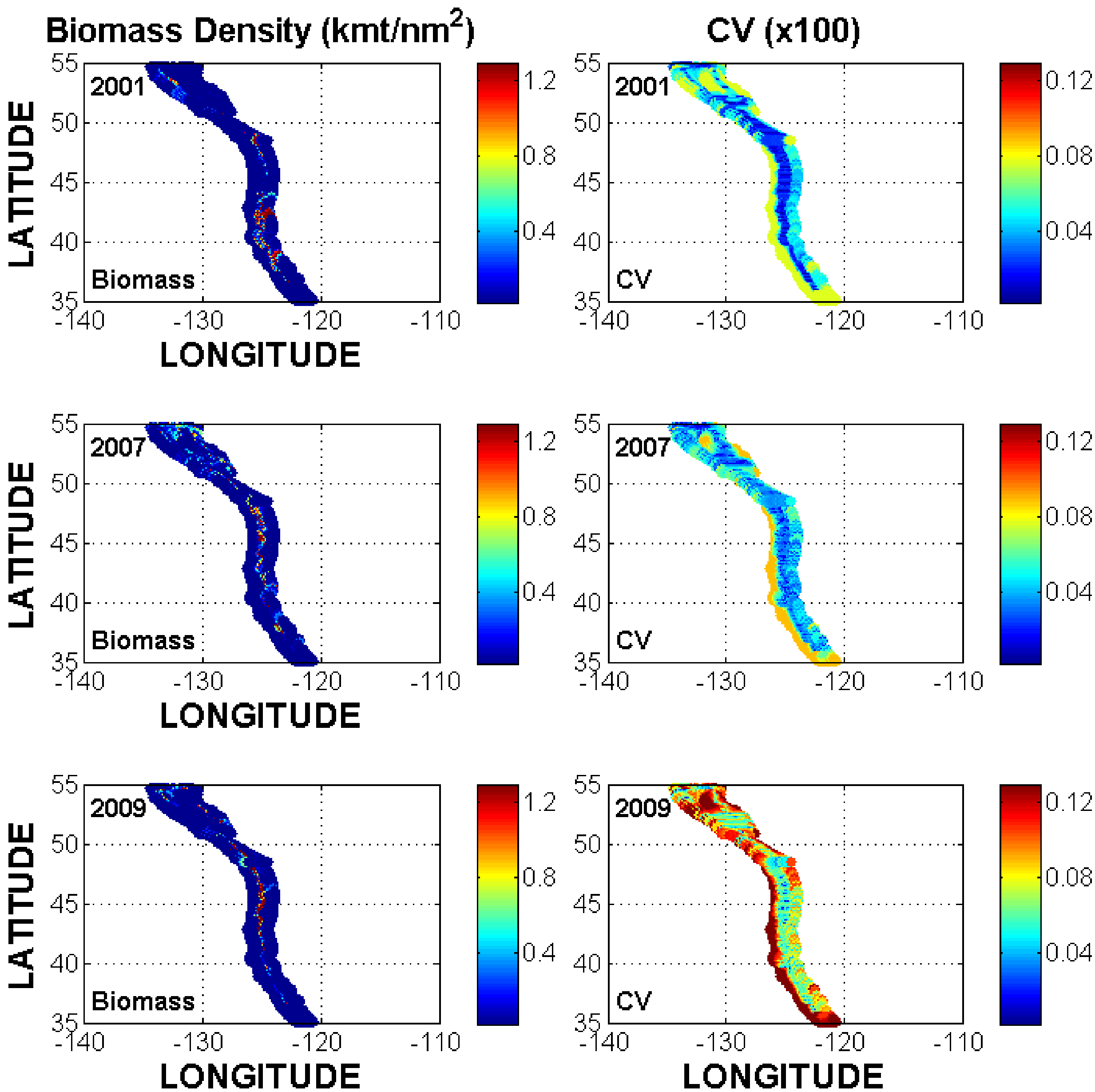

Figure 9. Biomass and variance maps from Kriging process for survey years 2001, 2007, and 2009.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

c) Codend video camera work for improved knowledge of the biological composition of areas of backscatter observed during fisheries acoustic surveys

One challenging but crucial, element of fisheries acoustic surveys is accurate groundtruthing of the echo return. Assignment and proportioning of areas of backscatter to the correct species or mix of species affects fish biomass calculations. Typically, survey groundtruthing is done by midwater trawls targeting a single scattering layer of interest. However, the depth at which each species is caught is unknown. Therefore, this method is problematic when multiple scattering layers are present. Also, small scatters are missed which may be important contributors to the echo intensity. To address these issues, pilot work initiated in 2008 on the *Oscar Dyson* was continued during the 2010 intervessel calibration cruise (IVC) on the *Bell M. Shimada*. This was done using a video camera mounted in the codend of an open midwater trawl which enabled us to look at several scattering layers during each tow. For comparison, we conducted tows with a closed net and no camera at the same location. We then examined each acoustic echogram and the corresponding tow to compare backscatter calculations attributable to our species of interest. We found that there were some differences in these measurements between the two types of tows. We conclude that this method appears to provide improved knowledge of acoustic backscatter observed during fisheries acoustic surveys and plan to integrate this method into future surveys.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

d) Biomass estimate of Humboldt squid (*Dosidicus gigas*) off the west coast of North America

The population of Humboldt squid (*Dosidicus gigas)* has seen an explosion in the Eastern North Pacific over the last several years. The species has gone from being rarely seen in the waters off OR, WA, and BC to becoming a major predator in the marine food web in this area (Figure 10). This population explosion has the potential to cause large impacts in major fish stocks. The biennial 2009 Joint U.S. – Canada Pacific hake (*Merluccius productus*) acoustic trawl survey also noted large amounts of Humboldt squid over much of the survey area. Because Humboldt squid could be acoustically confused with Pacific hake, and because the presence of Humboldt squid disrupted the normal shoaling pattern of hake, an estimated depth threshold was used to help distinguish Humboldt squid from hake. Accordingly, the biomass estimate of Pacific hake for 2009 was less certain. Several methods were explored to quantify the uncertainty and assess the reliability of the hake biomass estimate. The estimated biomass of the Humboldt squid from 2009 hake acoustic and trawl survey was 1.46 million metric tons (mmt), a number similar to the estimated hake biomass. The sensitivity and uncertainty were analyzed using the method of bootstrapping.

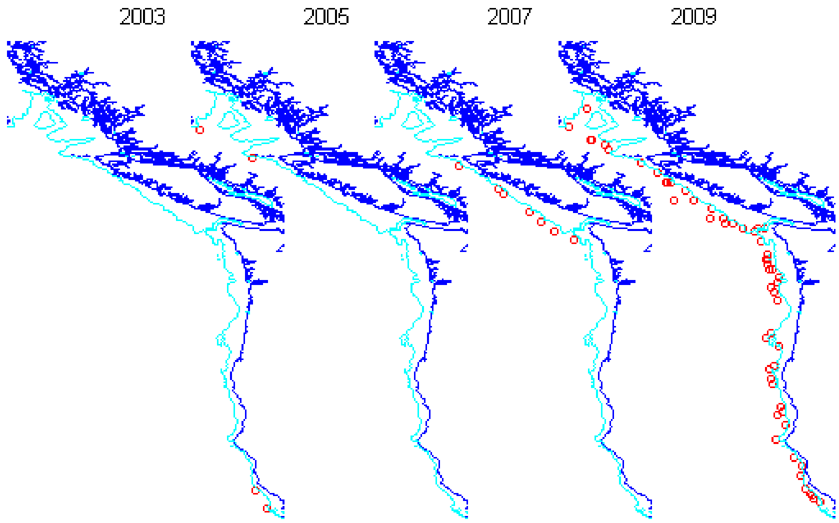

Figure 10. Historical trawl locations when Humboldt squid were present. Humboldt squid was not observed before 2003.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

8. Economic Data Collection and Analysis

a) Regional Economic Impact Analysis

The Input Output Model for Pacific Coast fisheries (IO-PAC) was used to calculate the economic impacts of the latest groundfish management decisions by the Pacific Fishery Management Council. Full documentation of the model will soon be published as a NOAA technical memo.

There will be ongoing improvements to the model as additional data are made available. The second phase of development will be to incorporate recreational fishing into the model, and to expand the coverage of commercial fleets. Additionally, the model will be used as a starting point for the development of a computable general equilibrium model.

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.

For more information, please contact Jerry Leonard at Jerry.Leonard@noaa.gov

b) Fleet Restructuring, Rent Generation and the Design of Individual Fishing Quota Programs

Economist Carl Lian and his coauthors were recently awarded the Dr. S.Y. Hong Award for Outstanding Article in the journal *Marine Resource Economics*. This annual award is given by the Marine Resource Economics Foundation in recognition of the outstanding article published in their journal, and is one of the top prizes in the field of natural resource economics. The winning paper, titled "Fleet Restructuring, Rent Generation and the Design of Individual Fishing Quota Programs," provides important insights into the effects of catch share management on fleet restructuring, harvesting costs, and profitability for the Pacific Coast groundfish fishery.

Catch shares refer to a range of management programs that allocate a specific portion of the total allowable fishery catch to individuals, cooperatives or communities. For example, under a catch share program, a fisherman would receive a secure but temporary privilege to harvest a specific quantity of fish. The Pacific Coast groundfish trawl fishery is currently managed by a controlled access program that regulates commercial fish harvest with gear restrictions, vessel entry restrictions, area and seasonal closures, and per-vessel catch limits.

Lian and his colleagues examined the economic implications of adopting a catch share management program for the Pacific Coast groundfish limited-entry trawl fleet (excluding whiting). Using data collected by the NWFSC's economic program, they estimated the relationship between harvesting costs and the scale of vessel operations and vessel efficiency. Their model uses an innovative approach to analyze data from the pre-catch share fishery to project economic performance after catch share implementation. Among their key findings, were: (1) the non-whiting groundfish trawl fleet earned economic profits of $0 to negative $2.5 million during 2004, (2) fleet restructuring under catch shares will reduce the number of vessels participating in the fishery by 50% to 66%, and (3) catch share management will lower annual harvesting costs for the fleet by $18 to $22 million, causing a corresponding increase in economic profits.

This paper is significant both in terms of economic methodology and its applicability and use in fishery management. This analysis has the potential to become a standard tool for assessing the regulatory effects of catch shares. The research was also timely and extremely relevant in that it provided the foundational economic information necessary to move forward with the Pacific Coast groundfish catch share program. Without this research, the current economic status and the projected future status of the industry under the program would have been largely unknown.

For more information, please contact Carl Lian at Carl.Lian@noaa.gov

9. Observer Data Collection and Analysis

The FRAM division's At-Sea Hake and West Coast Groundfish Observer Programs continued collecting fishery-dependent data during 2010 on groundfish fleets along the entire West coast.

a) NWFSC U.S. West Coast At-Sea Hake Observer Program

The At-Sea Hake Observer Program deploys two fisheries observers on each of fifteen at-sea Pacific hake processing vessels for every fishing day. Observer sea days in 2010 exceeded 1,300 days. There were over 2,400 individual hauls conducted in the at-sea hake fishery, and 99.8% of those hauls were sampled by observers for species composition and biological data. Due to low total catch limits on some bycatch species in this fishery, observer data are crucial to the successful real-time management of the fishery. The 2010 season saw the continuation of bycatch quotas divided among the mothership, catcher-processor, and shoreside sectors. This change, in 2009, allowed management to end fishing for a specific sector if a bycatch allocation is reached, while the other sectors remain open to catch their respective hake quotas. Widow, darkblotched and canary rockfish species each have specific bycatch quotas for the hake fishery. The 2010 hake season was successfully fished to the total hake allocation without exceeding any of the sector-specific bycatch caps.

Looking forward to 2011, new trawl catch shares regulations will allocate individual target and bycatch quotas at the vessel or co-op level. Despite these changes, observer coverage levels and sampling protocols will remain the same for the at-sea hake fishery.

For more information, please contact Vanessa Tuttle at Vanessa.Tuttle@noaa.gov

b) NWFSC West Coast Groundfish Observer Program

During 2010, the West Coast Groundfish Observer Program deployed observers in bottom trawl and fixed-gear fisheries along the entire U.S. West Coast, exceeding 3000 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. The program observes both federally managed and state managed fisheries and in 2010, eleven distinct fishery sectors were observed. Due to its unique data collection circumstances, the program continues to stress safety and data quality.

For more information, please contact Janell Majewski at Janell.Majewski@noaa.gov

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 table 4 below, were completed during 2009 - 2010.

Table 4. Recent summaries of data collected on observed trips

Report Title	Fisheries in Report	Date Range of Data
Data Report and Summary Analyses of the U.S. West Coast Limited Entry Groundfish Bottom Trawl Fishery, Oct 2010	Limited Entry Groundfish Bottom Trawl	January 1, 2009 – April 30, 2010
Data Report and Summary Analyses of the U.S. West Coast Non-Nearshore Fixed Gear Groundfish Fishery, Oct 2010	Limited Entry Sablefish-endorsed fixed gear, Limited entry non-sablefish-endorsed fixed-gear, open access fixed-gear	January 1, 2009 – April 30, 2010
Data Report and Summary Analyses of the U.S. West Coast Nearshore Fixed Gear Groundfish Fishery, Oct 2010	California nearshore fixed-gear, Oregon nearshore fixed-gear	January 1, 2009 – April 30, 2010
Data Report and Summary Analyses of the U.S. West Coast California Halibut Trawl Fishery, Oct 2010	California halibut bottom trawl	January 1, 2009 – April 30, 2010
Data Report and Summary Analyses of the California and Oregon Pink Shrimp Trawl Fisheries, Oct 2010	California Pink Shrimp Trawl, Oregon Pink Shrimp Trawl	January 1, 2009 - December 31, 2010
Estimated 2009 Discard and Total Catch of Selected Groundfish Species, Oct 2010	Limited Entry Groundfish Bottom Trawl, Limited Entry Sablefish-endorsed fixed gear, Limited entry non-sablefish-endorsed fixed-gear, open access fixed-gear, California nearshore fixed-gear, Oregon nearshore fixed-gear, California halibut bottom trawl, California Pink Shrimp Trawl, Oregon Pink Shrimp Trawl, At-Sea Midwater Hake Trawl, Research catch, EFP catch, tribal, recreational	January 1, 2009 – December 31, 2009
Observed and Estimated Total Bycatch of Salmon in the 2009 U.S. West Coast Groundfish Fisheries, January 2011	Limited Entry Groundfish Bottom Trawl, Limited Entry Sablefish-endorsed fixed gear, Limited entry non-sablefish-endorsed fixed-gear, open access fixed-gear, California nearshore fixed-gear, Oregon	January 1, 2009 – December 31, 2009

	nearshore fixed-gear, California halibut bottom trawl, California Pink Shrimp Trawl, Oregon Pink Shrimp Trawl	
Observed and Estimated Total Bycatch of Green Sturgeon and Eulachon in the 2002-2009 U.S. West Coast Groundfish Fisheries, Feb 2011	Limited Entry Groundfish Bottom Trawl, Limited Entry Sablefish-endorsed fixed gear, Limited entry non-sablefish-endorsed fixed-gear, open access fixed-gear, California nearshore fixed-gear, Oregon nearshore fixed-gear, California halibut bottom trawl, California Pink Shrimp Trawl, Oregon Pink Shrimp Trawl	January 1, 2002 – December 31, 2009
Pacific Halibut Bycatch in the U.S. West Coast Groundfish Fishery from 2002 through 2009, Oct. 2010	Limited Entry Trawl, Limited Entry Sablefish-endorsed fixed gear, Limited entry non-sablefish-endorsed fixed-gear, open access fixed-gear, California Pink Shrimp Trawl, Oregon Pink Shrimp Trawl	January 1, 2002 – December 31, 2009
Estimated Bycatch of Marine Mammals, Seabirds, and Sea Turtles in the 2002-2009 U.S. West Coast Commercial Groundfish Fishery, Mar 2011	Limited Entry Trawl, Limited Entry Sablefish-endorsed fixed gear, Limited entry non-sablefish-endorsed fixed-gear, open access fixed-gear, California Pink Shrimp Trawl, Oregon Pink Shrimp Trawl	January 1, 2002 – December 31, 2009

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) Implementation of West Coast Groundfish Trawl Catch Shares Program

The NOAA NMFS Northwest Fisheries Science Center is responsible for at-sea monitoring under the trawl catch share program. In 2010, the observer program, in conjunction with the NOAA Northwest Regional Office, the Pacific Fisheries Management Council, NOAA Office of Law Enforcement, and NOAA General Counsel, completed the necessary regulation to implement the program in 2011.

For more information, please contact Janell Majewski at Janell.Majewski@noaa.gov

e) The rise and fall of Humboldt squid bycatch in the At-Sea Pacific hake fishery

The at-sea Pacific hake fishery is made up of motherships, which receive catch from a fleet of smaller catcher vessels, and large catcher-processors, operating off the Washington and Oregon coasts. The Northwest Fisheries Science Center administers the At-Sea Hake Observer Program which deploys two fisheries observers on each vessel for real-time data collection, including species composition sampling for bycatch data. The surprising appearance in 2004 of Humboldt squid (*Dosidicus gigas*) bycatch in the at-sea hake fishery left scientists and fishers scratching their heads. The appearance coincided with the geographic expansion of Humboldt squid in the last decade, both north and south along the North and South American coast lines. Various authors suggest the expansion is a result of changing ocean conditions coupled with Humboldt squid's ability to quickly exploit niches. From 1991 to 2003, the total bycatch of all squid species within the at-sea hake fishery was low, averaging just 0.03% of the total catch. From 2004 to 2007, squid bycatch increased from the historic average of 0.03% to 0.6%, with overall squid catch for this period averaging about 900 mt year^{-1}. During that same period, bycatch of other species decreased to lower than average values. Beginning in 2006, following the recognition of Humboldt squid as the major component of overall squid bycatch in the at-sea hake fishery, observers were directed to identify Humboldt squid to the species level. In 2008, Humboldt squid bycatch rose to 2,800 mt or 1.5% of the total catch. Humboldt squid bycatch rose again in 2009 when 4,400 mt of bycatch were recorded, representing 5.7% of the total catch in the at-sea hake fishery. This fishery has an historic overall bycatch rate of less than 2%, so this level of bycatch was unprecedented. Then in 2010, squid bycatch declined to just 0.2% of total catch (223 mt). Further investigations into the rise and fall of Humboldt squid bycatch will be presented.

For more information, please contact Vanessa Tuttle at Vanessa.Tuttle@noaa.gov

10. Recent Publications

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NMFS Southwest Fisheries Science Center

Draft Agency Report to the Technical Subcommittee

of the Canada-U.S. Groundfish Committee

May 2011

Edited by Stephen Ralston

With contributions from E.J. Dick, John Field, Alec MacCall,
Donald Pearson, Ole Shelton, 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. Recentlyn Dr. Francisco Werner was appointed to the position of SWFSC Director and the Deputy Director is Kristen Koch. All three SWFSC laboratories have supported the essential needs of the National Marine Fisheries Service (NMFS) and the Pacific Fishery Management Council (PFMC) for groundfish, including as active members of the PFMC's Scientific and Statistical Committee (SSC), the Groundfish Management Team, and other management teams and advisory bodies.

The SWFSC 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 only source of groundfish research at the La Jolla facility. 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 much of the California coast since 1951. Researchers at the La Jolla laboratory 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. Stephen Ralston) 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, salmonid ocean and estuarine ecology, habitat ecology, and the molecular ecology of fishes. Specific objectives of the 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 at 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) providing professional services (many of which fall into the above categories) at all levels, including inter-agency, state, national and international working groups.

The Environmental Research Division (ERD) is led by Acting Director Dr. Steven Bograd and 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. The 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

Genetic research on larval rockfish at the SWFSC

The Ichthyoplankton Ecology (directed by William Watson) and Molecular Ecology (directed by John Hyde) Programs within FRD collaborated to conduct two research projects in 2010 on the early life history of rockfish (*Sebastes* spp.) species in the Southern California Bight. Both projects utilized ethanol-preserved larvae collected during ichthyoplankton surveys within and around the Cowcod Conservation Area (CCA) in February 2002-2005 (Figure 1).

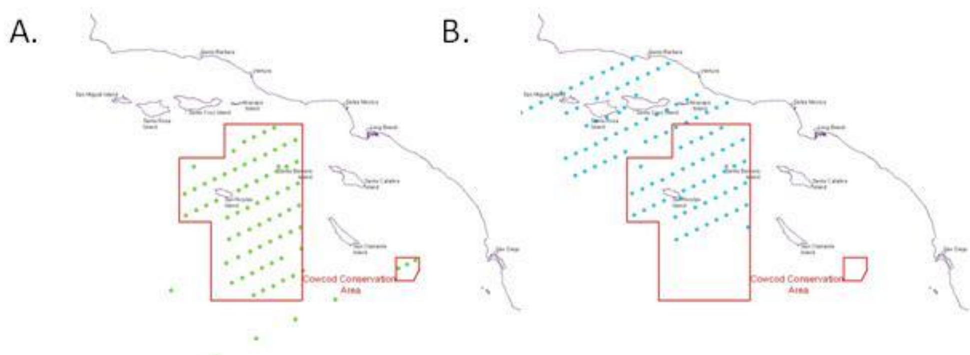

Figure 1. Location of ichthyoplankton sampling stations with and around the Cowcod Conservation Area (delineated by red polygons) in **A.** 2002, 2003, 2004 and **B.** 2005.

The first line of research focused on genetic identification of rockfish larvae. From a morphological perspective, it is possible to identify with certainty the larvae of six rockfish species; the others can be identified only to genus. Elucidation of the identity of members of this species complex is paramount for understanding rockfish population ecology, assemblage dynamics, and taxonomy, and for informing stock assessments. To identify rockfish to the species level, the *cytochrome* b mitochondrial gene was sequenced from individual larvae and matched to a particular species following the techniques of Hyde and Vetter (2007). Preliminary results based on sequences for 796 (of 3466) individuals collected at 36 (of 67) sample stations from the 2002 CCA survey indicate that the *Sebastes* spp. complex contains a minimum of 26 species (Figure 2). Future research will determine spatial patterning of the rockfish species and whether assemblage composition varies among sample years.

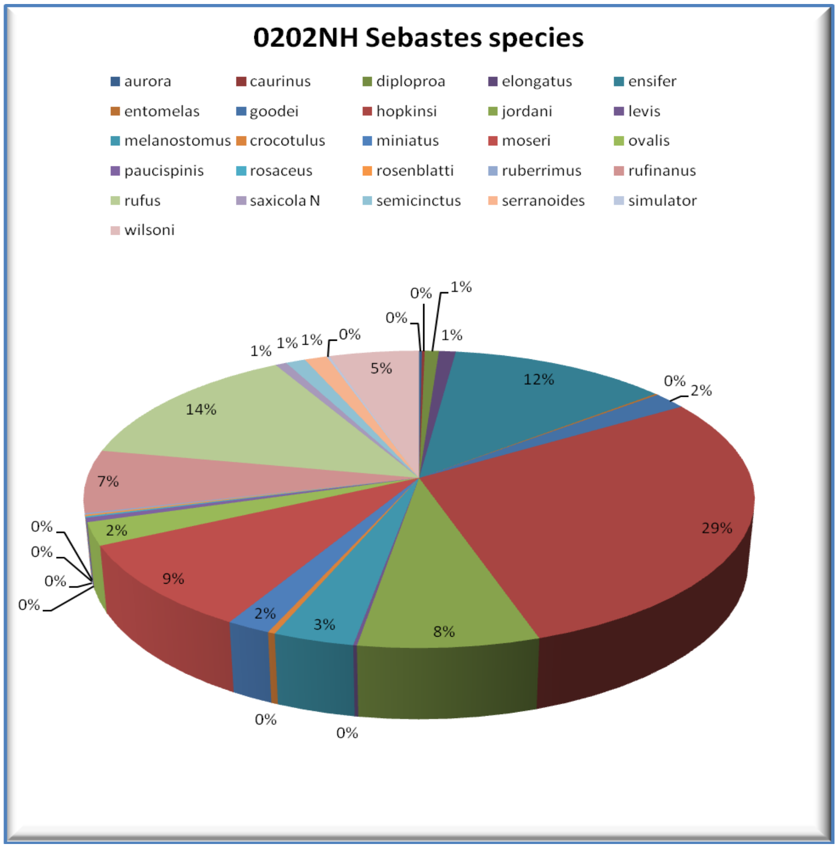

Figure 2. Larval rockfish species composition in the Cowcod Conservation Area, February 2002.

The second part of the rockfish genetic research investigated stock structure of cowcod (*Sebastes levis*). This research was motivated by results of genetic and otolith microchemistry analyses of adult cowcod rockfish suggesting that there are distinct cowcod populations north and south of Point Conception and that there may be genetic separation between inshore and offshore populations within the Southern California Bight (Simon et al. 2010). To investigate population genetic structure of cowcod within the Southern California Bight the mitochondrial control region was sequenced and genetic structure compared between individual cowcod larvae collected inshore and offshore during the 2002 CCA survey relative to the boundary identified by Simon et al. (2010) (Figure 3) . Thirty-three cowcod larvae were collected from 17 sample stations in 2002 and separated *a priori* into inshore (stations 28, 29, 48, 49, and 51) and offshore (stations 5, 13, 14, 16, 17, 31, 42, 43, 54, 64, 72) groups. Results of Analysis of Molecular Variance indicated that there was no genetic difference between the two groups. Future analysis of samples from the CCA (2003-2005) should provide a more robust test of genetic distinctiveness of inshore and offshore cowcod populations if more specimens are found from inshore stations.

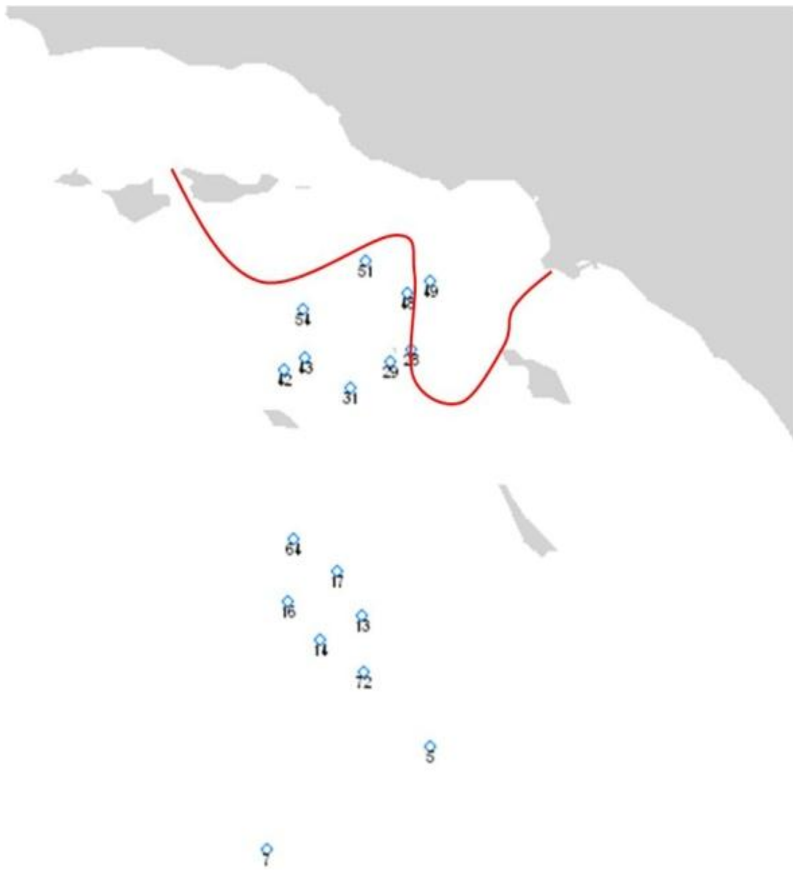

Figure 3. Station locations where at least one cowcod larva was collected during 2002 CCA surveys. Numbers next to stations depict station identity (order occupied). The red line depicts a potential boundary identified by Simon et al. (2010) that may separate inshore and offshore cowcod stocks within the Southern California Bight.

Juvenile Surveys

The FED at the SWFSC completed the 28th year of its annual May-June survey of the distribution and abundance of pelagic juvenile rockfishes aboard the Canadian F/V Frosti. This marked the first time the midwater trawl survey was completed on a contracted private vessel, the result of a budgetary shortfall within NOAA's Office of Marine and Aviation Operations (OMAO). Objectives of the survey include collecting data for use in estimating future recruitment to rockfish and other groundfish stocks, and otherwise monitoring the general state of the physical and biological environment (including krill, other forage fish, and oceanographic conditions).

The SWFSC midwater trawl survey data are usually coupled with comparable data collected by the Northwest Fisheries Science Center (NWFSC) to provide a coastwide view of pelagic juvenile rockfish distribution and abundance. However, because a survey was not conducted by the NWFSC in 2010, coastwide indices of abundance for 2010 could not be developed for use in groundfish stock assessments. Nonetheless, three species that are well-sampled by the SWFSC survey (i.e., *Sebastes hopkinsi*, *S. jordani*, and *S. paucisipinis*) have distributions that are sufficiently far to the south that the absence of information from the northern portion of the survey frame did not hamper year-class estimation. The catch rate of bocaccio (*S. paucispinis*), an overfished species, has been trending upwards since 2006, with 2010 yielding the highest value in the 10-year time series (Figure 4); catch rates of the two other species in 2010 were unremarkable.

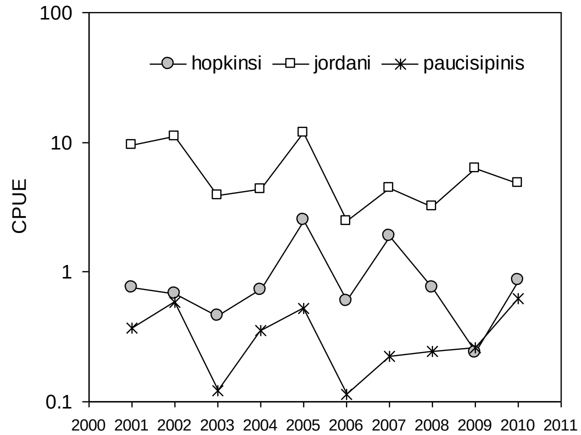

Figure 4. Standardized catch rates of three southerly distributed species taken in the SWFSC pelagic juvenile rockfish midwater trawl survey.

When considering the long term time series of forage species catches within the core area of the SWFSC survey (36°30'–38°20' N lat.), it is evident that two basic species assemblages occur within the central California region during May-June. Specifically, a principal components analysis of 15 well-sampled taxa reveals that an assemblage consisting of young-of-the-year (YOY) groundfish, market squid, YOY octopus, sergestid shrimp, California smoothtongue, and krill is inversely related to an assemblage that is composed of deep-scattering layer species and clupeoids (Figure 5). This fundamental dichotomy in forage availability accounted for 37% of the total variation in abundance of the 15 taxa considered. Broadly speaking it represents an assemblage dominated by cooler water shelf species versus warmer water oceanic species.

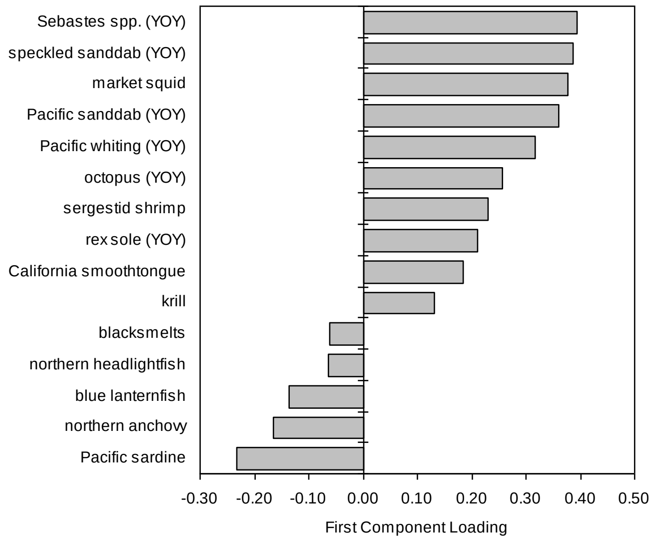

Figure 5. Loadings of 15 different taxa on the first principal component derived from an analysis of co-variation of SWFSC midwater trawl catches of forage species over the period 1990-2010.

It is illuminating to examine interannual variation in the availability of these two assemblages to the SWFSC survey by plotting the first principal component score over the last 21 years (Figure 6). The figure shows strong negative first component scores for 2005 and 2006, representing increased relative abundances of mesopelagics and clupeoids in those years. Since then, however, midwater trawl catches have been shifting back to the shelf-associated YOY groundfish assemblage. The survey catch composition in 2010 showed an increased abundance of krill, market squid, and YOY rockfish.

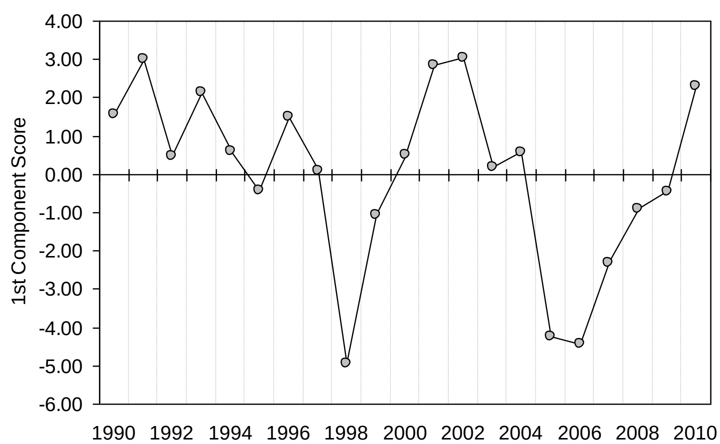

Figure 6. Time plot of the first principal component score obtained from an analysis of fifteen different forage species sampled by the SWFSC midwater trawl survey in the central California region. Positive values indicate that survey catches were largely comprised of YOY groundfish and other shelf-associated taxa (positive loadings in Figure 5); negative values are due to increased catches of mesopelagics and clupeoids.

Comparison of Pre-Recruit Indices

A publication by SWFSC scientists evaluated the efficacy of forecasting impending year class strength of bocaccio in order to better evaluate likely catches in recreational and commercial fisheries and to monitor rebuilding success (Field et al. 2010b). Accurate indices of the strength of incoming year classes both improve stock assessment estimates of future (near term) abundance trends, as well as aid regulators in making management decisions during those infrequent periods of high abundance of young fish. The study evaluated four datasets that provide estimates of impending year class strength in the southern and central California region (impingement data from power plant cooling systems, juvenile trawl survey, delta submersible survey, and recreational pier fishery catches), and evaluated their relative performance in the early detection of strong year classes. All surveys had predictive power for this highly variable populatio, although the study also found that because the fish recruit to the fishery at such a small size and age, pre-recruit indices provided only a relatively small (1-2 year) lead time with respect to informing managers of likely changes in productivity and consequent encounter and catch rates.

Harvest Impacts on Seabirds

Scientists from the FED published a manuscript linking the abundance and productivity of YOY rockfish to seabird breeding success (Field et al. 2010a), based on abundance time series from the FED juvenile rockfish survey and a comparable time series of seabird breeding success from the Farallon Islands (collected by PRBO Conservation Science). As juvenile rockfish are important prey to seabirds in the California Current, Field et al. quantified relationships between observed juvenile rockfish relative abundance and seabird productivity, used fisheries stock assessment approaches to estimate the relative abundance of juvenile rockfish in the absence of fishing, and compared the differences in seabird productivity that would have resulted without rockfish fisheries. Basic results showed that while the relative abundance of juvenile rockfish has declined to approximately 50% of the estimated unfished biomass, seabirds achieved 75% to 95% of the estimated un-impacted levels of productivity, depending upon the species of bird and various model assumptions.

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 Commission (PSMFC) and the California Department of Fish and Game (CDFG) to coordinate port sampling efforts and to maintain the California Commercial (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 landings estimation, the FED has 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. This yea,r E.J.

Dick resigned his seat on the Council's GMT and he was replaced by Rosemary Kosaka, an economist with the FED in Santa Cruz.

Model-Based Estimation of California Groundfish Landings

Estimation of species-specific landed catch can be challenging, particularly for mixed-species fisheries with limited sampling effort. Understanding uncertainty in those estimates is also critical to numerous management-related processes, e.g. stock assessment, specification of harvest levels, and catch monitoring. A framework for estimating landings and associated uncertainty was developed by Ole Shelton (University of California, Santa Cruz) and SWFSC staff (Shelton *et al*., In review). Bayesian hierarchical models for species compositions were developed and tested using data from California's commercial sampling programs. Combined with estimates of total landed weight by stratum, the models produce posterior distributions of species-specific landings for observed and unobserved strata.

Current Assessments

This is an "on" year for the Council's biennial stock-assessment cycle and FED scientists are engaged in five stock assessments, including full stock assessments of widow rockfish (Xi He), blackgill rockfish (John Field), and greenspotted rockfish (E.J. Dick). In addition, Field and Dick are completing updated assessments of bocaccio and cowcod, respectively, both of which are overfished stocks that are under rebuilding plans.

FED scientists have also been actively working on developing methods of assessing data-poor stocks and presented their findings to a Stock Assessment Review Panel in April. Included in the review were: depletion-corrected average catch (DCAC), depletion-based stock reduction analysis (DB-SRA), extended DB-SRA, and stock assessment based on fitting length-compositions only. The PFMC had adopted overfishing limits, acceptable biological catches (ABCs), and annual catch limits for ~50 groundfish stocks in 2010 that were based on the DB-SRA and, to a lesser extent, DCAC methodologies. The review was intended to provide a comprehensive evaluation of these two approaches using both simulated data and paired comparisons with results from data-rich stock assessments. In addition, enhancements to DB-SRA, including fitting CPUE time series developed by E.J. Dick and Alec MacCall, were evaluated by the review panel. Assessments using an extended DB-SRA approach have the potential to raise the tier level of stocks to data-moderate. Status determinations of data moderate stocks are considered more certain than those of data-poor stocks, which under the Council's current ABC control rule will allow an increase in ABC due to a reduction in scientific uncertainty. Extended DB-SRA is now a Bayesian approach, with DB-SRA providing a prior distribution. The abundance indexes provide an ability to update the prior distribution of final depletion. The new approach has been applied to several stocks for which data-rich assessments exist as a "ground truth" with good success.

California Cooperative Groundfish Survey

The FED has participated in the commercial groundfish market sampling program since 1978. The CalCOM database, website, and most programs used to process data were created and maintained by our staff in close cooperation with Brenda Erwin (PSMFC, Belmont, CA). This year, we are beginning the first major overhaul of the system since 1997. These changes will improve website access to the data, improve error checking, have better documentation, and will include significant improvements to the programs used to process the data. We hope to complete the work by the end of 2012.

Observer Effects on Commercial Landing Estimates

In cooperation with the NWFSC, a study is underway to determine whether the presence of an observer on board commercial fishing vessels has an effect on the composition of commercial market samples. If an effect exists, it could adversely impact estimates of commercial landings that rely on the market samples. In addition, age and length compositions from the fishery could be affected. A draft of a manuscript is in preparation should be ready for review by early May. At this time, we have found that the presence of an observer onboard does not appear to affect market samples. We have determined that cooperation between the observer and port sampling programs could be improved, which we will work to achieve in the upcoming year.

C. BY SPECIES, BY AGENCY

3. Shelf Rockfish

i. Research

ii. Assessments

Groundfish Aging

Four species of rockfish were aged by Don Pearson and Lyndsey Lefebvre in support of upcoming stock assessments and other research activities (Table 1). Widow rockfish were obtained from the commercial fishery, with most samples from bycatch in the Pacific whiting fishery. Although the PSMFC has primary responsibility for aging chilipepper rockfish, samples from research and commercial samples were cross-aged by Don Pearson. Greenspotted rockfish from research and recreational samples were aged to support the upcoming assessment. To support the upcoming blackgill assessment, we developed age criteria for this species and aged approximately 3,000 fish. Due to the difficulty of aging this this long-lived rockfish, each fish was aged twice independently and then the ages were resolved. Approximately 10% of all fish from all species were aged a second time to allow development of aging error matrices.

Table 1. Number of fish aged at Santa Cruz Laboratory

SPECIES	NUMBER AGED	NUMBER REAGED
Greenspotted Rockfish	2,900	300
Widow Rockfish	3,100	200
Chilipepper	3,800	400
Blackgill Rockfish	3,100	300

4. Slope Rockfish

ii. Assessments

Work on the blackgill rockfish is underway for the 2011 stock assessment and review. To support the upcoming blackgill assessment, we developed age criteria for blackgill rockfish and aged approximately 3,000 fish (included in Table 1 above). Due to the difficulty of aging this species, each fish was aged twice independently and then the ages were resolved. Approximately 10% of all fish from all species were aged a second time to allow development of age error matrices. Studies of maturity (including histological examinations) and fecundity are also ongoing to improve the available life history and reproductive information regarding this species. Preliminary fecundity studies suggest that blackgill have a strong increase in relative fecundity with size. Histological studies are likely to be important for this species due to the late age at maturity, and some suggestion of reabsorbtion of early stage ovaries at smaller sizes (younger ages). The catch reconstruction effort has also led to changes in the perception of the catch history for this species, which may also influence the next assessment. The review panel for this assessment will take place in August, 2011.

D. OTHER RELATED STUDIES

3. SWFSC Current Habitat Activities

SWFSC FED Habitat Ecology Team conducts research in response to the mandates of the Magnuson-Stevens Reauthorization Act of 2006, with a focus on deep-water California demersal communities. Our goal is to provide sound scientific information to ensure the sustainability of marine fisheries and the effective management of marine ecosystems, with objectives to: (1) improve stock assessments, especially of overfished rockfish species in complex habitats; (2) characterize fish and habitat associations to improve essential fish habitat (EFH) identification; (3) contribute to marine protected area (MPA) design & monitoring and to marine spatial planning; and (4) understand the significance of deep-sea coral habitats.

We use a variety of survey tools and approaches to improve our assessments of demersal fishes, macro-invertebrates (including members of deep-water coral communities), and associated seafloor habitats in water depths from 20 to 900 meters off central and southern California. Habitat-specific distribution and densities of juvenile and adult life stages of numerous Pacific Coast demersal species have been determined from non-extractive, visual surveys conducted with remotely operated vehicles (ROV), manned submersibles, scuba, laser line scan, and towed cameras, coupled with seafloor maps of the continental shelf and upper slope off California. These surveys have resulted in habitat-specific assemblage analyses on multiple spatial scales; fishery-independent stock assessments; baseline monitoring of MPAs; documentation of marine debris on the seafloor; and are being used in the California-NOAA-USGS Seafloor Mapping Program.

The FED Habitat Ecology Team recently co-convened a workshop *Comparative Assessment of Visual Survey Tools for Seafloor Communities*, held at Monterey Bay Aquarium Research Institute in Moss Landing, California 22-23 February 2011. The workshop was attended by 47 marine scientists and engineers from academic, government, and private groups in the U.S., Canada, and Australia, including representatives from all NMFS' Science Centers and Office of Science and Technology. Discussions focused on five types of underwater visual survey tools (AUVs, ROVs, manned subs, towed cameras, and scuba), and the capabilities, limitations, and tradeoffs in using these tools to conduct quantitative surveys. A workshop proceedings is being produced.

This September, we will be conducting comparative field studies of three underwater survey tools, specifically to evaluate the accuracy and precision of estimated densities and biomass of groundfish species in rocky areas and associated ecosystem information. Survey tools for this comparison include the Seabed AUV (NMFS NWFSC and PIFSC), Nuytco's Dual Deepworker submersible (SWFSC FED), and the Cooperative Optical Acoustic Survey Technique (COAST) (ROV and EK60 ecosounder; SWFSC FRD). In order to develop long-term surveys of those West Coast groundfish species that occur in untrawlable habitats (such as cowcod and yelloweye rockfishes), the performance, capability, and efficiency of these technologies must be assessed.

Using Habitat Information to Improve Stock Assessments

From our quantitative visual surveys, the FED Habitat Ecology team has developed an extensive database of habitat-specific fish abundance for over 100 species of demersal fishes off CA. Using this database, we are beginning to develop statistical models that predict densities of individual demersal fish species and multi-species fish assemblages over broad spatial scales. These models will be based on a number of associated habitat variables (e.g., depth, substratum type, patch size and configuration) and the densities of co-occurring fish species. These models will then be coupled with broad-scale seafloor habitat maps that are being developed for Calfornia.

The FED Habitat Ecology team also is using this database to evaluate the performance of two underwater survey vehicles (the *Delta* submersible and Phantom DS4 ROV). We compared habitat-specific densities estimated from the survey cameras of both vehicles and determined changes in fish behavior as potential reaction to the survey tools (Laidig et al. In Review). Similar species were seen in the visual surveys using each vehicle, but identification of species was more difficult using the ROV than using the submersible. Although fishes reacted to both vehicles, more fishes reacted to the ROV (51%) than to the submersible (18%). In general, fishes that occur higher off the bottom had a greater reaction to either vehicle than those fishes on the seafloor. Understanding survey biases, such as the ability to detect and identify various species and the behavioral response of the fishes to each vehicle, will result in improved survey design and interpretation, more accurate abundance estimates, and can help in selection of appropriate survey tools for specific species.

Predicting Distribution of Benthic Macro-invertebrates

As part of the California Seafloor Mapping Project (CSMP), the FED Habitat Ecology team has been collaborating with USGS and others to create a suite of maps detailing seafloor morphology and geology, and characterizing potential benthic habitats derived from high-resolution multibeam sonar data. We are using a towed camera sled to groundtruth these data and to survey biological components of the habitats. From presence/absence of macro-invertebrates associated with specific sediment types, depth, and latitude, we have developed multivariate models using logistic regression to predict the distribution of various species. Coupling these results with spatial information on bottom type and depth, we have created maps of probability of occurrence of these important components of seafloor communities (Krigsman et al. In Review). These maps will provide managers, policy makers, and the public with information that can be used in the conservation and management of sustainable marine resources.

NMFS' Marine Fisheries Habitat Assessment Improvement Plan (HAIP)

The FED Habitat Ecology Team led a group of NMFS scientists in development of the first nationally coordinated plan to focus on marine fisheries habitat science. There are ever-increasing demands being placed on marine habitats across many sectors of the U.S. economy, but the role of marine habitats in supporting fishery production and in providing other critical ecosystem services is poorly understood. Although habitat information is needed in almost every NMFS program, habitat science has received relatively little programmatic support compared to other disciplines. The recently published Habitat Assessment Improvement Plan (HAIP; NMFS, 2010; available at http://swfsc.noaa.gov/HabitatEcology) outlines current gaps in NMFS habitat science, steps to improve habitat assessments, and the need for an integrated, fully supported, national habitat science program. The HAIP will help NMFS meet mandated responsibilities to sustain marine fisheries and associated habitats, and will contribute to President Obama's new ocean policy. NMFS and all of its partners will benefit from and contribute to the success of the HAIP.

Deep-Sea Coral Communities and Fisheries Habitats off California

The FED Habitat Ecology Team has developed a research program to assess deep-sea coral communities associated with fisheries habitats off California. From preliminary observations, these areas are home to diverse and abundant assemblages of black corals, sea fans, *Lophelia*, and sponges in a myriad of types, colors, and sizes. Underwater surveys of corals, sponges, and associated habitats and fishes are being conducted on rocky banks in 20-900 m water depth using direct observations from a ROV, a manned submersible, and an autonomous underwater vehicle (AUV). Such data also are being retrieved from archived video of past visual surveys, all of which will contribute to a comprehensive deep-sea coral database. In addition, our Deepsea Coral and Sponge Image Database from our 2010 cruises off Southern California is available at http://swfsc.noaa.gov. This research will assist in (1) understanding those factors that influence settlement and distribution of corals in the deep sea; (2) informing the Pacific Council's management of Essential Fish Habitat; (3) addressing petitions for conservation; and (4) NOAA's Coastal and Marine Spatial Planning processes. This is a collaborative effort among investigators from NOAA's National Marine Fisheries (SWFSC and NWFSC), University of

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GROUNDFISH PUBLICATIONS OF THE SWFSC, 2008 – PRESENT

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STATE OF ALASKA
GROUNDFISH FISHERIES

ASSOCIATED INVESTIGATIONS IN 2010

Prepared for the Fifty-first Annual Meeting of the Technical Subcommittee of the Canada-United States Groundfish Committee

With new contributions from:
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April 2011

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 2010

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 GOA FMP. In 2007 the dark rockfish was removed from both the GOA and the Bering Sea and Aleutian Islands (BSAI) FMP. Thus in these areas the state manages these species in both state and federal waters. 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, and one full-time fisheries technician located there. One full-time biologist, one full-time fisheries technician and one full time research analyst for this project are based in Douglas. Seasonal technicians and port samplers are employed in Petersburg, Ketchikan and Sitka. The project also receives 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 (NPFMC). In 2010, the project leader also served as member of the NPFMC Plan Team halibut bycatch working group. The goals of the working group are to determine a best method for extrapolating the catch of bycatch on the IPHC survey to the halibut fishery as a way to comply with Annual Catch Limit (ACL) requirements.

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 logbook collection and data entry. Four resource assessment surveys were conducted during 2010. The Southeast Groundfish project is funded in part with NOAA Grant NA08NMF4070534.

b. Central Region

Central Region groundfish staff is headquartered in Homer and is comprised of a regional groundfish management biologist, a regional groundfish/shellfish research project leader, a groundfish sampling coordinator, a groundfish fish ticket entry position, three marine research biologists, five to six seasonal technicians, and one seasonal commercial catch sampler. An assistant 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 research 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, Pacific cod, pollock, lingcod, rockfishes, skates, sharks, and flatfishes. Data are collected through commercial catch sampling, fishermen interviews, logbooks, onboard observing, and through ADF&G trawl 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 area management biologist, an 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. 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 Portland, Oregon. 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 (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 are 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 are routinely reviewed for accuracy with corrections applied as required. Within the confines of confidentiality agreements, raw data are 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 personnel 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.

Groundfish fishery milestones for this ongoing ADF&G AKFIN program are primarily the annual production of catch records and biological samples. In calendar year 2010, ADF&G AKFIN staff processed 23,961 groundfish fish tickets, collected 32,925 groundfish biological samples and measured 15,747 age structures (see tables below for regional breakdown). These basic measures of ongoing production in support of groundfish marine fisheries management by AKFIN funded ADF&G staff are representative of the level of annual productivity by the AKFIN program since its inception in 1997. (Contact: Lee Hulbert)

Groundfish Fish Tickets Processed -Calendar Year 2010

ADF&G Region	
1 - Southeast	4,036
2 - Central	2,907
4 – Westward; Kodiak, AK Pen.	15,573
Westward; BSAI	1,445
Total	23,961

Groundfish Biological Data Collection - Calendar Year 2010

ADF&G Region	AWL Samples Collected	Age Structures Measured
1 - Southeast	9,362	7,508
2 - Central	8,751	2,425
4 - Westward	14,812	5,814
Total	32,925	15,747

Intergency Electronic Reporting 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 are 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 began development of a consolidated landing, production, and IFQ reporting from a sole source – the Interagency Electronic Reporting System (IERS). The web-based reporting component of this system is ***eLanding.*** The desktop application for the at-sea catcher processor fleet is ***seaLandings***. Vessels using the seaLandings application email landing and production reports to the centralized database as an email attachment. ***tLandings*** was developed to address electronic reporting on-board salmon tender vessels. The application and the landings reports are stored on a thumb drive and delivered to the shoreside processor for upload to the eLandings database. Fisheries management agencies use a separate application, the ***IERS Agency Interface***, to view and edit landing reports. The IERS management/development team have developed and are expanding an ***eLogbook***, for groundfish catcher processors and crab catcher vessels. Initial deployment of the eLogbook occurred in 2010.

The IERS has been in successful operation in the groundfish and IFQ halibut/sablefish fisheries since July 2006.

Our approach, throughout this project has been staged implementation, which allows a small staff to successfully manage this ambitious project. We expect the IERS will be fully implemented with the salmon fishery by the end of the 2012 season. Statewide shellfish and herring fisheries will be addressed in 2013.

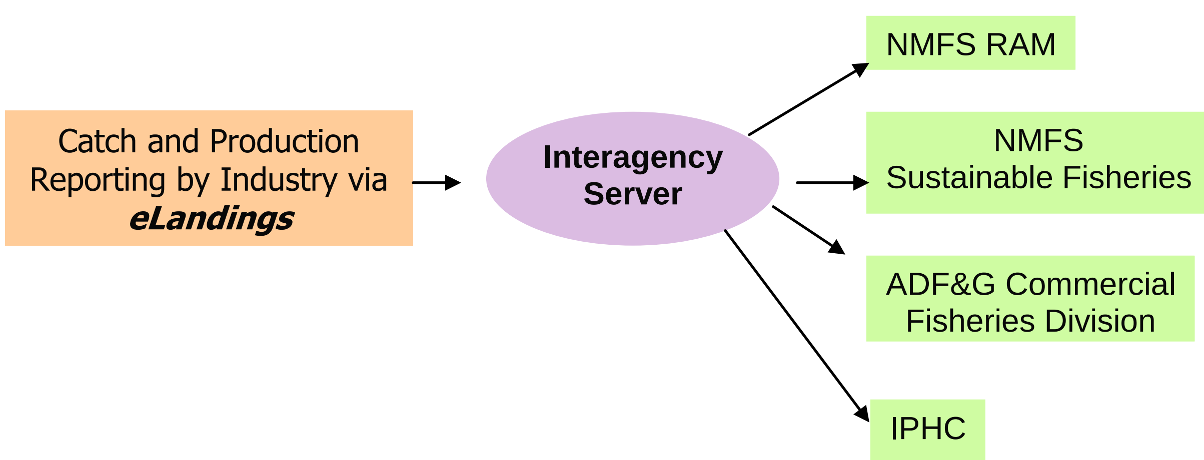
The ADF&G is currently in the next implement of the system with salmon fisheries and hope to have the system in use for these fisheries by 2013.

Alaska Department of Fish and Game personnel, funded by AKFIN, Rationalized Crab Cost Recovery funds and IFQ Halibut/Sablefish Cost Recovery funds, 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 ADFG does not expect to require the IERS for any state managed fisheries in the immediate future.

During 2010, the IERS recorded more than 29,250 landing reports in crab, groundfish and salmon fisheries.

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 application. 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.

The IERS is extensively documented on a public and secure wiki at https://elandings.alaska.gov/confluence/

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 , seaLandings, and tLandings applications, with immediate data validation and business rules, has improved data quality and allows personnel to function at a higher level. User support on a 24/7 basis 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, currently hosted by the State of Alaska, validated and reviewed, and pulled to the individual agency databases. Landing data are 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 are distributed to the State of Alaska Commercial Fisheries Entry Commission (CFEC) 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 are 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 2010. Age structures from 10,056 groundfish representing 9 species were received from statewide commercial and survey harvest sampling efforts. A total of 9,203 age data were released back to managers, which included data from samples received in previous years. Over 2,541 additional age data were produced through precision testing. A total of 16,279 otoliths (representing 8,198 specimens) were measured. The majority (>70%) of funding for this project is through the Alaska Fisheries Information Network, and the remaining is from State funding. Five people were employed in 2010 for approximately 38 work months to age groundfish and invertebrate age structures or conduct associated work, for example, sample preparation, data entry, archiving, otolith measurements, and project work. One new full-time position was filled in October 2010, bringing the number of full-time employees to three. Two additional positions are seasonal, one of which was being hired in December 2010.

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 to further guide release of age data; transgression of control limits direct reviewing of some or the entire sample.

In 2010, the ADU was in production status for all species received except for gadids from commercial fisheries. 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.

Project work on the ADU's radiocarbon studies for the purpose of validating age is now in the writing stages, although on hold due to other high priority work.

The ADU project culturing walleye pollock to measure otolith weight at age, continues. These fish reached age-4 in 2010, and have been under tank culture at the NMFS Auke Bay Marine Station, Juneau Alaska since their capture in 2006 at age-0. This project reaches maturity in 2011 and it will conclude in 2012.

In 2010, ADU staff also tagged and released 115 wild pollock in Auke Bay, for a three year total of 2,415 tagged pollock. The longest distance for a recovery (of a tag which did not include the fish) was approximately 20 miles (north of Benjamin Island in Lynn Canal), and the longest time between tagging and recovery was approximately one year. Pollock and other fish tagging updates are available at http://tagotoweb.adfg.state.ak.us/ADU/Tagged.aspx.

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. We completed development of an online age structure invoicing system, *OASIS*, which was deployed late 2010. All samples sent to the ADU are first invoiced online, which provide for standardization of sample information prior to receipt of the sample. (Contact Kristen Munk)

2. Description of the State of Alaska recreational groundfish fishery program (Sport Fish Division)

ADF&G manages 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. No recreational fisheries are included in the Gulf of Alaska Fishery Management Plan.

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, rockfishes (all species combined), lingcod, Pacific cod, and sharks (all species combined), and a mandatory logbook to assess harvest of selected species in the charter boat fishery. 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 state general funds and the Federal Aid in Sport Fish Restoration Act. 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, with assistant project biologists located in Ketchikan (Kathleen Wendt) and Juneau (Vacant). The project biometrician (Sarah Power) and Research Analyst (Diana Tersteeg) are 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, lengths of harvested rockfish 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.

The Regional Management Coordinator and Area Management Biologists in Yakutat, Haines, Sitka, Juneau, Petersburg, Craig, 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.

b. Southcentral Region Sport Fish

The **Southcentral Region** groundfish staff consisted of two Regional Management Biologists as well as Area Management Biologists and assistants for the following areas: (1) PWS and the North Gulf areas, (2) Lower Cook Inlet, and (3) Kodiak, Alaska Peninsula, and the Aleutian Islands. In addition, a region-wide harvest assessment project was based in the Homer office, consisting of a project leader, project assistant, and six technicians. The research project biometrician was located in Anchorage. Ongoing assessment of sport harvest and fishery characteristics at major ports throughout the region is the primary activity. Data 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 hindered 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 are hoped to provide for sustained yield over the long term. Lack of stock assessment information coupled with increasing effort and harvest in several groundfish sport fisheries accentuate the need for a comprehensive management plan and 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, providing information to the Alaska Board of Fisheries, advisory committees, and local fishing groups, 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, Western, and Eastern Gulf of Alaska. Approximately 972 fish were tagged in 2010, bringing the total number of tags released to 17,409. By year's end, 20 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 2010.

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 internal waters of Southeast Alaska are comprised of two areas, the Northern Southeast Inside Area (NSEI) and the Southern Southeast Inside Area (SSEI).The GHR was based on average historic harvest levels rather than on a biomass-based ABC estimate. This fishery is most intense in the winter months, in season management actions are small area closures intended to spread out the fleet and reduce the risk of localized depletions. 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 five 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. However, in 2009 a new BOF regulation became effective permitting use of longline gear in PWS. This change was largely in response to the very low levels of effort and harvest and the high level of interest from the longline gear group. With the exception of longline gear in PWS, guideline harvest levels (GHL) are allocated by gear type. The annual GHLs are based on the estimate of acceptable 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 to15% and then 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 plan were season, gear and harvest specifications. The fishery GHL was set by regulation at three percent based on the estimate of acceptable 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. In 2009, vessels participating in the B season were restricted to under 60’ overall length for all legal gear types. In 2010, this regulation was once again changed to allow pot vessels 125’ or less to participate in the B season beginning August 1. Prior to August 1, during the B season, all vessels must still be less than 60’.

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 NSEI area during the winter months. Pots have been the dominant gear in **Cook Inlet** and longline gear the dominant gear in recent **Prince William Sound** fisheries. 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 2010, less than 14% 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 2010 totaled 395 mt. In 2009, 279 mt was landed.

The 2010 GHLs for the state-managed Pacific cod seasons in the Cook Inlet and Prince William Sound Areas of the **Central** Region were 1,839 mt and 356 mt, respectively. Harvest from the Cook Inlet Area state-managed Pacific cod fishery totaled 1,417 mt while the Prince William Sound Area harvest totaled 374 mt. In 2011 Cook Inlet will receive its maximum allocation of 3.75% of the CGOA ABC and the PWS allocation will increase from 15% to 25% of the EGOA ABC. 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 2010 recreational harvest of Pacific cod are not yet available from the statewide harvest survey, but the 2009 estimates were 11,527 fish in **Southeast** and 24,763 fish in **Southcentral Alaska**. The average estimated annual harvest for the most recent five-year period (2005-2009) was 10,506 fish in **Southeast** Alaska and 14,517 fish in **Southcentral** Alaska. There are no estimates of average weight in the sport harvest in either region.

2. Rockfishes

Commercial rockfish fisheries 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* species, except *Sebastolobus*, which are defined separately.

a. Research

In the **Southeast Region,** port sampling effort for rockfish expanded in 2008 to include the sampling of DSR caught as bycatch in the IFQ halibut fishery. 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 2010, the directed fishery for demersal shelf rockfish (DSR) opened in the Southern Southeast Outside (SSEO) area of the Southeast Outside District (SEO). Length, weight and age structures were collected from 490 yelloweye rockfish caught in the directed fishery. The remaining areas of SEO, the East Yakutat Section (EYKT), Central Southeast Outside (CSEO) and Northern Southeast Outside (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 no biological samples of yelloweye rockfish were collected from the internal waters fishery. Over 974 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 2238 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 1118 km^2 of rocky habitat has been mapped, approximately 37% of what is estimated to occur. The most recent collections of data were from Cape Felix in SSEO in August 2010. 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. The geologic interpretations for the Cape Felix area are underway at Moss Landing Marine Labs, and we expect these analyses to be completed by the summer of 2011. (Contact Kristen Green). Work is also in progress on an age-structured assessment model for yelloweye rockfish. (Contact Dave Carlile).

Skipper interviews and port sampling of commercial rockfish deliveries in **Central Region** during 2010 occurred in Homer, Seward, Whittier, Anchorage and Cordova. Efforts throughout the year were directed at the sampling of rockfish delivered as bycatch to other groundfish and halibut fisheries, primarily slope and demersal shelf species. The directed jig fishery that targets pelagic rockfish begins July 1 and historically had been the focus of rockfish sampling during the last half of the year. However, very limited fishing effort had drastically reduced sampling opportunities from 2006 to 2009 until an increase in effort in 2010 resulted in additional sampling opportunity. In 2010, harvest of pelagic shelf rockfish was three times the previous four-year average, although catch was still less than half that in 2005. 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 shelf 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 Elisa Russ).

Development continued on marine habitat GIS in **Central Region**. Additional NOAA multibeam bathymetry and backscatter data were collected. Bathymetry data were gridded and incorporated and further analysis of backscatter data are planned. Margaret Spahn, ADF&G Homer, is responsible for this project. Multibeam and side scan sonar projects continue to be one of the major focal areas of the Central Region commercial fisheries research program. Multibeam bathymetry data were collected from the vicinity of the Chugach Islands in August 2010; data processing is currently underway. (Contact Margaret Spahn or Dr. Ken Goldman).

Central Region conducts ROV surveys along the north Gulf of Alaska coast from the Kenai Peninsula to Prince William Sound to monitor the local abundance of lingcod and DSR in selected index sites. These sites are on the order of 100's of sq km and tend to be relatively isolated rocky banks boarded by land masses, deep fjords, and / or expanses of deeper soft substrates. In 2009, a Resurrection Bay lingcod ROV survey was conducted to estimate the abundance of legal size lingcod within the bay. Analysis of these data was completed in 2010 and estimates of abundance for yelloweye and quillback rockfish were made in addition to lingcod. The estimated abundance of yelloweye rockfish was 93,912 (95% CI 63,670 – 128,632) and quillback rockfish was 290,185 (95% CI 213,933 – 376,869). Laser measurements were made to estimate fish length and these lengths will be used with a length weight relationship to estimate biomass. These analyses have not been completed, however.

The rocky bank surrounding and extending to the south of outer Pye Island was mapped with multibeam during a department survey in 2008. The seafloor habitats within the survey area were delineated and an ROV survey to estimate DSR and lingcod abundance and biomass was conducted there in May 2010. No analyses or population estimates have been completed since video reviews were only just completed. (Contact Mike Byerly or Dr. Ken Goldman).

The **Westward Region** continued its port sampling of the commercial rockfish and Pacific cod harvests in 2010. 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 Mejjati).

Staff from the Kodiak office has completed aging black rockfish otoliths through the 2010 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 ended in 2010 and is currently being analyzed. Daily and seasonal movement data were collected from 85 black rockfish and 55 dark rockfish tags that were released off the east side of Spruce Island, just north of the port of Kodiak. In addition, hydroacoustic surveys of black and dark rockfish were conducted in 2010 in the Westside District of the Kodiak Management Area and the Chignik Management Area in an effort to generate biomass estimates for both black and dark rockfish. Surveys are planned for the South Alaska Peninsula Area and several districts in the Kodiak Area in 2011 (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 5,380 rockfish were sampled at Ketchikan, Craig, Klawock, Wrangell, Petersburg, Juneau, Sitka, Gustavus, Elfin Cove, and Yakutat in 2010 (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 4,169 rockfish were sampled from the sport harvests at Seward, Valdez, Whittier, Kodiak, and Homer in 2010 (Contact Barbi Failor).

The Division of Sport Fish completed a three year research project that investigated the effectiveness of deepwater release at improving the discard survival of yelloweye rockfish. This project used mark-recapture to generate a maximum likelihood estimate of the 17-day survival probability of yelloweye rockfish (n = 182) caught by hook-and-line (depth range = 18 – 72 m) and subsequently released at depth. In a separate study, yelloweye were captured with hook-and-line (n=95) and released at the water's surface for observation of submergence success. The submergence probability of yelloweye rockfish was then used as the conceptual upper bound of survival of individuals released at the water's surface. The average Cormack-Jolly-Seber survival probability for yelloweye released at depth was remarkably high (0.988, 95% CI = 0.426 – 0.999) and positively correlated with individual total length. Survival probability was not significantly influenced by capture depth or exposure to barotrauma and other capture stressors. Submergence success of yelloweye rockfish released at the water's surface was 0.221 (95% CI = 0.149 – 0.315) and suggests that the maximum survival potential of individuals released at the surface is low. The results of this study indicate that the average survival of discarded yelloweye rockfish can be substantially improved with the use of deepwater release (Contact Sam Hochhalter).

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. The most recent yelloweye rockfish density survey was conducted in EYKT in 2009. Yelloweye rockfish density for the current stock assessment is based on the latest best estimate by management area. The CSEO and SSEO areas were last surveyed in 2007 and 2005 respectively, NSEO was surveyed in 2001. Density estimates by area range from 1,068 to 2,196 adult yelloweye per km^2. A submersible research cruise is planned for summer 2012, when we plan to conduct surveys for yelloweye rockfish density in SSEO.

No rockfish stock assessments were conducted in the **Central Region** in 2010. Population estimates from ROV surveys have not yet been used to set harvest limits or incorporated into a stock assessment.

In the **Southeast Region,** no black rockfish surveys were conducted in 2010.

In the **Westward Region,** hydroacoustic equipment was deployed in a preliminary effort at stock assessment of black and dark rockfish. Surveyed areas included the Westside District of the Kodiak Management Area and the Chignik Management Area (contact Carrie Worton).

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 commercial 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 Fisheries meeting in early 2006, the season for the directed fishery of DSR in SEO was changed to occur in the winter only from January 5th 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 (TAC) for DSR was allocated 84% to the commercial sector and 16% to the sport sector. At the 2009 Board of Fisheries meeting, it was decided that the anticipated harvest of DSR in the subsistence fisheries would be deducted from the TAC before the split in allocation is made between commercial and sport fisheries. This change was adopted for the first time in the 2010 fishery.

The 2010 TAC for DSR in SEO was 295 mt, which resulted in an allocation of 241 mt to commercial fisheries and 46 mt to sport fisheries (after a deduction of 8 mt for the subsistence fishery). A significant portion of the total commercial harvest is taken as bycatch mortality during the halibut fishery. We continue to use the method for bycatch determination we developed in 2006 to which recognizes the significance of depth as a component of the bycatch rate. Full retention of DSR has been in regulation in state waters since 2002 and in Federal water since 2005.

The commercial fishery for DSR in SEO opened in SSEO in 2010 with a 30 mt quota. Sport fishery 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 preliminary estimate of total sport fishery removals for 2010 was 36 mt (SE = 2 mt). (Contact Kristen Green).

Management of the commercial black rockfish fishery 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 SSEOC, totaling 147 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 1.1 mt landed in directed and bycatch fisheries combined in 2010.

Shortspine thornyhead, shortraker rockfish, rougheye rockfish and redbanded rockfish may be taken as bycatch only (no directed fishing). A total of 98 mt of slope rockfish were landed in NSEI and SSEI during 2010, similar to the 2009 landing of 97 mt.

Rockfish in **Central Region's** Cook Inlet and PWS Areas are managed under their respective regulatory Rockfish Management Plans. Plan elements include a fishery GHL of 68 mt for each area and 5-day trip limits of approximately 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 2010, 47 mt of black rockfish were harvested from five sections in the Kodiak Area. Guideline harvest levels were attained in three sections. In the Chignik Management Area, 21 mt of black rockfish were harvested. The 2010 black rockfish harvest in the South Alaska Peninsula areas remains confidential because of minimum participation. In 2010, 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.

For the 2007-2010 seasons, the entire **Southeast Alaska** region's sport bag and possession limit for pelagic rockfish was 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).

As a result of the pervasive lack of quantitative stock assessment information, rockfish regulations in **Southcentral Alaska** have been designed to discourage targeting of rockfish yet allow for retention of incidental harvest. Bag limits are lower for demersal and slope species because of their lower natural mortality rates. The bag limit in Cook Inlet was five rockfish daily, only one of which could be a non-pelagic species (DSR or slope species). The bag limit in Prince William Sound during the period May 1-September 15 was four rockfish, no more than two of which could be a non-pelagic species. During the period September 16-April 30, the bag limit was 8 rockfish, of which no more than 2 could be non-pelagic species. During both periods, the first two non-pelagic rockfish caught were required to be retained. The bag limit in the North Gulf Coast area was four rockfish daily, including no more than one non-pelagic rockfish. The bag limit in the Kodiak and Alaska Peninsula areas was 10 fish daily of any species, but that limit was revised by the Alaska Board of Fisheries in late 2010. The daily bag limit effective in 2011 will be 5 rockfish, no more than two of which can be non-pelagic species, and no more than one of the non-pelagic species may be a yelloweye.

d. Fisheries

Directed fisheries for demersal shelf rockfish and black rockfish occurred in **Southeast** in 2010. Effort in the directed black rockfish fishery was minimal with only 3 vessels participating. The directed DSR fishery in 2010 in outside waters was opened in SSEO only for a total harvest of 29.5 mt. There was also a directed DSR fishery in internal waters in 2010 (SSEI and NSEI); the total harvest was 20.6 mt.

The total amount of rockfish (all species) taken as bycatch in all commercial fisheries conducted east of 140^0 W Longitude in 2010 in state and Federal water was 492 mt. DSR bycatch made in conjunction with the IFQ halibut fishery in outside as well as internal waters contributed 148 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 2010 **Cook Inlet Area** directed rockfish fishery opened July 1 and closed December 31 with a harvest of 10.1 mt. Total rockfish harvest including bycatch to longline, pot and jig fisheries was 24 mt. Total rockfish harvest for the PWS Area rockfish bycatch-only fishery was 47.6 mt. This included a 3 mt incidental catch of demersal and slope rockfish from the walleye pollock trawl fishery and a 44 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 are available only from creel surveys.

The SWHS reported harvest for the general category of "rockfish", and the charter vessel logbook recorded rockfish harvest in three categories - pelagic, yelloweye, and other non-pelagics. DSR are part of the "non-pelagic" category. Recreational rockfish harvest is typically estimated in numbers of fish. Estimates of the 2010 harvest are not yet available from the statewide harvest survey, but the 2009 estimates were 93,751 fish in Southeast and 115,343 fish in Southcentral Alaska. The average estimated annual harvest for the most recent five-year period (2005-2009) was 96,552 rockfish (all species) in Southeast Alaska and 101,431 fish in Southcentral Alaska.

3. Sablefish

a. Research

In 2010, 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 2010 fishery and survey CPUE for NSEI are not yet available yet.

The cost of these surveys is offset by the sale of the fish landed, but in 2010 for the first time, the three commercial fishermen that participated in the surveys were allowed to sell their share of PQS from the total testfish harvested in the survey, thus reducing the total testfish harvest impact on the quota.

In the SSEI longline survey there has been a downward trend in CPUE since 2006. In 2010, CPUE was 0.29 kg/hook compared to 0.36 kg/hook in 2009.

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) has been decreasing since 2005. In 2010, it was 0.15 round kg/hook, up slightly from 0.14 round kg/hook in 2009. In 2005, the SSEI CPUE was 0.24 kg/hook. In the NSEI fishery, the overall CPUE adjusted for hook spacing expressed in round kg/hook was 0.37 in 2010, down slightly from 0.39 kg/hook in 2009.

In 2010, ADF&G continued a mark/recapture study in NSEI, tagging and releasing 7,443 sablefish. Pot gear was used to capture the fish from May 31st to June 25th, one and a half months prior to the start of the fishery which commenced on August 15, 2010. 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. Tagged fish are distributed by area and depth in proportion to the harvested commercial catch using logbook data from the three previous years. No biological samples were taken in 2010 in the pot survey as sufficient sampling occurs during the longline surveys and in the commercial fishery (contact Deidra Holum).

Central Region, ADF&G conducted longline surveys for sablefish from 1996 through 2006 in Prince William Sound. Longline survey effort was extended into the North Gulf District in 1999, 2000 and 2002. All longline surveys were discontinued due to funding issues, and with the goal of transitioning to a pot longline survey, particularly in PWS. Between 1999 and 2005, sablefish were opportunistically tagged in PWS on ADF&G trawl surveys. Central Region staff will initiate a sablefish tagging project in 2011 using pot longline gear. Long-term goals include tag-recapture analysis potentially in combination with an age-structured model. (Contact Dr. Ken Goldman).

Skipper interviews and port sampling occurred in Whittier, Valdez, Cordova and Seward for the PWS Area commercial 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. Logbooks are required for both fisheries and provide catch and effort data by date and location. (Contact Elisa Russ).

b. Stock Assessment

In **Southeast**, the department is using mark-recapture methods with external 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. The Allowable Biological Catch (ABC) for 2010 was based on the 2008 Petersen–estimated number of sablefish fish in NSEI. The forecast for 2010 was made by decrementing the 2009 estimate to account for natural mortality, and adding a number of age-4 recruits equal to that of 2008. Each age class was converted to biomass using the average weight of that age class from the 2009 commercial fishery. The forecast for 2010 was 19,097,883 round pounds of sablefish. An $F_{50\%}$ (=0.071) harvest rate was applied to the point estimate of the forecasted biomass to give a ABC of 1,250,961 round pounds. This represents a 3% decrease from the 2009 ABC (1,290,868 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. In SSEI, only an annual longline survey is conducted to provide biological data as well as relative abundance information. (Contact Sherri Dressel).

c. Management

There are three separate internal water areas in Alaska which have state-managed limited-entry commercial sablefish fisheries. The NSEI and SSEI (**Southeast Region**), and the Prince William Sound Inside District (**Central Region**) each have separate seasons and guideline harvest ranges. In the Cook Inlet Area, there is an open access sablefish fishery.

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 forecasted for 2007. 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. In 2009, there were 88 permit holders eligible to fish. A stock assessment was conducted in 2009 with a forecast for 2010 and is referenced in the "stock assessment" section of this report. As in 2009, the point estimate rather than the lower 90% confidence level was used. However, in 2010, the testfish decrement was smaller because three permit holders participated in the survey, and harvested their share of their EQS during the survey rather than during the fishery. In 2010, an $F_{50\%}$ harvest rate was used rather than an $F_{45\%}$ rate as in 2009. The updated stock assessment combined with the changes listed above resulted in a 3% drop to the allowable harvest objective (AHO) for 2009. There were 87 permit holders eligible to fish in 2010. The Commercial Fisheries Entry Commission predicts that the number of permits will continue to be reduced and that the resulting number of permanent permits for this fishery will be approximately 76.

The SSEI quota was set at 265 mt for 2010, an 8% decrease from the 2009 quota. The quota reduction was based on declining survey CPUE since 2006, and declining survey CPUE from 2006-2009 (there was a slight increase in fishery CPUE in 2010). 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). For the 2009 fishery, CFEC denied 4 permits leaving 25 longline and 3 pot permits allowed to harvest sablefish in this fishery. In 2010, there were 24 longline and 3 pot permits allowed to harvest sablefish in this fishery.

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.

Commercial 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 Cook Inlet 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 2010 fishery GHL was 24 mt. In 2004, the BOF adopted sablefish fishery-specific registration, a logbook requirement, and a 48-hour trip limit of 1.3 mt. in Cook Inlet. For PWS, a limited entry program that included gear restrictions and established vessel size classes was adopted in 1996. 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. In 2009, the commissioner's permit requirement was removed by BOF action and regulations adopted which included a registration deadline, logbooks, and catch reporting requirements.

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 BOF 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.

The Southeast Alaska **sport fishery** for sablefish was regulated for the first time in 2009. Sport limits in 2010 were 4 fish per day, 4 in possession, with an annual limit of 8 fish applied to nonresidents only. A small number of sablefish were sampled during creel surveys in Southeast Alaska, indicating that recreational sablefish harvest was relatively small. Sablefish harvest was required to be reported in charter logbooks beginning in 2010.

The sablefish **sport fishery** in Southcentral Alaska was unregulated in 2010, with no bag, possession, or size limits. Port samplers throughout Southcentral Alaska encountered and sampled only three sablefish from the sport harvest.

d. Fisheries

In the **Southeast Region,** the 2010 NSEI sablefish fishery opened August 15 and closed November 15. The 87 permit holders landed a total of 478 mt of sablefish. The fishery is managed by equal quota share; each permit holder was allowed 5.5 mt. The 2010 SSEI sablefish fishery opened June 1 and closed November 15. Twenty-six permit holders landed a total of 253 mt of sablefish, each with an equal quota share of 9.4 mt. In SSEI, 24 permits were designated to be fished with longline gear and the remaining three fished with pot gear. One of the longline permits did not fish in 2010. (Contact Kristen Green).

In the **Central Region,** the 2010 open access sablefish fishery in the Cook Inlet North Gulf District opened at noon July 15 and closed at noon September 7. Nine vessels harvested 25 mt. In 2009, new season dates adopted by the BOF for PWS sablefish were April 15 – August 31. The new season opening date, one month later than in previous years, was adopted to reduce the opportunity for orca depredation on hooked sablefish which predominately occurred prior to May 1. The 2010 PWS harvest totaled 96 mt (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% for trawl gear only, no bycatch is allowed for all other gear types. The 2010 Aleutian Island fishery opened on May 15, 2010. Additional requirements for the fishery include registration and logbook requirements. The GHL was set at 242 mt for the state managed fishery. The harvest from the 2010 Aleutian Islands sablefish fishery was 94 mt. The season remained open until the November 15 closure date (Contact Trent Hartill or Heather Fitch).

Sablefish were included in the Statewide Sport Fish mail survey questionnaire for 2010, but those estimates will not be available until September 2011. Charter operators reported (in logbooks) a guided sport harvest of about 3,927 sablefish in Southeast Alaska and 153 sablefish in Southcentral Alaska in 2010.

4. Flatfish

a. Research

There was no research on flatfish during 2010.

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 nine years, with no harvest reported for the 2008-2010 season. The Southeast flatfish trawl areas are also the sites of a shrimp beam trawl fishery. In the past, most of the Southeast harvest was 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 2010.

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. Skipper interviews and biological sampling of **Central Region** commercial pollock deliveries during 2010 occurred in Seward and Kodiak. 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 Elisa Russ).

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

No stock assessment work was conducted on pollock in 2010 (Contact Dr. Ken Goldman).

c. Management

Prince William Sound pollock fishery regulations were amended by BOF action and for 2009, included a January 13 registration deadline, logbooks, catch reporting, check-in and check-out provisions, and accommodation of a department observer upon request. Prior to 200,9 these requirements were stipulated as terms of a commissioner’s permit. 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 Charlie Trowbridge). For **Cook Inlet,** directed fishing for pollock is managed under a “Miscellaneous Groundfish” commissioner’s permit. However, due to pelagic trawl closures associated with Steller sea lion conservation measures, no directed fishing has occurred in the Cook Inlet Area since 2000.

d. Fisheries
The 2010 **Prince William Sound** fishery opened on January 20 with a GHL of 1,651 mt. The Hinchinbrook section closed by emergency order at 9:00 p.m. February 25 while the Knight Island and Bainbridge sections closed by emergency order at midnight March 3. Total pollock harvest for all sections combined was 1,661 mt. Total bycatch was 20 mt, just over one percent of the GHL and was dominated by squid at 7.7 mt. (Contact Charlie Trowbridge).

6. Sharks

a. Research
In 2009, **Central Region** Commercial Fisheries Division began tagging all sharks with spaghetti-type tags. A research project on the reproductive biology of salmon sharks was initiated in the summer of 2010 with the goal of providing an accurate and precise estimate of the timing of reproductive activity (annual vs. biennial) and length-at-maturity via the examination of blood hormone concentrations. (Contact Dr. 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. Few samples were collected in 2010, most from a modest salmon shark fishery in Prince William Sound. Interviews also provided estimates of the numbers of salmon sharks and spiny dogfish kept and released by ADF&G statistical area (Contact Barbi Failor).

b. Stock Assessment
There is no stock assessment work being conducted on sharks in Central Region. (Contact Ken Goldman).

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 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 2010.

Estimates of **recreational shark harvest** in 2010 are not yet available from the Statewide Harvest Survey, but in 2009 an estimated 159 sharks of all species were harvested in Southeast Alaska and 237 sharks were harvested in Southcentral Alaska. The precision of these estimates is low; the Southeast estimate has a CV of 54% and the Southcentral estimate has a CV of 27%. The statewide charter logbook program also required reporting of the number of salmon sharks kept and released in the charter fishery. Charter anglers are believed to account for the majority of the recreational salmon shark harvest. The 2010 reported charter harvest from logbooks was 8 salmon sharks in Southeast Alaska and 19 salmon sharks in Southcentral Alaska.

7. Lingcod

a. Research

Beginning in the spring of 1996 and over the fourteen years since, in the **Southeast Region,** 9,128 lingcod have been tagged and 455 fish recovered. Opportunistic tagging of 17 lingcod in Sitka Sound occurred during 2010. Length, sex and tagging location are recorded for all tagged fish. Dockside sampling of lingcod caught in the commercial fishery continued in 2010 in Sitka and Yakutat with over 920 fish sampled for AWL. Otoliths were sent to the ADU in Juneau for age determination. (Contact Kristen Green).

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 were delivered gutted (Contact Elisa Russ).

Resurrection Bay was closed in 1993 to recreational and commercial fishing for lingcod to rebuild what was anecdotally believed to be a depleted stock. Central Region conducted a Resurrection Bay lingcod ROV survey in 2009 to estimate the abundance of legal size lingcod within the bay. This survey was conducted to serve as a benchmark for future assessments, potentially be correlated with other indices of abundance (e.g. standardized CPUE) to monitor changes in stock status, and potentially provide a basis for determining options for a limited but sustainable fishery. Analysis of these data was completed in 2010. This was a stratified random survey, stratified by habitat (high relief rugose rock, low relief rock, and soft substrates). Estimated lingcod density was 3,190, 1,266, and 0 fish / km^2 for high relief rock, low relief rock, and soft substrates, respectively. The estimated abundance of legal size lingcod within the regulatory line defining Resurrection Bay was 51,433 fish (95% CI 21,115 – 81,771).

The rocky bank surrounding and extending to the south of outer Pye Island was mapped with multibeam sonar during a department survey in 2008. Seafloor habitats within the survey area were delineated and an ROV survey to estimate DSR and lingcod abundance and biomass was conducted there in May 2010. No analyses or population estimates have been completed since video reviews were only just completed. (Contact Mike Byerly or Dr. Ken Goldman).

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 2010 included Juneau, Sitka, Craig/Klawock, Wrangell, Petersburg, Gustavus, Elfin Cove, Yakutat, and Ketchikan. Length and sex data were collected from 1,203 lingcod in 2010, 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 921 lingcod were sampled from sport harvest at Seward, Valdez, Whittier, Kodiak, and Homer in 2010. 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 2000. Commercial logbook data for the period 2002–2009 shows CPUE in fish per hook hour trending up since 2000 in CSEO but down from 2008. Fishery CPUE for 2010 is not yet available.

A lingcod stock assessment was not conducted in the **Central Region** in 2010. Population estimates from ROV surveys have not been incorporated into a stock assessment.

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 2009, a new BOF regulation permitted retention of lingcod in PWS waters following closure of the directed season.

No directed effort occurred for lingcod in the **Westward Region** during 2010. A large jump in the amount of incidental harvest in the bottom trawl fisheries occurred in 2008. In response, ADF&G reduced bycatch limits in 2009 from 20% to 5%, and the department maintained the 5% limit in 2010. Bycatch harvest totaled 23 mt in 2007, 250 mt in 2008, 39 mt in 2009, and 41 mt in 2010. The majority of the harvest occurred in the Kodiak Area with a minor amount occurring in the Chignik Area.

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 2010, lingcod bag limits for all anglers were one fish per day, one in possession. There were no size limits for resident anglers. Throughout most of Southeast Alaska, nonresident anglers were allowed to keep only fish between 30 and 35 inches and fish 55 inches or longer. In the Yakutat area, nonresidents were allowed to retain fish between 30 and 40 inches or fish 55 inches or longer. Nonresidents were also constrained by a two fish annual limit. Seasons varied by area. (Contact Robert Chadwick).

Conservative harvest strategies were established in 1993 for recreational lingcod fisheries in **Southcentral Alaska** in light of the lack of quantitative stock assessment information. Resurrection Bay was closed to lingcod fishing year-round to rebuild the population, although no formal rebuilding plan was put in place. The season was closed region-wide from January 1 through June 30 to protect spawning and nest guarding lingcod. Daily bag limits in 2010 were two fish in all areas except the North Gulf, where the daily bag limit was one fish. All areas except Kodiak had a minimum size limit of 35 inches to protect spawning females (Contact Matt Miller and Tom Vania).

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), bycatch in the other longline fisheries, and as bycatch in the salmon troll fishery. At the 2009 Board of Fisheries meeting, a regulation regarding lingcod bycatch was written such that managers in southeast can adjust the bycatch levels in- season to maximize the opportunity for current bycatch allocations to be met. For example, in years when the halibut catch limits are low, the bycatch of lingcod can be set higher without the risk of going over the longline allocation. The directed fishery landed 109 mt of lingcod in 2010, and an additional 69 mt was landed as bycatch in other fisheries (60 mt in the halibut longline fishery and 9 mt in the salmon troll fishery).

Central Region commercial lingcod harvests have primarily occurred in the North Gulf District of Cook Inlet and PWS. In 2010, the Cook Inlet GHL was 24 mt and the PWS GHL was 15 mt. Lingcod harvests in 2010 totaled 10 mt in Cook Inlet and 24 mt in PWS. Approximately half of the lingcod harvest in Cook Inlet resulted from directed jig effort. However in PWS, lingcod harvest resulted from bycatch to other directed (primarily halibut) longline fisheries. The Outside District of PWS closed at noon September 20 when the district GHL of approximately 11.5 mt total harvest was achieved. The Inside District remained open for the entire year (Contact Charlie Trowbridge).

No directed effort occurred for lingcod in the **Westward Region** during 2010. A large jump in the amount of incidental harvest in the bottom trawl fisheries occurred in 2008. In response, ADF&G reduced bycatch limits in 2009 from 20% to 5%. Incidental harvest totaled 23 mt in 2007, 250 mt in 2008, and 39 mt in 2009. The majority of the harvest occurred in the Kodiak Area with a minor amount occurring in the Chignik Area.

Recreational lingcod harvest estimates for 2010 are not yet available from the statewide mail survey, but in 2009 an estimated 9,299 lingcod were harvested in Southeast Alaska while 22,877 lingcod were taken in Southcentral Alaska. The average estimated annual harvest for the most recent five-year period (2005-2009) was 15,173 fish in Southeast Alaska and 21,416 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. 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.

Skates may be harvested in a directed fishery within the **Central Region** 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. A directed fishery in the Prince William Sound Area for big and longnose skates was prosecuted under this authority in 2009 and 2010. Skates may also be retained as bycatch up to 20% during other directed fisheries for groundfish or halibut.

In 2009, Central Region received a capital budget increment of $55K to conduct a trial fishery for big and longnose skates in PWS. Fishery GHLs based upon trawl survey density data were used to set Inside District GHLs of 9 mt for big and 50 mt lb for longnose skates. Trawl survey density data were extrapolated based upon area to the Outside District and yielded GHLs of 13.6 mt and 68 mt for big and longnose skates. The fishery was announced with a registration deadline in order to gauge participation and commissioner’s permits with stipulations for logbooks, reporting requirements and accommodation of a department observer were issued to 23 vessels. Management for the relatively small GHLs for big skate proved problematic in 2009 with one GHL exceeded by a single landing. Harvests of big skate totaled 21.4 mt and 37.6 mt from the Inside and Outside Districts in 2009. Longnose skate GHLs were not achieved in either district and harvest totaled 31.2 mt and 27.0 mt from the Inside and Outside Districts respectively. With enough funds remaining for a second year of skate fishing, the PWS fishery reopened in 2010 on March 6, concurrent with the commercial halibut fishery, with GHLs similar to those in 2009 and similar permit stipulations except for a trip limit restriction on big skate of 2,500 lb per consecutive two-day period. Although the Inside District big skate GHL was achieved and fishing there closed March 21, no other GHLs were achieved and the Outside District and longnose skate in the Inside District closed April 30. Skate harvest in the 2010 directed fishery was 12 mt of big skate and 35 mt of longnose skate. (Contact Charlie Trowbridge)

For the directed skate fishery, data was collected through dockside sampling, onboard observing, and logbooks. In 2009, there was 18% observer coverage which increased to 56% in 2010. Over 2,000 combined skates were sampled for length, weight, and sex. In 2010, skates were additionally sampled for gonad condition and disc width. A total of 464 vertebrae samples were collected and analyzed for age determination for both years combined. A sub-sample of vertebrae from 2010 was sent to the NOAA Fisheries Narragansett Laboratory, Apex Predators Program, for additional histological sampling. During both 2009 and 2010, halibut comprised the greatest proportion of discarded bycatch. Big skate was the second largest component of discarded bycatch due to GHLs being achieved and implementation of big skate trip limits while fishermen continued to target longnose skate. (Contact Elisa Russ). Work on a "Developing Fisheries" policy, intended to reduce the potential for a fishery to escalate beyond management control has halted at present.

In the **Central Region**, skates may also be retained as bycatch up to 20% during other directed fisheries for groundfish or halibut. Bycatch harvest in 2010 of combined big and longnose skates in the **Prince William Sound Area** was 49 mt and 3 mt in the **Cook Inlet Area**.

In 2009, **Central Region** Commercial Fisheries Division began tagging all big, longnose and Aleutian skates greater than 70 cm total length with spaghetti-type tags. Starting in 2010, all skate species of all sizes were tagged on ADF&G surveys. (Contact Dr. Ken Goldman)

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 in Southcentral Alaska and creel surveys and port sampling in Southeast Alaska. Harvest estimates 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’s Scientific and Statistical Committee has periodically reviewed the states estimation and projection methods, and the council has used the information in the design and analysis of regulations for the sport charter fishery (Contact Scott Meyer).

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 long-term goal is to have the database house all Central Region commercial fisheries survey and port sampling data in a GIS relational format.

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) has 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 2010 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	27	32	1	16	101	Tr	118
2009	29	34	1	18	132	2	153
2010	29	35	2	17	107	2	128

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.

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,** several projects 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 2010 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	27	113	closed	190	91	2	0	closed
2009	37	87	closed	164	152	3	0	closed
2010	30	78	closed	159	104	5	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 2010, 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, other salmon, halibut, pelagic rockfish, yelloweye rockfish, other rockfish, lingcod, sablefish, and salmon sharks. The Sport Fish Division conducted 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 was presented to the North Pacific Fishery Management Council in October and December 2009.

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Web Pages

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Commercial Fishing home page:
http://www.adfg.alaska.gov/index.cfm?adfg=fishingCommercial.main

News Releases: http://www.adfg.alaska.gov/index.cfm?adfg=newsreleases.main

Sport Fishing home page: http://www.adfg.alaska.gov/index.cfm?adfg=fishingSport.main

Age Determination Unit Home Page: http://tagotoweb.adfg.state.ak.us/

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.adfg.alaska.gov/index.cfm?adfg=CommercialByFisheryGroundfish.main

Commercial Fisheries Entry Commission: http://www.cfec.state.ak.us/

State of Alaska home page: http://www.alaska.gov

Gene Conservation Laboratory Home Page:
http://www.adfg.alaska.gov/index.cfm?adfg=fishinggeneconservationlab.main

Demersal shelf rockfish stock assessment document:
http://www.afsc.noaa.gov/refm/docs/2010/GOAdsr.pdf

Adobe PDF versions of groundfish charts can be viewed or downloaded at
http://www.adfg.alaska.gov/index.cfm?adfg=CommercialByFisheryGroundfish.groundfishmaps

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APPENDIX I. ALASKA DEPARTMENT OF FISH AND GAME PERMANENT FULL-TIME GROUNDFISH STAFF DURING 2010.

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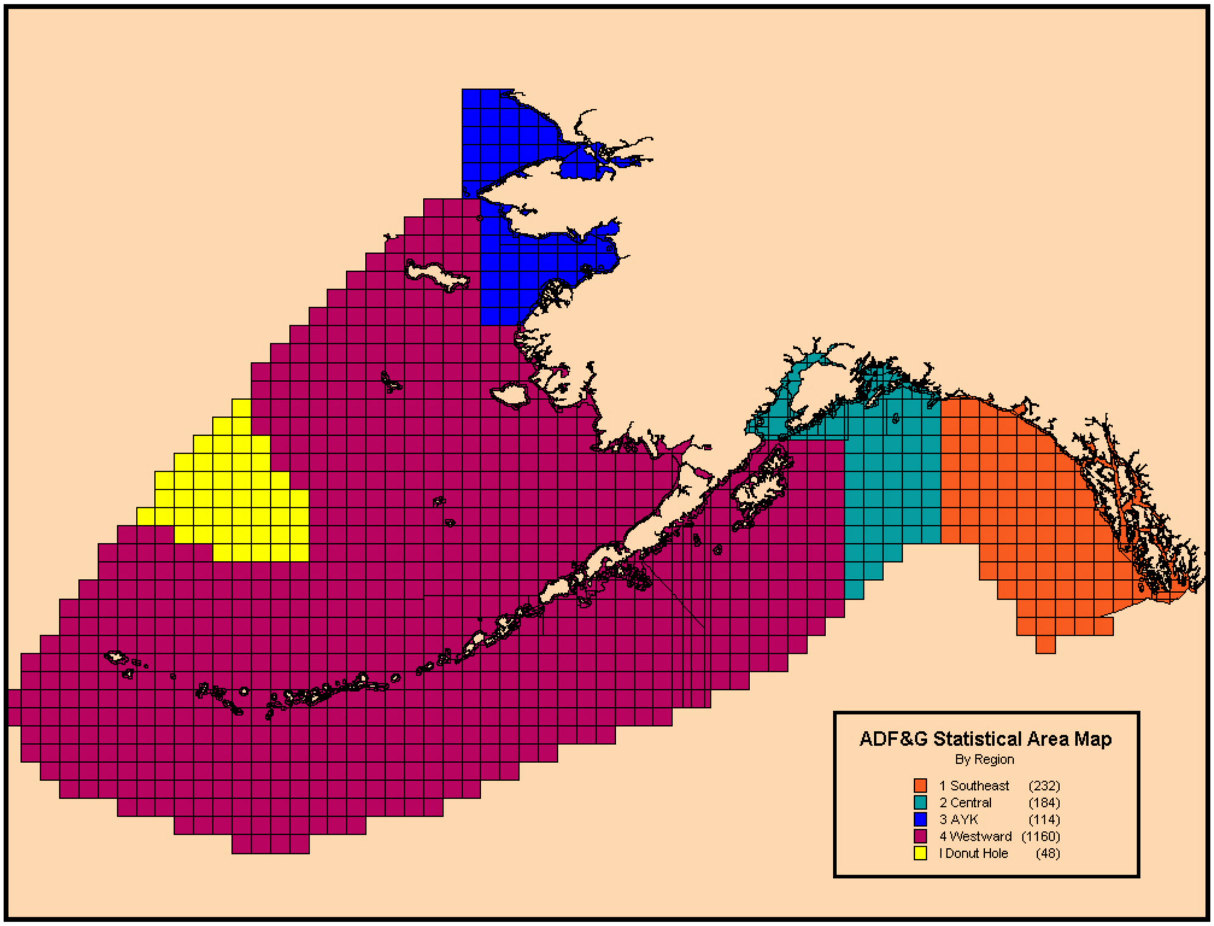
Appendix II

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

Species	Location	Year	Sample size	Tissues
	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
	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

Species	Location	Year	Sample size	Tissues
	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

Species	Location	Year	Sample size	Tissues
	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

California Department of Fish and Game
Agency Report
to the
Technical Subcommittee
of the
Canada-United States Groundfish Committee

June 2011

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A. AGENCY OVERVIEW

Within the California Department of Fish and Game (CDFG), the Marine Region is responsible for protecting and managing California's marine resources under the authority of laws and regulations created by the State Legislature, the California Fish and Game Commission (CFGC) and the Pacific Fishery Management Council (Council). The Marine Region is unique in the CDFG because of its dual responsibility for both policy and operational issues within the State's marine jurisdiction (0 – 3 miles). It was created to improve marine resources management by incorporating fisheries and habitat programs, environmental review and water quality monitoring into a single organizational unit. In addition, it was specifically designed to be more effective, inclusive, comprehensive and collaborative in marine management activities.

The Marine Region has adopted a management approach that takes a broad perspective relative to resource issues and problems. This ecosystem approach considers the values of entire biological communities and habitats, as well as the needs of the public, while ensuring a healthy marine environment. The Marine Region employs approximately 200 permanent and seasonal staff that provide technical expertise and policy recommendations to the CDFG, CFGC, Council, and other agencies or entities involved with the management, protection, and utilization of finfish, shellfish, invertebrates, and plants in California's ocean waters.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

B. MULTISPECIES STUDIES

1. Research and Monitoring

a. Commercial Fishery Monitoring

Statistical and biological data from landings are continually collected and routinely analyzed by CDFG staff to provide current information on groundfish fisheries and the status of the stocks. California's primary commercial landings database is housed in CDFG's Commercial Fisheries Information System. Outside funding also enables California fishery data to be routinely incorporated into regional databases such as Pacific Coast Fisheries Information Network (http://www.psmfc.org/pacfin).

Commercial sampling occurs at local fish markets where samplers determine species composition of the different market categories, measure and weigh fish and take otoliths for future ageing. Market categories listed on the landing receipt may be single species (e.g., bocaccio) or species groups (e.g., group slope rockfish). Samplers need to determine the species composition so that landings of market categories can be split into individual species for management purposes.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

Table 1. Commercial groundfish landings and samples taken in 2010.

Common Name	Metric tons	Len	Oto	Common Name	Metric tons	Len	Oto
Flatfish:				Flatfish:			
Dover sole	2622	1192	348	Hornyhead turbot	5	159	--
Petrale sole	213	2011	3	Rock sole	2	--	--
Arrowtooth flounder	68	337	--	Pacific sanddab	0	1078	30
Rex sole	55	1542	1	Fantail sole	0	30	--
English sole	24	944	10	Curlfin sole	--	46	--
Starry flounder	13	193	--	Slender sole	--	19	--
Sand sole	8	112	--	CO turbot	--	1	--
Rockfish:				Rockfish:			
Chilipepper rockfish	342	1481	450	Redbanded rockfish	1	319	--
Blackgill rockfish	95	1284	133	Unspecified rockfish	0	--	--
Group slope rockfish	78	--	--	Canary rockfish	0	57	5
Splitnose rockfish	64	999	33	Aurora rockfish	0	942	30
Black rockfish	53	174	--	Speckled rockfish	0	170	--
Gopher rockfish	28	625	15	Shortbelly rockfish	0	148	--
Brown rockfish	27	465	--	Rosy rockfish	0	24	--
Darkblotched rockfish	17	1097	238	Flag rockfish	0	17	--
Grass rockfish	12	358	1	Greenblotched rockfish	0	12	2
Vermilion rockfish	12	147	4	Squarespot rockfish	0	22	--
Black-and-yellow rockfish	11	300	--	Pacific ocean perch	0	47	--
Widow rockfish	10	311	100	Group bolina rockfish	0	--	--
Bank rockfish	7	274	50	Cowcod	0	--	--
Bocaccio	4	68	16	Greenstriped rockfish	0	21	--
California scorpionfish	3	--	--	Group gopher rockfish	0	--	--
Blue rockfish	3	95	--	Group nearshore rockfish	0	--	--
Copper rockfish	3	83	--	Group rosefish rockfish	0	--	--
China rockfish	2	129	1	Honeycomb rockfish	0	--	--
Treefish	2	69	--	Group small rockfish	0	--	--
Group shelf rockfish	1	--	--	Yelloweye rockfish	0	--	--
Yellowtail rockfish	1	7	4	Rosethorn rockfish	0	3	2
Kelp rockfish	1	44	--	Calico rockfish	0	--	--
Quillback rockfish	1	16	--	Pinkrose rockfish	0	--	--
Greenspotted rockfish	1	294	1	Rougheye rockfish	--	121	28
Starry rockfish	1	21	--	Shortraker rockfish	--	8	--
Group red rockfish	1	--	--	Stripetail rockfish	--	2	--
Olive rockfish	1	9	--	Tiger rockfish	--	1	--
Skates:				Skates:			
Longnose skate	141	638	--	Sandpaper skate	--	9	--

Common Name	Metric tons	Len	Oto	Common Name	Metric tons	Len	Oto
Skates:				Skates:			
Unspecified skate	23	--	--	California skate	--	1	--
Big skate	1	8	--				
Round fish:				Roundfish:			
Sablefish	2449	4933	--	Lingcod	47	375	--
Pacific whiting	2427	448	--	California sheephead	31	11	--
Longspine thornyhead	552	4502	--	Cabezon	23	280	--
Shortspine thornyhead	462	2856	--	Unspecified thornyheads	13	--	--
California halibut	236	3	--	Kelp greenling	2	--	--
Unspecified grenadier	95	--	--	Spotted ratfish	0	8	--
Pacific grenadier	--	331	--	Rock greenling	0	1	--
Sharks:				Sharks:			
Spiny dogfish	6	--	--	Soupfin shark	3	--	--
Leopard shark	3	--	--				

Source: Commercial Fisheries Information System (landings) and California Cooperative Groundfish Survey (sample data).

b. Recreational Fishery Monitoring

The California Recreational Fisheries Survey (CRFS) began in January 2004 to provide catch and effort estimates for marine recreational finfish fisheries. The CRFS generates monthly estimates of total recreational catch for four modes of fishing (beach/bank and shore, piers and jetties, commercial passenger fishing vessels (CPFVs), and private vessels launched from public launch ramps) for six geographic districts along California's 1000 plus miles of coast. The data are used by state and federal regulators to craft regulations to protect fish stocks and provide recreational fishing opportunities. The sampling data and estimates are available on the Recreational Fisheries Information Network (http://www.recfin.org).

The CRFS is a multi-part survey which uses field sampling and telephone surveys. Each year the CRFS samplers interview more than 60,000 anglers at more than 500 sites, and examine approximately 200,000 fish. The licensed angler telephone survey completes about 26,000 interviews annually. The telephone survey is contracted and is not done by CDFG staff. The high sampling levels have contributed to greater accuracy and precision in estimating catch and effort, especially for overfished species such as yelloweye rockfish.

As a condition of their fishing permit, operators of CPFVs are required to submit a record of their fishing activities on a log provided by the CDFG. The operators must complete and submit a log of each fishing trip. Each log documents the target species, the fishing method, the type of bait, the number and type of fish landed or released, the number of anglers and hours fished, and the location where most of the fish were caught. In 2010, 28,700 logs were received by CDFG and processed. The database is maintained in CDFG's Commercial Fisheries Information System. In 2011, CRFS began using the mandatory CPFV logs along with a field validation survey to estimate CPFV effort. A voluntary telephone survey was used to estimate CPFV effort prior to 2011. Catch rates are based on a field survey which consists of onboard and dockside sampling of CPFV trips.

For additional information, go to http://www.dfg.ca.gov/marine/crfs.asp.

Contributed by Connie Ryan (cryan@dfg.ca.gov)

c. Inseason Monitoring

Commercial fishery

The CFGC has authority under state law to manage nearshore species (as defined by the state's Marine Life Management Act and the Nearshore Fisheries Management Act). The CFGC has given CDFG the authority to take action as a routine management measure to close the recreational and/or commercial sectors of the cabezon, California sheephead, and greenling fisheries upon projected attainment of their respective established optimum yields and fishery allocations. The CDFG also has authority to make inseason trip limit adjustments to the commercial fisheries for cabezon, California sheephead and greenlings. In 2009 and 2010, the CDFG closed the commercial greenling fishery early (September 1 and November 1, respectively) as it has for the past seven years. Commercial cabezon trip limits were not changed inseason in 2009 and 2010. Previously, trip limits were reduced in period 5 (September-October) in order for the fishery to remain open year round. Currently, inseason monitoring is used to track landings against statewide total allowable catches, statewide and/or regional allocations and trip limits.

Inseason monitoring of California commercial nearshore species landings is now conducted by CDFG biologists in the areas north and south of 40°10' North Latitude near Cape Mendocino. This work is done in conjunction with inseason monitoring, management and regulatory tasks conducted by the Council. Weekly tallies of landing receipts are used for inseason monitoring. At present, inseason monitoring focuses on overfished species such as cowcod and yelloweye rockfish.

Recreational fishery

The CDFG has additional authority to take inseason action to modify management measures or close the recreational fishery for groundfish if harvests are projected to exceed or be well below federally-established harvest guidelines. Inseason monitoring of California recreational groundfish species catch is conducted by CDFG biologists utilizing a mathematical model that includes projected catch based on previous years' data as well as current catch rates obtained weekly from CRFS staff. In July 2009, the inseason monitoring of yelloweye rockfish, a species that significantly constrains the recreational catch of all rockfish, became available online to the public at http://www.dfg.ca.gov/marine/groundfishcentral/tracking.asp.

In May 2008, the CDFG took inseason emergency action to restrict fishing depth to less than 20 fathoms in the Northern and North-Central Groundfish Management Areas (California/Oregon border to Pigeon Point) for the recreational fishery to protect overfished rockfish species (canary and yelloweye rockfishes). The CDFG did not implement proposed Yelloweye Rockfish

Conservation Areas, despite the Council's recommendation, because it was uncertain that the savings (catch reduction) would benefit the fishery.

In August 2008, the CDFG again took inseason emergency action to split the North-Central Groundfish Management Area at Point Arena into the North-Central North of Point Arena and the North-Central South of Point Arena Groundfish Management Areas (Figure 1). Additionally the North-Central North of Point Arena Groundfish Management Area was closed to groundfish fishing for the remainder of the year. This was done to ensure that California did not exceed its recreational catch of yelloweye rockfish. At the time the emergency action was taken the state had already caught 62 percent of the allowable catch of yelloweye rockfish, with 84 percent taken above Point Arena. Closing the area north of Point Arena allowed the remaining areas to remain open through the end of the season and the yelloweye rockfish allowable catch was not exceeded. Along with this, the emergency action extended the 20 fathom depth closure that was due to expire based on the May 2008 emergency action.

In January 2009, the CFGC adopted regulations for the 2009-2010 recreational groundfish fishery to make them consistent with proposed federal regulations. The changes included:

- Modify the season for the Northern Groundfish Management Area from May 1 through December 31 to May 15 through September 15, and make permanent the 20 fathom depth closure.
- Modify the season for the North-Central North of Point Arena Groundfish Management Area from June 1 through November 30 to May 15 through August 15 and make permanent the 20 fathom depth closure.
- Maintain the season for the North-Central South of Point Arena Groundfish Management Area from June 1 through November 30 and the depth closure at 30 fathoms.
- Modify the season for the Monterey South-Central Groundfish Management Area from May 1 through November 30 to May 1 through November 15.
- Modify the season for the Morro Bay South-Central Groundfish Management Area from May 1 through November 30 to May 1 through November 15.
- Increase the cabezon bag limit from one fish to two within the RCG 10-fish bag limit.
- Prohibit the take of bronzespotted rockfish.
- Increase the bocaccio bag limit from one fish to two within RCG 10-fish bag limit, except in the Cowcod Conservation Area where the bag limit would remain zero (no take).
- Allow the take of leopard shark in several enclosed bays statewide year round and in all depths.
- Remove the gear restrictions for Pacific sanddabs and "other flatfish" and increase the season to year round.

Figure 1. Recreational groundfish management areas, August 2008 through December 2010. Prior to August 2008, the North-Central North of Point Arena and the North-Central South of Point Arena were combined and called the North-Central Region.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

d. Study on the Effects of Allowing Limited Entry Trawl Permit Holders to Fish Fixed Gear

A study was conducted by the Nature Conservancy with cooperation from the Central Coast Groundfish Project, a private organization, to determine viability of a cooperatively managed community fishing association employing limited entry trawl permittees and using longline, trap, and hook and line gear under shared aggregate catch limits for both target and bycatch species. The study also looked at combining quota shares for overfished species and participants agreed to monitor activity jointly and to take collective action if necessary to limit the take of overfished species. The results of the two-year study revealed that the biggest economic factor was the cost of observer coverage. The community fishing association shared observers to help reduce costs. The study also showed that community fishing association members can work together to monitor the group's take of target and bycatch species to keep within aggregate catch limits, which, given the low catch limits for overfished species, can reduce the risk of having to stop fishing if a high number of overfished species are caught in one set. The results were presented to the Council prior to the adoption of the trawl rationalization program (individual quota program). The final report can be accessed at: http://www.pcouncil.org/resources/archives/briefing-books/september-2010-briefing-book-2/#groundfish.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

2. Management

a. 2010 State Management Measures Affecting Groundfish

Since 2007, commercial fishery management has remained basically the same. Recreational fishery management, on the other hand, has experienced many changes including increasing the number of groundfish management areas from five to seven and adding more species-specific regulations (e.g., leopard shark and Pacific sanddab) in order to maximize fishing opportunities while limiting the catch of "overfished" cowcod, bocaccio, canary, darkblotched, widow and yelloweye rockfishes. As a result the only groundfish fishery, recreational or commercial, to close early in 2010 was the commercial greenling fishery.

- Commercial measures:
    - The boundaries of the trawl rockfish conservation area (RCA) closure north of 40°10' North Latitude near Cape Mendocino remained at 75 – 200 fathoms for two-month management periods 1, 2, 3, 5 and 6;, 100 – 200 fathoms during period 4. In periods 1 and 6, the RCA lines were modified to exclude certain petrale sole areas from the RCA.
    - The boundaries of the trawl RCA closure south of the remained at 100 – 150 fathoms year-round, with a closure of the shoreline – 150 fm around the offshore islands south of Point Conception.
    - The boundaries of the non-trawl RCA closure north of 40°10' North Latitude remained at 20 – 100 fathoms year round.
    - The boundaries of the non-trawl RCA closure south of 40°10' North Latitude remained at 30 – 150 fathoms between 40°10' North Latitude and Pt. Conception, and 60 – 150 fathoms south of Pt. Conception, including the offshore islands, year round.
    - The season lengths for groundfish in waters off California remained the same as in previous years.

- Recreational measures for groundfish including rockfish, cabezon, and greenlings (RCG complex); lingcod; leopard shark; Pacific sanddab and "other flatfish"; other federal groundfish; and associated state-managed species (rock greenlings, California sheephead, and ocean whitefish) included season length and depth/area closures:

- Northern Groundfish Management Area (Oregon border to 40°10' North Latitude, see Figure 1):
  - Season length: Open May 15 through September 15. Lingcod is open May 15 through Sept 15. Leopard shark within Humboldt Bay is open year round; outside of Humboldt Bay the same season as other species applies. Pacific sanddab and "other flatfish" are open year round. Divers and shore-based anglers are open year round for all species except lingcod which is open April 1 through November 30.
  - Depth restrictions: Fishing allowed shoreward of the 20 fathom contour line, except for Pacific sanddab and "other flatfish" which have no depth restrictions. No depth restrictions for leopard shark within Humboldt Bay; outside the bays the same 20 fathom restriction applies.
- North-Central North of Point Arena Groundfish Management Area (40°10' North Latitude to Point Arena, see Figure 1):
  - Season length: Open May 15 through August 15. Pacific sanddabs and "other flatfish" are open year round. Divers and shore-based anglers are open year round for all species except lingcod which is open April 1 through November 30.
  - Depth restrictions: Fishing allowed shoreward of the 20 fathom contour line, except for Pacific sanddab and "other flatfish" which have no depth restrictions.
- North-Central South of Point Arena Groundfish Management Area (Point Arena to Pigeon Point, see Figure 1):
  - Season length: Open June 13 through October 31. Pacific sanddabs and "other flatfish" are open year round. Leopard shark is open year round within the following areas: San Francisco Bay, Bodega Harbor, Tomales Bay, Bolinas Bay and Drake's Estero Bay; outside these areas the same season as other species applies. Divers and shore-based anglers are open year round for all species except lingcod which is open April 1 through November 30.
  - Depth restrictions: Fishing allowed shoreward of the 20 fathom contour line, except for Pacific sanddab and "other flatfish" which have no depth restrictions. Leopard shark has no depth restrictions within the bays mentioned above; outside the bays the same 20 fathom restriction applies.
- Monterey South-Central Groundfish Management Area (Pigeon Point to Lopez Point, see Figure 1):
  - Season length: Open May 1 through November 15. Leopard shark is open year round within Elkhorn Slough, outside the same season as other species applies. Pacific sanddab and "other flatfish" are open year round. Divers and shore-based anglers are open year round for all species except lingcod which is open April 1 through November 30.
  - Depth restrictions: Fishing allowed shoreward of the 40 fathom contour line except for Pacific sanddabs and "other flatfish" which have no depth restrictions. Leopard shark has no depth restrictions within Elkhorn Slough; outside the same 40 fathom restriction applies.

- Morro Bay South-Central Groundfish Management Area (Lopez Point to Point Conception, see Figure 1):
    - Season length: Open May 1 through November 15. Lingcod is open May 1 through November 15. Pacific sanddab and "other flatfish" are open year round. Divers and shore-based anglers are open year round for all species except lingcod which is open April 1 through November 30.
    - Depth restrictions: Fishing allowed shoreward of the 40 fathom contour line except for Pacific sanddabs and "other flatfish" which have no depth restrictions.
- Southern Groundfish Management Area (Point Conception to U.S./Mexico border, see Figure 1):
    - Season length: Open March 1 through December 31. Lingcod is open April 1 through November 30. California scorpionfish, Pacific sanddab and "other flatfish" are open year round. Lingcod is open April 1 through November 30. Leopard shark is open year round within Newport Bay, Alamitos Bay, San Diego Bay and Mission Bay; outside the same season as other species applies. Divers and shore-based anglers are open year round for all species except lingcod which is open April 1 through November 30.
    - Depth restrictions: Fishing allowed shoreward of the 60 fathom contour line. California scorpionfish is limited to less than 40 fathoms January 1 through February 28; 60 fathoms the rest of the year. Leopard shark has no depth restrictions within the bays mentioned above; outside the bays the same 60 fathom restriction applies. Divers and shore-based anglers are open year round for all species except lingcod which is open April 1 through November 30.
- Cowcod Conservation Areas (in federal waters near San Diego, Figure 1):
    - Season length: Nearshore rockfishes, ocean whitefish and California sheephead are open March 1 through December 31. Lingcod is open April 1 through November 30. California scorpionfish, Pacific sanddab and "other flatfish" are open year round. The above mentioned species are open year round to divers and shore-based anglers, except that lingcod is open April 1 through November 30. Shelf rockfish, slope rockfish and other federal groundfish are closed year round.
    - Depth restrictions: Fishing allowed in waters less than the 20 fathom contour line.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

b. Nearshore Management

In 2002, the CFGC adopted California's Nearshore Fishery Management Plan (FMP) for 19 species (black, black-and-yellow, blue, brown, calico, China, copper, gopher, grass, kelp, olive, quillback, and treefish rockfishes; cabezon; kelp and rock greenlings; California scorpionfish; California sheephead; and monkeyface prickleback). All but California sheephead, rock greenling and monkeyface prickleback are also included in the Council's federal Groundfish FMP. The Nearshore FMP is based on a framework management approach that gives the CFGC a comprehensive management strategy to prevent overfishing, rebuild depressed stocks, ensure conservation, promote habitat protection and provide for non-consumptive uses.

The CFGC adopted seasonal closures, total allowable catch, and trip limits for cabezon, kelp greenling, and California sheephead. Additionally, the CFGC provided CDFG with authority to close any of these fisheries upon attainment of the total allowable catch. Seasonal closures coincide with federal groundfish closures in waters off the state of California.

Between 2008 and 2010, the CFGC took no action regarding commercial groundfish fisheries in California (state regulations provide for automatic conformance with federal regulations. No changes were made to state-managed species such as cabezon, kelp greenling and California sheephead. The CDFG and the CFGC both took action to make changes relative to the recreational fishery between 2008 and 2010 (see Section Inseason Monitoring Section above).

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

c. Restricted Access for Nearshore Fisheries

The State of California began a restricted access program for the commercial nearshore fishery in 2003. The Nearshore Fishery Permit is required to take 10 shallow nearshore species: black-and-yellow, gopher, kelp, China, and grass rockfishes, kelp and rock greenlings, California scorpionfish, California sheephead, and cabezon. These species can be taken with hoolk and line gear only; trap gear can be used with a trap endorsement. The Nearshore Fishery Permit program was set up on a regional basis with four regions: North Coast Region (Oregon border to 40°10' North Latitude near Cape Mendocino), North-Central Coast Region (40°10' North Latitude to Point Año Nuevo), South-Central Coast Region (Point Año Nuevo to Point Conception), and South Coast Region (Point Conception to the U.S./Mexico border). Nearshore Fishery Permit holders may only take these nearshore species within the region for which the permit is issued. Both transferable and non-transferable Nearshore Fishery Permits are issued.

A permit capacity goal was set for each nearshore region: 14 for the North Coast Region, 9 for the North-Central Coast Region, 20 for the South-Central Coast Region, and 18 for the South Coast Region. Until a region reaches its capacity goal, transferability is on a two-for-one basis, whereby two permits are purchased, one is retired and the other is used to fish. When the program began in 2003, a total of 224 permits were issued. In 2010, the number of permit had decreased to 167; however the number of permits in each region remains above its respective capacity goal.

The Nearshore Fishery Bycatch Permit program, which was started in 2003, authorized the take, possession, and landing of shallow nearshore species by vessels using only trawl or entangling nets (gill and trammel nets). Fifteen Nearshore Fishery Bycatch Permits were issued in 2010.

A Deeper Nearshore Species Fishery Permit program was also implemented in 2003. This permit allows the take of the following eight species of deeper nearshore rockfishes: black, blue, brown, calico, copper, olive, quillback and treefish. The permit is non-transferable, because there is no capacity goal for the fishery. Permit holders are not restricted by gear and may catch and land these species anywhere in the state where fishing is allowed. A total of 294 permits were issued in 2003; the number of permits issued decreased to 206 in 2010.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

C. By Species

1. Pacific Whiting

a. Primary Whiting Season

California shore-based landings of trawl caught Pacific whiting (*Merluccius productus*) totaled 2421 metric tons in 2010, 3.7 percent of the 65,938 metric ton optimum yield (OY) for the United States shore-based sector. Landings in 2010 represented a 35 percent increase from the 1792 metric tons landed in 2009. The increase in landings was largely due to an increased OY in 2010.

Nine vessels targeted whiting with trawl gear during the 2010 primary season. The primary whiting season in California waters north of 40° 10' North Latitude near Cape Mendocino started April 1, 2010. The area south of 40° 10' North Latitude opened April 15, 2010. The first landing occurred on May 1, 2010. On May 16, 2010, NMFS closed the primary season south of 42° North Latitude with 2421 metric tons of whiting landed. The fleet landed 82 percent of the 2961 metric ton allocation for the season south of 42° North Latitude. The coastwide season opened June 15. There were no shore based whiting landings in California during the coastwide season.

b. Shoreside Whiting Exempted Fishing Permit Fishery

Nine midwater trawlers participated in the 2010 EFP fishery and landed 2421 metric tons of unsorted whiting at six fish businesses with first receiver status. The trawlers fished under the provisions of an exempted fishing permit, which required maximized retention of total catch, and allowed them to land unsorted whiting catches at fish businesses with first receiver status without penalty for taking prohibited species or exceeding federal groundfish trip limits.

Total bycatch for all EFP whiting vessels weighed 47 metric tons. The bycatch included 266 Chinook salmon (0.50 metric tons total) for a harvest rate of 0.11 salmon per metric ton of whiting. Rockfish bycatch amounted to 46 metric tons with a harvest rate of 19 kilograms rockfish per metric ton of whiting. Rockfish bycatch represented the majority (98 percent) of the whiting bycatch and was primarily made up of chilipepper, splitnose and widow rockfishes at 24, 14 and 9 metric tons, respectively.

NOAA Fisheries' Shoreside Whiting Catch Monitor program conducted onboard monitoring the whiting fishery in 2010. At the docks, Pacific States Marine Fisheries Commission technicians collected species composition and biological samples of whiting and rockfish bycatch species.

Contributed by Mike Fukushima (mfukushima@dfg.ca.gov)

2. Chilipepper Rockfish

Exempted fishing permits have been granted in recent years to study the use of different gears, commercial and recreational, to target chilipepper rockfish inside RCAs currently closed to groundfish fishing. The RCAs were implemented to protect overfished rockfish species such as yelloweye and canary rockfish. This has resulted in underutilization of other healthy rockfish stocks (e.g., chilipepper rockfish). The goal of these studies is to determine if alternate fishing strategies can provide additional fishing opportunities for both recreational and commercial fisheries while protecting overfished stocks. At this time, there are no progress reports available.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

3. Kelp Greenling

The kelp greenling (*Hexagrammos decagrammus*) is one of the19 nearshore finfish species in California's Nearshore FMP. It inhabits nearshore kelp beds and rocky reefs to a depth of 150 feet, and is harvested by recreational and commercial fisheries from Point Conception to the Oregon border. Little is currently known about kelp greenling population dynamics, and kelp greenling was listed as having a "data-poor" status in a 2005 stock assessment review. Specifically, there is lack of sound scientific data pertaining to age and growth, maturity, abundance, distribution, and size class structure. The CDFG's Fisheries Independent Scuba Assessment Project initiated an age, growth and maturity study in November 2007. The specific objectives of the study are to: 1) determine age and growth parameters of kelp greenling using otoliths from all size classes and sexes; 2) verify periodicity of growth band formation by otolith edge analysis, and marking captive fish with oxytetracycline; 3) estimate length/age at maturity by visual and histological inspection of reproductive tracts; and 4) determine spawning season by comparing monthly gonadosomatic and hepatosomatic indices.

A total of 385 kelp greenling were collected through monthly sampling. Females ranged from 126 to 411 mm total length (n = 162). Males ranged from 116 to 391 mm total length (n = 223). Otoliths were examined and there was no significant difference between left and right otolith length. Maturity data collected indicates that kelp greenling spawn from September to January. Preliminary estimates of size at 50 percent maturity are 275 mm and 215 mm total length for females and males, respectively. Age data analysis is currently underway.

Contributed by Sean Hoobler (shoobler@dfg.ca.gov)

4. Cabezon

The cabezon (*Scorpaenichthys marmoratus*) is one of the 19 nearshore finfish species in California's Nearshore FMP. Successful implementation of the Nearshore FMP requires collection of missing essential fishery information. For cabezon, there is limited information available on population abundance, natural mortality and changes in biomass. In addition, previous age estimates for cabezon have not been validated. The CDFG's Fisheries Independent Scuba Assessment Project has initiated two studies. The first study is a multiple mark-recapture survey to collect information on catch, size, abundance and movement of cabezon and associated nearshore fishes in Carmel Bay, from Cypress Point to Yankee Point. The study area encompasses three marine protected areas (MPAs), allowing reserve effects to be investigated. [Note: Mark-recapture work was done in Carmel Pinnacles MPA. That data is not included here.] A total of 1673 fishes comprised of 16 species were caught in the Carmel Bay study areas during 2008-2010. Cabezon were the fourth most common species caught, composing 6 percent of the catch (107 fish). The recapture rate of fishes has been low (46 fish or 3 percent) but comparable to other studies in this area. Data from this study is currently being analyzed. The results of these studies will provide essential fishery information for use in future stock assessments and management decisions.

The second study is for age validation. Chemical age validation techniques will be used, because otolith edge analysis methods were unsuccessful in validating cabezon ages greater than 6 years in previous studies. Cabezon held in local aquariums will be injected with oxytetracycline or immersed in Alizarin red, marked externally for individual identification, and then sacrificed after one year. Periodicity of growth band formation can then be validated. In 2010, five adult cabezon were collected and injected with oxytetracycline. Due to complications, these fish were sacrificed from 8 to 11 months after injection. Marked otoliths are currently being processed.

Contributed by Diane Haas (dhaas@dfg.ca.gov)

D. OTHER RELATED ACTIVITIES AND STUDIES

1. Marine Life Protection Act (MLPA) Process

Overview: The MLPA, passed by California State Legislature in 1999, requires the CDFG to redesign its system of marine protected areas (MPAs) to increase its coherence and its effectiveness at protecting the state's marine life, habitat, and ecosystems. Significant advances have been made towards the successful implementation of the MLPA on a regional basis, and the development of a cohesive statewide network of MPAs statewide. Previous attempts to implement the MLPA on a statewide level through a single action were unsuccessful. As a result, a Memorandum of Understanding established in 2004 created a public-private partnership commonly referred to as the MLPA Initiative, which split the state into five separate regional MPA planning processes (Figure 2). Four of five regional MPA planning processes have been completed thus far; three of these have been adopted by the CFGC, two of which are currently in effect, the third will go into effect later this year. The fourth region is pending CFGC adoption and the fifth has yet to undergo a planning process. Options for a planning process in the fifth and final region are currently under development. This section provides a description of the MPA classification system used in California, includes an update regarding the status of each region and an overview of its MPAs, and provides information on research and monitoring of adopted MPAs in California.

a. Classifications:

There are different classifications used in California's MPA network. This includes three MPA designations, and one additional marine managed area designation:

- State Marine Reserve (SMR): Prohibits all take and consumptive use (commercial and recreational, living or geologic). Permitted research, and non-consumptive uses may be allowed.
- State Marine Park (SMP): Prohibits commercial take but may allow select recreational harvest to continue. Access for research and non-consumptive use is encouraged.
- State Marine Conservation Area (SMCA): May allow select recreational and commercial harvest to continue. Access for research and non-consumptive uses is encouraged.
- State Marine Recreational Management Area (SMRMA): Provides subtidal protection equivalent to an MPA, while still allowing legal waterfowl hunting to continue. No other uses are restricted.

Figure 2. Marine Life Protection Act Study Regions.

b. Regional Planning Update and MPA Overview:

Central Coast Region: This region extends from Pigeon Point south to Point Conception (Figure 2). A network of 29 MPAs covering approximately 204 square miles of state waters or about 18% of the study region has been in place since September 2007 (Table 2; Figure 3).

Table 2. Central coast region marine protected areas.

Type of Marine Protected Area (number)	Area (square miles)	Region (Percentage)
State Marine Reserve (13)	84	7
State Marine Conservation Area (14)	111	10
State Marine Park (1)	6	< 1
State Marine Recreational Managed Area (1)	3	< 1
Total (29)	**204**	**18**

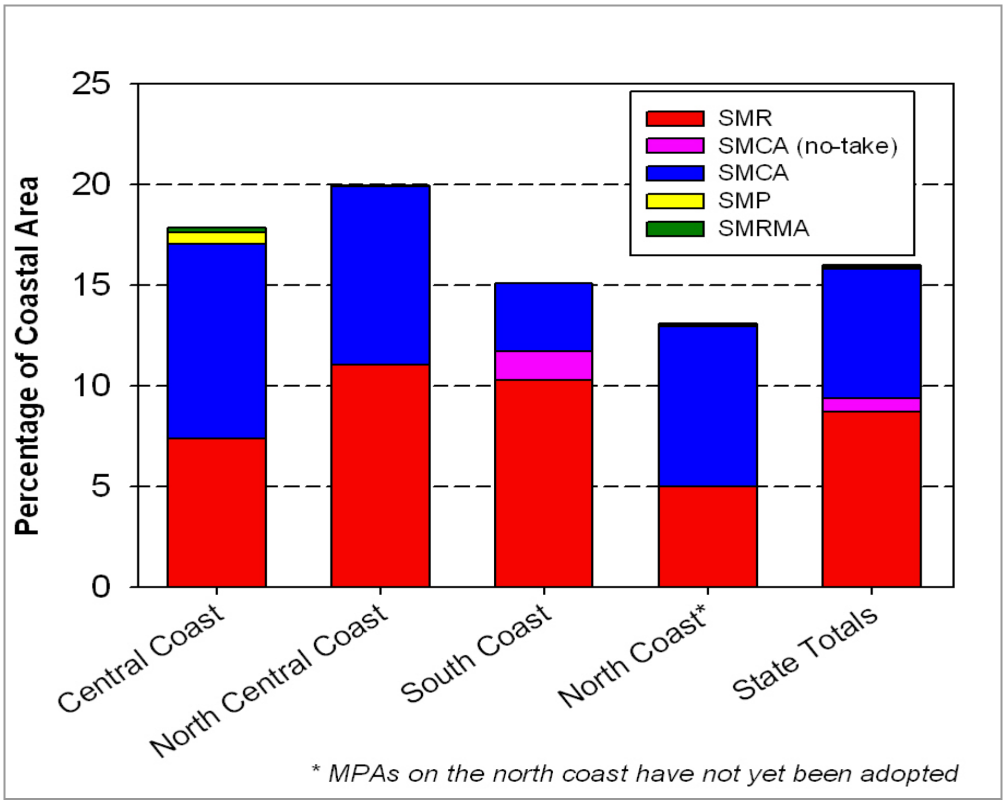

Figure 3. Marine protected area designation percentage by coastal region.

North Central Coast Region: This region extends from Alder Creek near Point Arena south to Pigeon Point (Figure 2). A network of 25 MPAs, including seven special closures covering approximately 152 square miles of state waters and representing approximately 20% of the study region has been in effect since May 2010 (Table 3; Figure 3).

Table 3. North central coast region marine protected areas.

Type of Marine Protected Area (number)	Area (square miles)	Region (Percentage)
State Marine Reserve (10)	84	11
State Marine Conservation Area (12)	68	9
State Marine Park (0)	N/A	N/A
State Marine Recreational Managed Area (3)	<1	< 1
Special Closures (7)	1	<1
Total (25)	**152**	**20**

South Coast Region: This region extends from Point Conception county south to the U.S./Mexico border (Figure 2). A network of 49 MPAs and 3 special closures (including 13 MPAs and 3 special closures previously established at the Channel Islands) covering approximately 354 square miles of state waters and representing approximately 15% of the region is expected to go into effect late 2011 (Table 4; Figure 3).

Table 4. South coast region marine protected areas.

Type of Marine Protected Area (number)	Area (square miles)	Region (Percentage)
State Marine Reserve (19)	242	10
State Marine Conservation Area (20)	80	3
No-take State Marine Conservation Area (10)	33	1
State Marine Park (0)	N/A	N/A
State Marine Recreational Managed Area (0)	N/A	N/A
Special Closures (3)	2	< 1
Total (49)	**354**	**15**

North Coast Region: This region extends from the California/Oregon border south to Alder Creek near Point Arena (Figure 2). The public planning process in this region occurred between July 2009 and February 2011. The planning process resulted in two final MPA proposals and additional recommendations for the CFGC to consider. The CFGC is expected to begin its formal regulatory process in mid-2011 with additional opportunities for public input.

San Francisco Bay Study Region: The San Francisco Bay Study Region (waters within San Francisco Bay, from the Golden Gate Bridge northeast to the Carquinez Bridge; Figure 2) is the fifth and final study region for consideration under the MLPA. The MLPA Initiative is currently developing an options report for how a MPA planning process might be approached in the San Francisco Bay Study Region. The options report will also consider other planning processes that have taken place within the study region, as well as lessons learned from previous regional MLPA planning processes.

c. Linking to the National System of MPAs:

To date, the CDFG has nominated the 25 MPAs and seven special closures adopted in the North Central Coast for inclusion into the United States National System of MPAs, in addition to the Central Coast MPAs previously nominated. As of the March 25, 2011 Federal Register notice, they have been officially listed as part of the National System of MPAs.

For more information, go to the MLPA website: http://www.dfg.ca.gov/mlpa.

2. Research on and Monitoring of Marine Protected Areas

Overview: One of the primary requirements of the MLPA is adaptive management. To facilitate this requires a comprehensive monitoring program to measure performance of MPAs relative to stated regional objectives and MLPA goals. This comprehensive monitoring program is being developed through collaboration between CDFG and the MPA Monitoring Enterprise. The MPA Monitoring Enterprise was created through the State's Ocean Protection Council and the Ocean Sciences Trust to coordinate the development of the MPA monitoring program, to house and analyze monitoring data, and synthesize results in a manner that assists managers and policy makers in adaptive management decisions. The MPA Monitoring Enterprise is currently in the process of developing monitoring priorities and a monitoring framework for the regional and the statewide networks of MPAs.

- *Central Coast MPA Monitoring Program:* The CDFG has begun initial plans to prepare a five-year review of the MPAs established in this region and a progress report to the CFGC is anticipated in late 2012. This report will rely on information collected from baseline monitoring studies conducted since 2007.

- *North Central Coast MPA Monitoring Program:* A comprehensive monitoring plan for MPAs in this region was developed through the MPA Monitoring Enterprise in partnership with the CDFG, and baseline monitoring projects for this region are currently underway in their second field season.

- *South Coast MPA Monitoring Program*: A comprehensive monitoring plan for MPAs in this region was developed by the MPA Monitoring Enterprise in partnership with the CDFG, was released for public review in April 2011. Proposals submitted for the South Coast Baseline Program are currently in review and projects that are awarded funding are anticipated to begin field work in the summer or early fall, pending MPA implementation. Approximately $4 million was approved by the California Ocean Protection Council and administered by Sea Grant for baseline studies.

- *Channel Islands MPA Monitoring Program:* In 1998, prior to enactment of the MLPA, a group of concerned citizens requested the CFGC establish a series of MPAs in the Channel Islands. Following a long process, the Channel Islands MPAs were implemented in 2003. Though not created under the MLPA, the Channel Islands MPAs will be considered in the MLPA process in the South Coast Region. Monitoring of the Channel Islands MPAs has reached its five year comprehensive evaluation. A special session dedicated to the five year evaluation was held at the California Islands Symposium on February 7 – 8, 2008. Monitoring projects included biophysical and socioeconomic-human use investigations. Please see http://www.dfg.ca.gov/marine/channel percent5Fislands/ for more information on the Channel Islands MPA monitoring.

- *CDFG Remotely Operated Vehicle (ROV) MPA monitoring*: Since 2003, the CDFG has used a ROV to perform visual surveys of fish populations and habitat in California's MPAs. The objective of these surveys is to establish baseline conditions inside and outside MPAs and to examine initial changes in fish size and density after MPA implementation. The ROV program works closely with the MPA Monitoring Enterprise to coordinate surveys with studies funded through the baseline monitoring programs. To date, extensive surveys have been completed in the Channel Islands (2003 – 2009), Central Coast Region (2007 – 2009), and North Central Coast Region (2009). The CDFG plans to continue ROV surveys in MPAs in the North Central Coast and South Coast regions in 2011 and 2012.

Contributed by Adam Frimodig (AFrirmodig@dfg.ca.gov) and Elizabeth Pope (EPope@dfg.ca.gov)

3. Baseline Population Study of nearshore species in Carmel Pinnacles State Marine Reserve, Carmel Bay

Carmel Pinnacles State Marine Reserve (Pinnacles) was established in September 2007 as one of 29 newly designated MPAs along the central coast of California. Prior to its implementation as an MPA, limited data had been collected on fish populations from this site. Over a three year period from 2008 through 2010, data on nearshore groundfish abundances, sizes, catch rates, and movements inside this MPA and in a nearby reference site at Carmel Point were collected by CDFG staff using mark/recapture methods. Fish were caught using both hook and line gear aboard a chartered vessel, and commercial live fish trap gear aboard a CDFG skiff. Sampling was conducted during summer through early fall each year; typically July through September. Species of interest included lingcod, cabezon, kelp greenling and rockfish. Following capture, fish were measured, tagged and released. Fish exhibiting excessive trauma or fish that were less than 20 cm total length were released without tagging.

Over three sampling years, a total of 87 volunteer anglers using hook and line gear caught 3449 fish, 2878 of which were tagged. The catch was comprised of 18 different species. Overall, more fish were caught outside the MPA than were caught inside, although fish were typically larger inside the MPA. Black, blue, canary, copper, olive, vermilion and yellowtail rockfish were caught more frequently at Carmel Point, while gopher, china and kelp rockfish were more common at Pinnacles. All other species were caught in similar numbers or too few were caught to report on. Blue, gopher and olive rockfish were the most common fishes caught both inside and outside of the MPA.

To complement hook and line sampling, a total 745 traps were deployed yielding 1237 caught fish, 1156 of which were tagged over the three years. Twelve species were represented in the catch. Gopher rockfish, china rockfish, and cabezon were the most common species trapped at Pinnacles, while gopher rockfish, black-and-yellow rockfish and kelp greenling were the most common fish trapped at Carmel Point. Gopher rockfish was overwhelmingly the dominant fish caught at both sites making up 74 and 80 percent of the catch at Carmel Point and Pinnacles, respectively. More fish were trapped inside the MPA than outside the MPA and fish inside the MPA were typically larger than those caught outside.

Collecting baseline data on fish communities at Carmel Pinnacles State Marine Reserve will provide an important metric for future comparison of population dynamics and MPA effectiveness. Data collected may also provide useful information for stock assessments for some "data-poor" species. This work complements similar studies being undertaken along California's central coast by researchers at Moss Landing Marine Laboratories and Cal Poly San Luis Obispo.

Contributed by Scot Lucas (slucas@dfg.ca.gov)

APPENDIX 1:

2010 CALIFORNIA GROUNDFISH COMMERCIAL FISHERY REVIEW

The 2010 California commercial groundfish harvest (Table 5) was approximately 14.3 thousand metric tons (31.4 million pounds), with an ex-vessel value of $20.5 million. Total harvest was 20 percent lower in 2009 compared to 2008, but remained essentially unchanged between 2009 and 2010. Revenue increased slightly, rising 4.5 percent in 2009 and 3.0 percent in 2010, totaling $19.9 and $20.5 million, respectively. Despite a 37.1 percent decrease in total landings between 2000 and 2010, revenue increased a modest 2.0 percent over the same time period. Much of the decrease in landings between 2000 and 2010 is due to reductions in allowable catch and limiting participation in various sectors of the groundfish fishery (e.g., groundfish trawl, sablefish fixed gear).

In 2010, 76 percent of the groundfish landed was taken by bottom and mid-water trawl gear, a slight decrease from the 80 percent observed in 2009. Line gear accounted for the second largest amount at 19 percent, a slight increase from 15 percent observed in 2009. Trap gear was steady at 4 percent in both 2009 and 2010, while gill and trammel net landings account for less than 0.5 percent of the total catch. Since 2000, there has been a 47 percent decrease in trawl landings due to increased restrictions and a vessel buyback program. Gill and trammel net gear decreased 91 percent due in large part to increased state and federal regulations. On the other hand, trap landings and hook and line gear landings increased 60 and 30 percent, respectively, between 2000 and 2010 as fishermen sought alternate ways to catch groundfish.

Pacific whiting, Dover sole, sablefish, thornyheads and petrale sole dominated California's 2010 groundfish harvest, making up approximately 81 percent of the state's landings (84 percent of groundfish revenue). Pacific whiting experienced a 35 percent increase in 2010 compared to 2009, with landings of 2427 and 1792 metric tons, respectively. The increase in landings was due to an increase in the allocation of Pacific whiting in 2010. Landings of Dover sole increased slightly (4.7 percent) in 2010. Sablefish landings increased by 9 percent while thornyheads were essentially unchanged. Petrale sole decreased 43 percent compared to 2009. Rockfish landings were virtually unchanged between 2009 and 2010; however, landings decreased 61 percent between 2000 and 2010 due to increased restrictions aimed at protecting overfished rockfish species (e.g., canary and yelloweye rockfish) resulting in lower allowable catches coastwide.

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

Table 5. California commercial groundfish landings (metric tons) for 2008-2010.

	2008	2009	2010[1]	2000	Percent change between 2000 and 2010
FLATFISH					
Arrowtooth flounder	44	45	68	26	158.6
Dover sole	3024	3167	2622	3287	-20.2
English sole	139	73	24	303	-92.1
Petrale sole	929	532	213	635	-66.4
Starry flounder	10	17	13	21	-36.9
Sanddabs	126	107	56	744	-92.5
Other flatfish	147	114	66	270	-75.6
ROCKFISH					
Bocaccio	7	6	4	25	-84.7
Canary	1	1	0[2]	16	-97.2
Chilipepper	103	241	342	447	-23.4
Darkblotched	30	46	17	11	51.9
Shortbelly	--[2]	0	0	4	-94.3
Splitnose	86	57	64	23	182.7
Widow	31	4	10	718	-98.6
Yellowtail	4	2	1	49	-97.8
Minor shelf	26	22	16	150	-89.2
Minor slope	205	222	182	326	-44.2
Black (north of 40° 10')	95	90	50	41	23.5
Minor Nearshore (north of 40° 10')	18	5	3	13	-74.6
Shallow nearshore (south of 40° 10')	55	52	54	85	-36.6
Deeper nearshore (south of 40° 10')	37	39	36	70	-48.7
Unspecified rockfish[2]	1	1	0	23	-98.0
California scorpionfish	4	3	3	19	-82.2
Longspine thornyhead	695	540	552	880	-37.3
Shortspine thornyhead	418	485	462	289	59.9
Unspecified thornyhead[2]	2	2	13	75	-82.6
ROUNDFISH					
Cabezon	23	18	23	116	-80.3
Kelp greenling	1	1	2	23	-93.0
Lingcod	70	57	47	54	-14.1
Longnose skate[3]	--	78	141	--	--
Pacific whiting	4944	1792	2427	4986	-51.3
Sablefish	1552	2249	2449	1859	31.7
Spiny dogfish	45	45	6	9	-37.6
Other fish	279	143	125	822	-84.8
TOTAL	**14,266**	**11,283**	**11,119**	**17,665**	**-37.1**

Notes:
1. Landings data for 2010 are preliminary.
2. Zero (0) indicates that less than 1 metric tons was landed; -- indicates no landings occurred.
3. Unspecified rockfish and unspecified thornyhead market categories were discontinued in 2001.
4. Longnose skate market category was added in 2009. Prior to that, longnose skates were included in the unspecified skate category.

Source: California Fisheries Information System.

APPENDIX 2:

2010 CALIFORNIA GROUNDFISH RECREATIONAL FISHERY REVIEW

The 2010 California recreational groundfish fishery caught approximately 641 metric tons (Table 6), based on estimates generated by the Recreational Fisheries Information network (RecFIN) from data collected by California Recreational Fisheries Survey (CRFS) samplers using both sampler examined catch and fish observed discarded dead. Recreational groundfish catch in 2010 was approximately 15 percent less than in 2009 and was likely due to participation in other fisheries or less effort as regulations were essentially the same in 2009 and 2010. Changes to the sampling protocol instituted in 2004 prevent a direct comparison between 2000 and 2010 recreational catch. However, given that the recreational fishery has seen increased restrictions since 2000, much like the commercial fishery, the overall catch is likely lower.

Rockfishes made up 77 and 78 percent of the recreational groundfish catch in 2009 and 2010, respectively. This is not surprising given that anglers most commonly reported bottomfish as the target species when asked by CRFS samplers. Of the rockfish, black and vermilion were the most frequently caught in 2009 and 2010, followed by brown, gopher and copper rockfishes. California scorpionfish, a closely related species in southern California, accounted for 5 percent of the rockfish catch both years. Of the non-rockfish groundfish, lingcod was most frequently caught at 10 and 9 percent in 2009 and 2010, respectively. Lingcod was followed by sanddabs, leopard shark, cabezon and California sheephead (not a groundfish species, but a state nearshore species).

Contributed by Traci Larinto (tlarinto@dfg.ca.gov)

Table 6. California recreational groundfish catch[1] (metric tons) for 2009-2010.

	2009	2010[2]		2009	2010
Flatfish					
Butter sole	--[3]	0.0[3]	Sanddabs	33.6	43.6
English sole	--	0.0	Sand sole	0.3	0.5
Petrale sole	0.6	0.3	Starry flounder	0.8	0.6
Rock sole	0.8	0.4	**Flatfish total**	**36.1**	**45.5**
Rockfish					
Bank rockfish	0.0	0.1	Halfbanded rockfish	0.4	0.4
Black-and-yellow rockfish	11.6	11.2	Honeycomb rockfish	3.5	4.0
Black rockfish	243.0	179.8	Kelp rockfish	4.2	6.2
Blue rockfish	45.3	45.9	Mexican rockfish	0.0	0.0
Bocaccio	46.5	56.9	Olive rockfish	24.4	11.9
Brown rockfish	60.3	69.3	Quillback rockfish	5.6	2.7
Calico rockfish	0.2	0.3	Rosethorn rockfish	--	0.1
California scorpionfish	66.0	63.3	Rosy rockfish	4.3	4.6
Canary rockfish	14.6	12.7	Speckled rockfish	6.6	7.0
Chilipepper	2.0	2.7	Squarepsot rockfish	2.7	1.6
China rockfish	19.9	16.5	Starry rockfish	23.8	18.6
Copper rockfish	59.8	47.8	Stripetail rockfish	0.0	0.0
Cowcod	--	0.0	Tiger rockfish	0.2	0.1
Flag rockfish	6.2	5.1	Treefish	7.9	5.3
Freckled rockfish	0.0	0.1	Unspecified rockfish	42.1	14.6
Gopher rockfish	57.4	75.9	Vermilion rockfish	130.4	139.1
Grass rockfish	9.2	5.7	Widow rockfish	1.5	0.7
Greenblotched rockfish	0.3	0.2	Yelloweye rockfish	4.6	1.3
Greenspotted rockfish	15.5	11.2	Yellowtail rockfish	49.0	24.3
Greenstriped rockfish	1.5	0.8	**Rockfish total**	**970.7**	**848.0**
Roundfish					
Cabezon	31.8	23.5	Rock greenling	0.6	0.3
California sheephead	31.7	20.1	Sablefish	0.0	--
Kelp greenling	14.6	10.4	Unspecified greenling	0.0	--
Lingcod	127.7	94.3			
Monkeyface prickleback	3.9	4.4	**Roundfish total**	**210.4**	**153.0**
Sharks and skates					
Big skate	0.5	0.0	Soupfin shark	0.4	1.2
California skate	0.0	0.0	Spiny dogfish	4.5	1.5
Leopard shark	34.9	34.6	**Sharks and skates total**	**40.4**	**37.4**
			GRAND TOTAL	**1258**	**1084**

Notes:

1. Recreational catch includes sampler examined catch and discarded dead catch.
2. Catch data for 2010 are preliminary.
3. Zero (0) indicates that less than 1 metric ton was caught; -- indicates no catch was recorded.

Source: The Pacific Recreational Fisheries Information Network (RecFIN).

OREGON'S GROUNDFISH FISHERIES AND INVESTIGATIONS IN 2010

OREGON DEPARTMENT OF FISH AND WILDLIFE

2011 AGENCY REPORT
PREPARED FOR THE 3-4 MAY MEETING OF THE TECHNICAL SUB-COMMITTEE OF THE CANADA-UNITED STATES GROUNDFISH COMMITTEE

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OREGON DEPARTMENT OF FISH AND WILDLIFE

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. MRP 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 current annual program budget is approximately $8 million, with about 70% coming from state funds including sport license fees, commercial fish license and landing fees, and a small amount of state general fund. Grants from federal agencies and non-profit organizations account for the remaining 30%.

B. MULTISPECIES STUDIES

1. Sport Fisheries Project

Sampling of the ocean boat sport fishery by MRP's Ocean Recreational Boat Survey (ORBS) continued in 2010. Starting in November 2005, major ports were sampled year-round. We continue to estimate catch during unsampled periods in minor ports 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. Two minor ports were sampled, during the winter of 2010-2011, to attempt to validate estimates for unsampled periods. Black rockfish (*Sebastes melanops*) remains the dominant species caught in the ocean boat fishery. Lingcod (*Ophiodon elongatus),* several other rockfish species, cabezon (*Scorpaenichthys marmoratus)* and kelp greenling (*Hexagrammos decagrammus)* are also commonly landed. Oregon's fishery for Pacific halibut (*Hippoglossus stenolepis)* continues to be a popular, high profile fishery requiring International Pacific Halibut Commission (IPHC), federal, and state technical and management considerations.

The ORBS program continued species composition, length and weight sampling of groundfish species at Oregon coastal ports during 2010. Since 2003, as part of a related marine fish ageing research project, lingcod fin rays and otoliths from several species of nearshore groundfish including rockfish species, kelp greenling and cabezon were gathered. 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 is monitored in-season for catch limit tracking purposes. In-season action was taken in 2010 to prohibit retention of cabezon by anglers fishing from boats. The shore fishery remained open. As in recent years, the retention of canary rockfish (*S. pinniger)* and yelloweye (*S. ruberrimus)* rockfish was prohibited year round. In order to remain within the yelloweye rockfish impact cap (via discard mortality), the recreational bottomfish fishery was restricted to inside of 20 fathoms from July 23 to the remainder of the year. 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, with Newport having the most 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 2011 and 2012.

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 comprised the majority of both shore- and estuary-based boat landings by number of fish, but have not dominated catch in recent years. ODFW continues to pursue funding opportunities to reinstate the shore and estuary sampling program.

Contact: Lynn Mattes (541) 867-0300 ext. 237 (Lynn.Mattes@state.or.us)

2. Yellowtail rockfish Exempted Fishing Permit

In 2009 and 2010, the Oregon Chapter of the Recreational Fishing Alliance (RFA-OR) in conjunction with ODFW received an exempted fishing permit (EFP) from the National Marine Fisheries Service (NMFS) to test experimental recreational fishing gear to target under-utilized yellowtail rockfish (*S. flavidus)* while avoiding the overfished yelloweye rockfish on select charter fishing trips. The experimental terminal tackle gear has a long leader (30-60 ft) between the weight and hooks, with a float to keep the line vertical in the water column. Ten charter vessels from three sections of the Oregon coast were to conduct three trips each over the course of the fishing season, to distribute trips spatially and temporally. ODFW supplied onboard samplers for each trip to gather information on total catch, gear set up, location, and to collect biological information from retained fish.

Due to a delay in issuance of the permit by NMFS, no trips under this EFP were conducted in 2010. NMFS issued the permit for 12 months from the data of issue, rather than 12 calendar months. Therefore, it is anticipated that this project will proceed with the planned 30 trips occurring in 2011.

Contact: Lynn Mattes (541) 867-0300 ext. 237 (Lynn.Mattes@state.or.us)

3. Commercial Fisheries Monitoring and Sampling

Data from commercial groundfish 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 continued in 2010 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 (Table 1).

Contact: Carla Sowell (541) 867-0300 ext. 222 (Carla.Sowell@state.or.us)

Table 1. Fish ticket landings, age and length data collected for major groundfish species.

Species	mt	Structures Collected	Lengths Collected*
Flatfish			
Arrowtooth flounder	2,295	1412	2232
Dover sole	6,885	1978	3163
English Sole	129	180	210
Pacific sanddab	100	804	834
Rex Sole	377	270	330
Flathead sole	2	10	10
Rockfish			
Black rockfish	102	1016	4208
Blue rockfish	3	349	427
Yellowtail rockfish	93	1083	1638
Nearshore rockfish[1]	7	88	658
Nominal shelf rockfish[2]	7	492	564
Nominal slope rockfish[3]	172	3742	3984
Thornyheads[4]	1,571	3469	4757
Other species			
Cabezon	23	9	769
Chub mackerel	49	1	1
Giant wrymouth	0	0	1
Greenlings[5]	18	49	1828
Jack mackerel	3	9	9
Longnose skate	764	399	1110
Other skates[6]	170	96	361
Other grenadiers	0	10	40
Pacific cod	55	342	374
Pacific grenadier	43	190	220
Pacific whiting (hake)	31,538	1130	3145
Sablefish	2,852	3744	4253
Spiny dogfish	125	50	113
Rebuilding species			
Canary rockfish	4	341	366
Darkblotched rockfish	149	2322	2824
Lingcod	77	214	1155
Pacific ocean perch	58	1971	2442
Petrale sole	507	2008	2753
Widow rockfish	31	1294	1381
Yelloweye rockfish	1	2	2

Notes: (1)Nearshore rockfish species are black and yellow, China, copper, gopher, grass, and quillback rockfish, (2) Shelf rockfish species are bocaccio, chilipepper, cowcod, greenspotted, greenstriped, pygmy, redstripe, rosethorn, rosy, silvergrey, speckled, stripetail, tiger, and vermilion rockfish, (3) Slope rockfish species are aurora, bank, blackgill, redbanded, rougheye, sharpchin, shortraker, splitnose, and yellowmouth rockfish, (4) Thornyhead species are longspine and shortspine thornyhead, (5) Greenling species are kelp, rock, and whitespotted greenling, and (6)

Other skate species are big, black, California, sandpaper, and starry skate, and (*) Lengths include lengths collected with age structures and length only measurements.

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. A manuscript summarizing the aurora rockfish maturity study was accepted for publication in *Environmental Biology of Fishes*. Additional sampling of Pacific ocean perch (*S. alutus)* was also conducted to examine interannual variation in abortive maturation (skip spawning) as a function of maternal age. Lab work analyzing maturity data for female quillback (*S. maliger)* and china (*S. nebulosus)* rockfish was completed and development of a report summarizing these results was started. Contact: Bob Hannah (bob.w.hannah@state.or.us)

5. Marine Finfish Ageing Unit

In 2010, the following primary tasks were completed by the age and growth specialist: 1) completion of production age reading for commercial black rockfish otolith samples from 2006 through the end of 2009; and 2) completion of production age reading for recreational black rockfish samples from 2006 to 2007. Since the age and growth specialist spends a significant amount of time on black rockfish age determination each year, the possibility of using otolith weight as a reliable predictor of age was explored. Age estimates, fork lengths and otolith weight data were collected from 535 black rockfish and analyzed. No significant difference was found between the weight of the left and right otolith. Results showed that fork length was significantly correlated with otolith weight, but similar to fork length, otolith weight measurements varied greatly among individuals from the same age class. It was clear that the same conclusion would be made even with the use of validated age data. In summary, since somatic and otolith growth vary widely among individuals, even within the same region and sex, otolith weight is not a good predictor of age for this species.

Additionally, progress was made on two age method comparison studies. In a cooperative study with WDFW, we have been testing the usefulness of otoliths as an alternative structure for lingcod age determination by comparing the age data and precision statistics for otoliths with similar data for fin ray age structures, which require significantly more time to collect and prepare. The preliminary results show that age reading precision is greater for fin ray sections than it is for broken-and-toasted otoliths, though this conclusion will not be finalized until age estimates are produced by a second age reader for each structure type. We are also working on a new and improved preparation method for longnose skate vertebral centra. A set of 135 longnose skate centra representing all available size classes of both males and females was selected from commercial landing samples. Age data was collected from centra pairs; one centrum prepared via the traditional thin-sectioning method, and another centrum, from the same individual, prepared via the histological method. Preliminary results from one age reader show that, on average, the histological method produces a larger number of growth bands, though a validation study would be required to determine correct interpretation of the bands. Also, the histological method produced more distinguishable growth bands when compared to the traditional method.

The age and growth specialist was away from work for the last two months of the year, working for ODFW's Recreational Fisheries Program as part of a job rotation opportunity.

Contact: Josie Thompson (541) 867-0300 x247 (Josie.E.Thompson@state.or.us)

6. Movement of rockfishes using acoustic telemetry

A manuscript describing the spatial and vertical movements of eight species of rockfish at Siletz Reef, a high-relief rocky reef on the open Oregon coast, was accepted at the *North American Journal of Fisheries Management*. A 4-month study of the movements of quillback, copper (*S. caurinus)*, black and brown (*S. auriculatus)* rockfish at Cape Perpetua, an area of low-relief emergent structure being considered for marine reserve status, was conducted in 2010. The data from this study, which utilized Vemco's VPS acoustic telemetry technology, is currently being analyzed to estimate home range and other movement parameters.

Contact: Bob Hannah (bob.w.hannah@state.or.us) or Polly Rankin (polly.s.rankin@state.or.us)

7. Discard mortality of rockfishes

A study of the 48 h post recompression survival of seven species of Pacific rockfish was completed using a purpose-built individual caging system designed to minimize cage effects. A manuscript is in preparation describing the results from this study. In 19 field deployments of 10-16 individual cages, 287 rockfish from 7 species were captured, scored for barotrauma, evaluated behaviorally and caged on the seafloor to determine survival. With the exception of 3 blue rockfish (*S. mystinus*), fish condition after cage confinements ranging from 41-71 h (and in one case up to 17 d) was uniformly excellent. At capture depths up to 54 m, post-recompression survival was 100% for yelloweye (n=25) and copper rockfish (n=10) and 77.8% for blue rockfish (n=36, solid sub-type). At capture depths up to 64 m, survival was 100% for canary (n=41) and quillback rockfish (n=28) and 90.3% for black rockfish (n=144). In black rockfish, survival was negatively associated with capture depth (m, $p<0.01$) and with surface-bottom temperature differential (°C, $p<0.01$). In blue rockfish, survival was negatively associated with capture depth ($p<0.01$). Severe barotrauma and surface behavior scores were not good indicators of survival potential across rockfish species, but were useful within species. Severe barotrauma was negatively associated with survival in both black and blue rockfish ($p<0.01$). Higher scores on reflex behaviors at the surface were positively associated with survival in these two species ($p<0.01$). These findings, in light of other research on rockfish submergence abilities after surface release, suggest that requiring hook-and-line fishers to use recompression devices or techniques like venting to help discarded rockfish submerge may increase survival of some species.

Contact: Bob Hannah (bob.w.hannah@state.or.us), or Polly Rankin (polly.s.rankin@state.or.us)

8. Development and testing of a video lander for studying demersal fishes on nearshore rocky reefs.

We continued to work on determining the utility of a video lander to study the abundance and distribution of demersal fish living on nearshore rocky reefs. Work in 2010 included completed surveys of portions of Stonewall Bank, Siletz, Seal Rocks, and Cape Perpetua reef systems. To date, more than 700 drops have been completed and only a handful of the "sacrificial base" portions of the lander have been lost. Visibility has been excellent at offshore reefs, such as Stonewall Bank, and variable, but mostly acceptable, at nearshore reefs. The data suggest that the lander design has a high retrieval probability from all types of reefs.

Contact: Bob Hannah (bob.w.hannah@state.or.us) or Matthew Blume (matthew.blume@state.or.us)

9. Shrimp trawl impacts on mud seafloor macroinvertebrate populations

In 2010, we conducted a study to directly evaluate seafloor impacts from shrimp trawl footropes using an underwater video system. We filmed several replicates of 1 h tows with each of 4 types of footropes and have analyzed the video data to generate counts and severity of interactions between the footropes and seafloor invertebrates. Not surprisingly, elevating portions of the footrope or utilizing low-friction components in footrope construction reduced the incidence and severity of these interactions.

Contact: Bob Hannah (bob.w.hannah@state.or.us), Steve Jones (steve.a.jones@state.or.us), Mark Lomeli (PSMFC), Waldo Wakefield (NWFSC).

10. Tests of Bycatch Reduction Devices (BRDs) with reduced vertical bar spacing in shrimp trawls

We conducted a field study in 2010 that examined how reduced spacing of vertical bars in rigid-grate BRDs reduced bycatch in shrimp trawls, with special emphasis on bycatch of eulachon smelt. Reducing bar spacing in a rigid-grate BRD from 25.4 mm to 19.1 mm reduced eulachon bycatch by 16.6% ($p<0.05$), with no reduction in ocean shrimp catch ($p>0.05$). It also reduced bycatch of slender sole, other small flatfish and juvenile darkblotched rockfish by 36.8%, 71.8% and 76.3% ($p<0.01$) respectively, with no effect on bycatch of whitebait smelt or YOY Pacific hake (*Merluccius productus*, $p>0.05$).

Contact: Bob Hannah (bob.w.hannah@state.or.us), Steve Jones (steve.a.jones@state.or.us)

11. Reducing eulachon entrainment at the footrope of a shrimp trawl

We conducted a field study in 2010 examining how footrope changes can be used to reduce entrainment and subsequent bycatch of eulachon and other small demersal fish in a shrimp trawl. An experimental footrope, modified by removing the central one third of the trawl ground line, reduced eulachon bycatch by 33.9%, ($p<0.001$). It also reduced bycatch of slender sole (*Lyopsetta exilis*), other small flatfish, and juvenile darkblotched rockfish (*Sebastes crameri*) by 80% or more ($p<0.001$), but had no effect on bycatch of whitebait smelt (*Allosmerus elongatus*) or Pacific herring (*Clupea pallasii*). The experimental ground line also reduced the catch by weight of ocean shrimp by 22.2% in hauls yielding commercial quantities of shrimp (>194 kg/haul, $P<0.0001$) and by 23.2% in all hauls. Variation in catch of ocean shrimp and eulachon in response to differences in fishing line height (FLH) between the paired semi-pelagic trawls indicated that reducing FLH may help reduce shrimp loss with the experimental ground line without a proportional increase in eulachon bycatch.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

12. Developing an improved rockfish species composition expansion model

Work was initiated to develop a better model to apply species composition data collected by port samplers to fisheries catch data. The original framework relies on a series of borrowing rules based on temporal (quarterly) and spatial (nearest major port) factors. Documentation on the original borrowing rules and rationale are no longer available. However, researchers at Oregon State University recently developed a model to estimate the existing borrowing rules. While many different fish families are affected by these rules, rockfish, due to the species diversity and nominal category designation (i.e. slope, shelf, and nearshore) are most in need of a better expansion model. This work consists of two prongs. First, develop a better model to apply the species composition data historically (from 1987-present); second, develop a statistical model and improve port sampling effort so there are fewer unsampled strata and to eliminate the need to "borrow" data from across quarters and nearby ports. Recent work includes a correspondence analysis of rockfish species composition across ports from 2005-2009 and exploration of the potential strata designation (spatial area defined, depth, gear, etc).

Contact: Susan Hilber (Susan.E.Hilber@state.or.us)

13. Marine reserves in Oregon

In 2009, the Oregon legislature passed marine reserves legislation (HB 3013) that directed state agencies to implement marine reserve recommendations made by the Oregon Ocean Policy Advisory Council (OPAC), provided for funding of marine reserves work, and required ODFW to develop a marine reserves work plan.

The specific call of the legislation was to implement the OPAC recommendations by:

1) Adopting rules to establish two marine reserve pilot sites;
2) Studying and evaluating potential marine reserves at three additional areas; and
3) Supporting the development of a new marine reserve proposal at one final area.

ODFW hired marine reserves staff to work on implementation of HB 3013, and a marine reserves work plan was finalized in November 2009, for work to be conducted during the 2009-2011 biennium. A summary of completed and planned work follows.

Pilot sites:

- The two pilot sites were established through state agency rule making. Harvest prohibitions are to take effect after baseline data have been collected.
- ODFW staff worked with external scientific experts and local community members to develop ecological and human dimension (socioeconomic) monitoring programs for current and future sites.

- ODFW staff is working with pilot site community teams to develop management plans for each site. Management plans are to be completed by June 2011 and will include: ecological and human dimensions monitoring plans, strategies for outreach and education, and strategies for compliance and enforcement.
- Biological and human dimensions baseline/year zero data for long term monitoring began in July 2010 and will continue through 2011.
- ODFW will provide monitoring reports in early spring of 2012.

Evaluation sites:

- Community teams representing diverse and balanced stakeholder interests, as prescribed in HB 3013, were formed for each of the three evaluation sites. Teams met January-November 2010, one to two times per month.
- Each team evaluated the original proposal recommended by OPAC in 2008, as to whether the site met sideboards established by Governor's Executive Order 08-07. The teams concluded that the site is large enough to allow scientific evaluation of ecological benefits, but small enough to avoid significant economic or social impacts.
- In November 2010, all three community teams forwarded final marine reserve recommendations to ODFW.
  - The recommendations for the Cape Perpetua and Cascade Head sites were made with strong support of the community teams. The results are compromise proposals that included a marine reserve and less restrictive protected areas.
  - All voting members of the Cape Falcon community team voted in support of some type of modified marine reserve at the site, but could not reach full agreement on the exact size, shape and conditions for the reserve. In the end, the Cape Falcon team narrowly adopted the original marine reserve proposal forwarded to the team by OPAC.
  - ODFW used the community teams' recommendations and the information gathered throughout the community team process to forge marine reserve recommendations.

- ODFW consulted with OPAC in December 2010. Given the lack of strong support for the team's final recommendation for the Cape Falcon site, ODFW worked with OPAC and individual members of the Cape Falcon community team to modify the proposal to reduce negative social and economic impacts while maintaining a sound ecological footprint. ODFW also presented additional recommendations for marine reserve implementation that included details regarding: review and evaluation of the marine reserve system, commitment to funding, community engagement, monitoring and research, and mitigation associated with potential marine reserve sites. These recommendations were based on concerns raised during the community team process and were further bolstered during consultation with OPAC. After deliberation and discussion, OPAC reached a consensus supporting the ODFW package of site proposals and additional recommendations.

Contact: Cristen Don (Cristen.N.Don@state.or.us)

14. Hypoxia effects on seafloor communities

As part of an Oregon Sea Grant research grant, personnel from ODFW's Marine Habitat Project partnered with the Partnership for Interdisciplinary Study of Coastal Oceans (PISCO) to continue and expand documentation of the ecological effects, including disturbance and recovery, of recently discovered hypoxia events on seafloor communities. We conducted a survey of seafloor biota offshore of Cape Perpetua, Yaquina Head (Newport), and Siletz Reef with a Remotely Operated Vehicle (ROV) during spring and summer 2010. 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 continue the nearly-annual time series of ROV video data along a "permanent" transect line. We have monitored the Cape Perpetua reef complex regularly since 2000. Hypoxic events occurred on the inner shelf in 2010, but the oceanographic extent and duration of these events were not as extreme as in prior years (e.g., 2002 and 2006). However, we were not able to document post-hypoxic conditions.

Contact: Mike Donnellan (Michael.D.Donnellan@state.or.us)

15. Baseline Remotely Operated Vehicle survey of benthic biota in the Redfish Rocks Marine Reserve (MR) and Marine Protected Area (MPA) and associated reference sites

We completed baseline surveys of benthic biota occurring on deep rocky reefs (20-50 m) within the Redfish Rocks MR and MPA, and associated scientific control sites at Humbug Mountain and Orford Reef. Our objective was to conduct the first stage of a Before-After-Control-Impact study to assess the performance of these MPAs by rigorously quantifying the distribution and abundance of fish communities prior to administrative closure of the Marine Reserve and Marine Protected Area to fishing activities in January 2012. These data will be compared to data from a companion survey(s) conducted at a future date (TBD, pending funding availability and a determination of interval necessary for a reserve to "mature"). We used a ROV, newly equipped with a high definition video camera, and obtained approximately 45 hours of video footage over the course of 40+ 500-m strip transects within each area. Data processing is ongoing and a report will be produced during 2011.

Contact: Mike Donnellan (Michael.D.Donnellan@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. PIT tags (12mm x 2mm) were inserted in 4,133 black rockfish in 2010 during 20 days of fishing near Newport, Oregon. The total number of black rockfish tagged since the project began in 2002 is now 29,679. Carcasses of black rockfish are counted and electronically scanned for tags year-round upon being landed by recreational fishers. In 2010, 76% of the black rockfish landed in Newport and 31% of those landed in Depoe Bay were scanned for tags. We recovered 519 tags, all in Newport. All nine tag cohort years were recovered. We have had good recoveries each year and exploitation rates are less than expected for 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 2011 will increase 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 stock 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)

2. Photograph-based length estimation of recreational yelloweye rockfish discards

In 2010, we carried out a pilot project designed to collect data on the length distribution of yelloweye rockfish discarded in the recreational bottomfish and halibut fisheries off Oregon. Due to the prohibition on retention in most U.S. west coast fisheries, data of this type has become extremely limited in recent years. Anglers were asked to photograph any yelloweye encountered with a known-size reference object in the photograph frame. The relationship between the length of the fish and the size of the reference object in the photograph can then be used to estimate the length of fish using computer software. We used different approaches to collecting data from charter and private vessels because of their different operational modes. For the charter vessel fleet, we provided digital cameras to crewmembers of participating vessels, and asked that they photograph all yelloweye rockfish they encountered over the course of the season. For private vessels, we solicited participation at launch sites, provided participants with disposable film cameras, asked that they photograph any yelloweye rockfish encountered on their trip, and provided receptacles at convenient points for the cameras to be returned to. In terms of participation, our results were positive. For charter vessels, 20 vessels participated and all equipment was returned intact. For private vessels, we distributed 199 disposable cameras, of which 180 have been returned to date. In terms of usable photographs, results from the charter fleet were much more encouraging than from the private fleet. The charter fleet returned 115 photographs, of which 112 are useful for estimating yelloweye rockfish lengths. Private vessel participants returned only 13 photographs, most of which were not of yelloweye rockfish. Species photographed included canary, quillback, and copper rockfish. Only 3 photographs useful for estimating yelloweye rockfish lengths were returned by private vessel participants.

We are currently working on estimating lengths from all photographs, and are conducting comparisons of Adobe® Photoshop® and a software application specifically designed for this purpose, PHOFLEM, which was developed by Dr. Ta-Te Lin of the Department of Bio-Industrial Mechatronics Engineering, National Taiwan University.

Contact: Troy Buell (troy.v.buell@state.or.us)

D. PUBLICATIONS

Hannah, R. W. and P. S. Rankin. (in press). Site fidelity and movement of eight species of Pacific rockfish at a high-relief rocky reef on the Oregon coast. N. Amer. J. of Fish. Mgt.

Hannah, R. W. (in press). Use of a pre-recruit abundance index to improve forecasts of ocean shrimp (*Pandalus jordani*) recruitment from environmental models. CalCOFI Rep.

Hannah, R. W. (in press). Variation in the distribution of ocean shrimp (*Pandalus jordani*) recruits: links with coastal upwelling and climate change. Fisheries Oceanography.

Thompson, J. E. and R. W. Hannah. 2010. Using cross-dating techniques to validate ages of aurora rockfish (*Sebastes aurora*): estimates of age, growth and female maturity. Environmental Biology of Fishes 88:377-388.

E. PROJECTS PLANNED FOR YEAR 2011

1. Maturity studies

Work will continue on a report summarizing our maturity work on quillback and china rockfish.

Contact: Bob Hannah, (bob.w.hannah@state.or.us)

2. Rockfish movements

Analysis and write-up of the 2010 acoustic telemetry data from Cape Perpetua is planned.

Contact: Bob Hannah, (bob.w.hannah@state.or.us), or Polly Rankin (polly.s.rankin@state.or.us)

3. Testing a video lander for surveying rocky reefs

Work planned for 2011 includes a high-density lander survey of the northern portion of Stonewall Bank to evaluate the suitability of the boundaries of the yelloweye rockfish conservation area, as well as a pilot survey of Heceta Bank and Three Arch Rocks reefs, and development of a high definition version of the lander and a stereo-video version to try and obtain fish lengths from drop data.

Contact: Bob Hannah (bob.w.hannah@state.or.us), or Matthew Blume (matthew.blume@state.or.us)

4. Shrimp trawl impacts on mud seafloor macroinvertebrate populations

We will continue analysis and write-up of the 2010 data.

Contact: Bob Hannah, (bob.w.hannah@state.or.us)

5. Reducing eulachon entrainment at the footrope of a shrimp trawl

We plan to conduct a follow-up experiment to our 2010 footrope work to determine if reduced fishing line height can be used, with an absent central ground line, to improve shrimp catch without a commensurate increase in eulachon entrainment.

Contact: Bob Hannah (bob.w.hannah@state.or.us), Steve Jones (steve.a.jones@state.or.us)

6. Evaluation of eulachon behavior when exiting a shrimp trawl

We plan to conduct a study using high-definition stop-motion video to view the condition of eulachon and other fishes as they exit the escape opening of a bycatch reduction device in a shrimp trawl. The goal is to develop methods to evaluate the degree of exhaustion and residual reflex behaviors to shed light on the potential for post-exclusion mortality.

Contact: Bob Hannah (bob.w.hannah@state.or.us), Steve Jones (steve.a.jones@state.or.us)

7. Discard mortality of rockfishes

Additional planned work for 2011 to extend 2010 studies on yelloweye and canary rockfish into deeper waters has been postponed due to concerns that the modest impacts on yelloweye cannot be sustained without impacting Oregon's recreational fishery seasons. This work can hopefully be conducted in the next few years after allowable impacts have increased.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

8. Continue developing an improved rockfish species composition expansion model

We plan to continue to explore the coefficient of variations (CVs) for various potential strata to include in the new model as well as to collaborate with fisheries scientists and statisticians at Oregon State University to develop a better historical model to apply to existing catch data as well as develop a statistical model, and potentially reform port sampling protocol, to eliminate borrowing of data across quarters and ports, and introduce error terms into the predicted species compositions.

Contact: Susan Hilber (Susan.E.Hilber@state.or.us)

9. Marine Reserves

ODFW has forwarded recommendations to the 2011 Oregon Legislature. The Legislature is currently considering a marine reserves policy bill and ODFW Marine Reserves Program funding for the 2011-2013 biennium.

Contact: Cristen Don (Cristen.N.Don@state.or.us)

10. Baseline Remotely Operated Vehicle survey of benthic biota in the Redfish Rocks Marine Reserve (MR) and Marine Protected Area (MPA) and associated reference sites

Data processing is ongoing and a report will be produced during 2011.

Contact: Mike Donnellan (Michael.D.Donnellan@state.or.us)

Washington Contribution to the 2011 Meeting of the Technical Sub-Committee (TSC) of the Canada-US Groundfish Committee

May 3rd – 4th, 2011

Edited by

Tien-Shui Tsou

Contributions by

Yuk Win Cheng
Corey Niles
Wayne Palsson
Kurt Stick
Farron Wallace
Lorna Wargo

Washington Department of Fish and Wildlife

May 2011

Review of WDFW Groundfish Research, Assessment, and Management Activities in 2010

A. Puget Sound Area Activities

1. Puget Sound Groundfish Monitoring, Research, and Assessment

(Contact: Theresa Tsou 360-902-2855, tien-shui.tsou@dfw.wa.gov; 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 2010 bottom trawl survey. Unit tasks are primarily supported by supplemental funds from the Washington State Legislature for the recovery of Puget Sound bottomfish populations. 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 and Final Environmental Impact Statement

Twenty-eight 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. During the past two years, staff worked with fishers and citizens to create a Puget Sound Rockfish Conservation Plan. The plan was developed through the Washington State Environmental Policy Act, and a draft EIS was open for public comment in late 2009. Public comments were reviewed in early 2010 indicating a desire for more information and inclusion of the Neah Bay area in the plan. The DEIS was revised and a new comment period was held in the spring of 2010. Comments were reviewed and the plan revised during the remainder of 2010.

Highlights of the FEIS and Puget Sound Rockfish Conservation Plan are:

- Received 1,102 comments from 306 organizations or individuals.
- Geographic scope of plan was extended to include the Strait of Juan de Fuca from Cape Flattery east.
- Eight elements in the plan: Natural Production, Habitat Protection and Restoration; Fishery Management; Ecosystem; Monitoring Evaluation and Adaptive Management; Research; Outreach, Education and Ecotourism; and Enhancement (Artificial Habitat and Hatchery Production).

- Habitat Protection and Restoration: Develop a science based system of marine reserves that, with other actions, achieves the natural production objectives by protecting significant amounts of rockfish stocks, their habitats and ecosystems.

- Fishery Management: Improve system to report lost gear. Evaluate the potential effectiveness of voluntary and mandatory reporting and marking systems to prevent the accumulation of derelict gear to reduce rockfish mortality.

- Monitoring and Research: Forge partnerships with scientists & citizens to evaluate the effectiveness of conservation. WDFW co-sponsoring the Salish Sea Rockfish Research Workshop in June.

- Outreach, Education and Ecotourism: Added ecotourism to this element to capture importance of providing non-consumptive recreational opportunities.

- Enhancement: Achieve natural production objectives through use of hatchery production to rebuild depleted rockfish stocks; and artificial habitats consistent with the hierarchy of habitat protection and mitigation approaches.

b. ESA Petition for Deep-water Rockfishes

On April 28, 2010 NOAA, Fisheries listed three species of rockfish under the auspices of the Endangered Species Act. This list was put into effect on July 28, 2010. WDFW staff worked cooperatively to address the concerns over the listed species and together reviewed fisheries that might pose a threat to the rockfishes. WDFW responded and close or restricted several fisheries. The commercial bottom trawl, dogfish set net, and dogfish set line fisheries were closed by emergency regulation on July 27th, 2010 and permanent regulation changes were filed for consideration by the Washington Fish and Wildlife Commission. Earlier in the year, the Fish and Wildlife Commission acted to reduce the catch of ESA-listed rockfishes and other depressed rockfish stocks by prohibiting the retention of rockfish east of Port Angeles and prohibiting fishing for bottomfish in waters deeper than 120 feet east of Cape Flattery. The Commission also reduced the recreational rockfish limits in the Neah Bay area to only allowing six black or blue rockfishes per day. In the Sekiu area, a limit of one to three black rockfish depending upon the time of year. WDFW staff have been working to complete a Incidental Take Permit and Fishery Conservation Plan to address takes of the listed rockfishes by ongoing recreational and commercial fisheries.

c. 2008 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 m^2) 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, bocaccio, widow 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 was completed at the end of the 2009. Initial results found 420,000 quillback rockfishes and 535,000 copper rockfishes occur in the SJA. Standard errors for these common species were less than 14%. A manuscript is being prepared describing the methods and population survey results.

d. 2010 ROV Stereoscopic Survey of the San Juan Islands

MFS staff planned and began a new ROV survey of the San Juan Archipelago during in fall of 2010 based upon the success of earlier ROV survey. The survey design was based on a stereoscopic approach, similar to a systematic survey that aimed to survey all depth strata and habitats with one tool. The survey grid included 168 stations and also allowed for adaptive stations to be occupied when ESA listed rockfishes or high densities of rockfishes were observed. The goal is to produce population assessments for all benthic marine fishes occurring across all habitat types (i.e., rocky and unconsolidated seafloors). Stereoscopic statistical methods will be used to analyze the fish and habitat data. Results from the fish analyses will be compared those from a stratified habitat-based ROV survey of the SJI in 2008 and recent bottom trawl surveys to examine differences in density, species composition, and size produced by the different survey designs. Portions of the survey were also conducted at night and a 48-hour study was conducted over the same transect line every 6 six hours corresponding to slack current conditions. The survey began in late September and continued through the remainder of the year. In contrast to the 2008 survey, equipment problems and poor weather prolonged the survey into 2011.

e. Continued investigation of the 2006 Recruitment Event of Young-of-the-Year Rockfishes in Puget Sound

During 2010, 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 2007-2009, 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 2009, MFS staff observed what appears to be an immigration of 2+ year- old black rockfish to 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 are also following the recruitment of copper and quillback rockfishes that occurred in 2008 in Hood Canal.

f. Low Dissolved Oxygen Conditions at Sund Rocks Marine Reserve

MFS investigated a minor fish kill in Hood Canal that occurred in late September 2010. 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 2010 to detect potential impacts to fish populations inhabiting the local area.

During 2010, oceanographers did not observe any replenishment of bottom waters of Hood Canal with oxygenated waters from the Pacific Ocean. Dissolved oxygen in Hood Canal continued to decline during the spring summer in the deepest waters, which was in contrast to previous patterns when the middle water was the first to become hypoxic. Unusual fish behaviors were observed in early September when near surface oxygen concentrations were at 2 mg/L. By mid September, near surface oxygen concentrations were near 1 mg/L and fish were concentrated near the surface. On September 21st, southerly winds advected surface waters to the north and upwelled hypoxic waters to the surface.

On 21 September at 0630 at Hoodsport, MFS staff observed dead and dying spotted prawns on the shore and thousands of prawns and fish swimming along the water's edge. We inspected beaches at Potlatch, the Cushman Boat Ramp, Hoodsport Public Beach to the Hoodsport Hatchery, and Sund Rock Conservation Area. We found hundreds to thousands of dead shrimp and hundreds of fishes among the sites. We received a report from a citizen that dead shrimp were on the beach just south of Lilliwap. As we drove to Lilliwap from Hoosport, we saw thousands of spotted prawn along many sections of beach, especially south of Sund Rock. We noted, as did Ron Filgar-Barnes of the Skokomish Natural Resources office, that many fish and prawns were found dead in freshwater inlets along the beach. He also reported that there were no obvious mortalities at Union. On 22 September, we inspected a beach 2 miles north of Hoodsport and found hundreds of dead fish and spot prawns from the previous day. Interestingly, most dead fish were intertidal and shallow gunnels, pricklebacks, and sculpins. While the prawns looked fresh, most were in the shade during the day and in relatively good condition from the previous' days mortality event.

On 21 September, we conducted on dive at the Sund Rock Conservation Area. On our offshore to onshore transect, we found virtually all fish were in depths less than 20'. Most fish were at the Grotto in extremely dense schools and aggregations exceeding several hundred. Most were resting on the bottom or just above it and were oriented into the current and showing obvious buccal respiration. Lingcod and wolf-eel were also showing marked respiration and most wolf-eel were completely out of their dens as were several octopus. We saw one dead blackeye goby. At this time, the oxygen minimum was 0.3 mg/L at 45’ and was above 1 mg/L in waters shallower than 22’.

We documented 29 nominal species of marine fish and at least 3 species of invertebrates that perished during this fish kill. The occurrence of rockfish, lingcod, and wolf-eel in shallow water when oxygen concentrations are less than 2 mg/L in shallow water is consistent with our previous published work. The second day of the kill was more geographically extensive than the first day covering 5.7 miles of shoreline. We observed 880 dead fish and several thousand spotted prawns along the approximately one-half mile of shoreline that we checked. This rough sampling rate suggests that 10,000 fish many more prawns died during this event. Most fish were deep-water and sand oriented species likely showing that the hypoxic waters caused these species to be displaced to shallow water as waters with depleted oxygen rose to the surface. In particular, blackbelly eelpout, greenstriped rockfish, Dover sole, and rex sole have not been previously documented in our list of species affected by hypoxia. The eel-like gunnels typical of intertidal and shallow subtidal depths also perished showing their vulnerability to hypoxic waters at the surface. Fortunately, only a few rockfishes suffered mortality, and the strong recruitment of copper and quillback rockfishes from 2008 still appears to be intact.

g. 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 May through June 11th, 2010, 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.

This survey was the third “Index” survey of Puget Sound, a departure from the stratified – random designs use prior to 2008. This new design is used 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. 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. We occupied 51 index stations during 2009 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 22 survey days, we occupied 51 stations and conducted 102 bottom trawls (Figure 1). Some 100,000 individual fish among 89 species weighing 14 mt were collected. Spotted ratfish, English sole, and walleye pollock were the most common species in the samples in terms of weight, but this year, Pacific cod were the eighth-most abundant species. The cod measured between 18 to 64 cm and averaged 28 cm in total length, corresponding to a fish beginning its second year of life. The cod were present in all basins and the pattern suggests a strong 2008 year class. The climate of 2008 was one of the coldest since the mid-1970s supporting the idea that for two decades, cod have been limited in abundance by a warm climate.

h. 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 2010 included surveying a number of the Puget Sound reserves and comparable fished sites. Several reserves in central Puget Sound were visited six times during 2010 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 2009. 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 2009 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. Groundfish Trend Analysis

MFS staff began assembling historical catch and survey information to review the status of groundfish stocks in Puget Sound. Because inconsistent catch data have been collected over time lacking species composition, total catch, age composition, and other desirable attributes, demographic stock assessments and other population modeling are not possible for Puget Sound stocks. MFS began identifying and evaluating data limited techniques including DCAC, catch forecasting, and other trend analysis. The results will be ready in 2011.

i. Neah Bay Groundfish Management

The management of recreational and commercial groundfish fisheries were reviewed at the request of the Washington Fish and Wildlife Commission. The area lies east of Cape Flattery and west of the Sekiu area. The Washington Department of Fish and Wildlife (WDFW) held three public meetings during the summer of 2010 to discuss draft management alternatives and objectives for marine fish fisheries in the western Strait of Juan de Fuca. The draft proposals presented during the meetings were developed with input from an ad hoc citizen advisory group formed earlier this year and address recreational and commercial management of marine fish in waters stretching from the mouth of the Sekiu River west to the Bonilla-Tatoosh line in Marine Area 4 (Neah Bay). WDFW met with the ad hoc advisory group following the public meetings to discuss the comments received and to review additional material that WDFW staff developed in response to public input. Several alternatives to management were developed ranging from status quo to eliminating commercial fisheries for groundfish, reducing recreational catch limits and creating large marine reserves for bottomfish. New information added to the WDFW web site to provide more information on the members of the ad hoc focus group, more specific location information on the proposed closed areas and more habitat and biological information about the area under consideration. In addition to the new material, WDFW has revised Alternative 1 to include the proposed closure of commercial fisheries that have been inactive in the Neah Bay area. These commercial fishery closures were discussed with stakeholders during a separate process but were not originally included under the draft alternatives for public review.

The proposals and new information are available on WDFW's website at http://wdfw.wa.gov/conservation/fisheries/marinearea4/

WDFW staff briefed the Washington Fish and Wildlife Commission – a nine-member citizen panel that sets policy for department – on the revised alternatives and management objectives during the commission's December meeting in Olympia. A public hearing on the draft proposals also occurred at the December commission meeting. WDFW accepted comments through December 4, 2010. The Commission will consider and act on the alternatives during it February 2011 meetiung.

j. Other Activities

Tony Parra initiated a collaborative effort to describe a newly observed ecological phenomenon of small sculpins cleaning inside the mouths of lingcod. During surveys of marine reserves where larger lingcod are more common, WDWF divers have observed lingcod with their mouths agape. Further observations and photography found several species of sculpins inside the mouths or on the heads of the lingcod. While cleaner fish ecology has been described in several coral reef communities, the possible occurrence of these relationships in cold temperate communities underscores the subtle ecosystem relationships that need to be understood for ecosystem management.

Wayne Palsson was invited to an experts' workshop evaluating the impacts and methods to monitor tidal energy generation in the United States. This workshop was sponsored by the Department of Energy, Battelle Northwest, and the University of Washington. With the development of a pilot tidal energy project in Admiralty Inlet, there was an impending need to identify issues and approaches to monitoring prior to the initiation of the project. The proceedings documenting knowledge to date, rating potential impacts, and methods to monitor impacts is forthcoming.

2. Herring Stock Assessment (*Contact: Kurt Stick (360) 466-4345 ext. 243)*

Annual herring spawning biomass was estimated in Washington in 2010 using spawn deposition surveys. WDFW Fish Program staff based in the Mill Creek, La Conner, and Point Whitney offices currently conduct these assessment surveys of all adult herring stocks in Washington's inside waters annually. Stock assessment activities for the 2011 spawning season are in progress.

The herring spawning biomass estimate for all Puget Sound stocks combined in 2010 is 7,960 tons (see table below). The cumulative total is a considerable decrease from the 2009 total of 13,423 tons, less than half the recent peak of 17,765 tons in 2006, and also less than the mean cumulative total for the previous ten year (2000-2009) period of 14,115 tons.

The combined biomass of south/central Puget Sound (including Hood Canal) stocks in 2010 of 5,400 tons was the lowest estimated cumulative spawning biomass for this region since 1992. Cumulative biomass of north Puget Sound stocks, excluding the Cherry Point stock, in 2010 remained at a low level of abundance with a slight increase compared to 2009. The spawning biomass of the Cherry Point stock continued a negative trend in abundance in 2010, estimated to be only 774 tons, the lowest on record since estimates began in 1973. Estimated herring spawning activity for the Strait of Juan de Fuca region was also down in 2010, with an estimated spawning biomass of only 101 tons.

PUGET SOUND HERRING SPAWNING BIOMASS ESTIMATES (SHORT TONS) BY STOCK AND REGION, 2001-2010

	YEAR									
	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
Squaxin Pass	510	817	1025	557	755	436	828	2201	3150	1597
Purdy	500	125	496							
Wollochet Bay	11	359	45	35	27	67	52	152	106	133
Quartermaster Harbor	143	843	491	441	987	756	727	930	416	1320
Port Orchard-Port Madison	350	1755	1186	1589	2112	1958	700	1085	878	2007
South Hood Canal	214	156	223	70	244	210	176	207	166	187
Quilcene Bay	2012	3064	2531	2372	2530	1125	2342	916	2585	2091
Port Gamble	433	1064	208	826	774	1372	1257	1064	1812	1779
Kilisut Harbor	0	0	0	24	54	170	184	448	774	612
Port Susan	152	251	345	643	321	157	429	450	775	587
Holmes Harbor	673	1045	686	572	1297	498	673	678	573	275
Skagit Bay	402	1027	1342	1236	2826	1169	1245	2983	2215	2170
South-Central Puget Sound Total	5400	10506	8578	8365	11927	7918	8613	11114	13450	12758
Fidalgo Bay	103	15	156	159	323	231	339	569	865	944
Samish/Portage Bay	649	320	409	348	412	218	351	299	496	470
Int. San Juan Is.	24	0	60	33	285	41	67	72	158	219
N.W. San Juan Is.	0	0	0	0	0	0	0	13	131	62
Semiahmoo Bay	909	990	662	1124	1277	870	629	1087	1012	1098
Cherry Point	774	1341	1352	2169	2216	2010	1734	1611	1330	1241
North Puget Sound Total	2459	2666	2639	3833	4513	3370	3120	3651	3992	4034
Discovery Bay	26	205	248	42	1325	33	252	207	148	137
Dungeness/Sequim Bay	75	46	69	34	0	0	22	44	131	93
Strait of Juan de Fuca Total	101	251	317	76	1325	33	274	251	279	230
Puget Sound Total	7960	13423	11534	12274	17765	11321	12007	15016	17721	17022

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 Groundfish Monitoring, Research, and Assessment (*Theresa Tsou 360-920-2855, tien-shui.tsout@dfw.wa.gov; Farron Wallace 360-902-2712, Farron.Wallace@dfw.wa.gov) Marine Fish Science Unit*

Staff of the coastal Marine Fish Science (MFS) Unit includes Farron Wallace, Henry Cheng, Lorna Wargo, John Pahutski, Bob Le Goff, Donna Downs, Victoria Okimura, and Brian Walker. Unit tasks are primarily supported by the combination of state general and federal funds. The main activities of the unit include the assessment of groundfish populations off Washington coast, the monitoring of groundfish commercial landings, and the tagging project.

1. Black Rockfish Tagging Study (*Contact: Farron Wallace, 360-902-2712, Farron.Wallace@dfw.wa.gov; Lorna Wargo 360-249-1221, Lorna.Wargo@dfw.wa.gov*)

During 2010, a Washington Department of Fish and Wildlife Progress report "Summary of the Coastal Black Rockfish Tagging program" was completed. This report compiled nearly 30 years of black rockfish tagging studies, and is intended to serve as a key reference document describing changes in research objectives and methods that evolved over time as research built upon earlier studies.

In Washington State, the first black rockfish tagging project began in 1981. Since then, there were several major changes to objectives and scope of the project. These changes were reflected in the distribution of tagging effort over time. Between 1981 and 1985, black rockfish were tagged and released in selected areas located within the usual recreational fishing areas off the ports of Ilwaco, Westport and Neah Bay aboard both Department and recreational charter vessels. Between 1986 and 1990, an effort was made to allocate tagging effort in a random fashion throughout coastal waters fished by the Washington recreational fleet. Beginning in 1998, the study area was constrained to the central Washington coast in areas within the operation range of the Westport Charter. Between 1998 and 2000, distribution of tagging effort was based on the knowledge of the charter vessel captain and tagging crew to distribute tags "proportionally" to the resource in this area. In an effort to formalize methods and provide greater consistency in effort distribution through time, rocky habitat was identified and geo-referenced. Beginning in 2001, using this information, tagging effort was weighted proportionately and distributed relative to the amount of rocky habitat found in each 2-degree latitudinal block.

Tag release and recovery statistics reflected changes in research goals, objectives, and funding in both number of releases and in spatial distribution of the tagged fish releases. Between 1981 and 1990, a total of 52,042 fish were tagged with three-inch Floy FD-68B T-end spaghetti anchor tag of which 1,962 were recovered. In the early part of the study (1981-1985), tag recoveries were entirely dependent on voluntary returns. A catch sampling program was initiated in 1986 and continued through 1992 in an effort to recover tagged black rockfish from both the recreational and commercial fishery. Tagged black rockfish were also recovered through voluntary returns. Although the catch sampling program ended in 1992, voluntary returns continued through 1997. Beginning in 1998, fish were internally tagged with Code Wire Tags (CWT) or Passive Integrated Transponder (PIT) tags. A catch sampling program was again initiated to sample recreational catch for tags caught from the central Washington coast. Because these tags are not visible, there are no voluntary recoveries.

Tagged black rockfish have been part of the recreational catch for nearly three decades with some tagged fish recovered after more than 15 years at large. As a consequence of tag loss, fishing and natural mortality, and immigration and emigration tags from all release groups show a significant declining recovery rate through time. Although the largest proportion of tag recoveries occurred near the area of release, data clearly show that tag recoveries could occur at extended distances from the release area. However, there was a declining tag recovery trend with increasing distance from release area.

Although tagging objectives and methods have varied through time, tagging information has provided key information to determine population dynamics for the Coastal Washington black rockfish stock located between Cape Falcon, Oregon and Cape Flattery, Washington. Continuation of a data collection program that measures biomass or population trends such as the current tagging program is essential for monitoring the health of this important coastal resource and for supporting future stock assessment of this species. Much consideration has been taken to ensure proper evaluation of these data. Importantly, changes in spatial and temporal distribution of tag releases and the spatial-temporal changes in the fisheries need to be considered for proper interpretation of tag recovery rates and movement patterns.

The black rockfish tagging program was last reviewed in 2008 based on program costs and its efficacy in providing information needed for sustainable ecosystem management. An overall conclusion was that there was an urgent need to develop a long term monitoring program with greater spatial extent for multiple fish species to support Washington State fisheries management. The review recommended the use of fixed stations for capture and recapture of all fish species along the entire Washington coast using PIT tags. The experiment was first conducted in spring of 2009 and will continue through 2012 when an evaluation and comparison of study results will be preformed. The new study design is hoped to provide unbiased biological information on spatial movement and growth for multiple fish species commonly caught in the recreational fishery. It will also improve validity and reliability of estimates on abundance trends. Current protocols for tag release and recovery will continue.

2. Underwater Remotely Operated Vehicle Survey *(Contact: Farron Wallace, 360-902-2712, Farron.Wallace@dfw.wa.gov)*

Information from the WDFW/ International Pacific Halibut Commission (IPHC) cooperative survey has been incorporated into the Pacific Fishery Management Council's yelloweye rockfish stock assessment since 2001. Unfortunately, the survey catch rate information has varied substantially among years making the population trend information difficult to interpret. In an effort to better understand IPHC survey covariates, WDFW conducted a video survey of IPHC rockfish stations located off the Washington coast. The objectives of the survey were to gather data to establish habitat associations and explore catch rates of rockfish across time and area using ROV survey technology. This information will improve our knowledge and capability to develop a more efficient and cost effective way to survey rockfish populations in areas not accessible to traditional survey techniques and do not induce mortality. A long-term no-take monitoring survey program will significantly contribute to rockfish population status determination. These data will inform stock assessments that will in turn inform fishery managers to develop effective management measures to promote conservation of this valuable living resource.

We made over 2,300 fish observations of 36 species or species groups, fifteen of which were rockfish. Rockfish were encountered most frequently and found in highest density on most transects relative to other species. Several invertebrates such as sea urchins and feather stars were encountered most frequently and had highest densities among all other invertebrates. The primary habitat found among transects was gravel and sand as secondary habitat interspersed with boulders that were found in stacked piles or scattered. Many of the rockfish species including yelloweye, rosethorn, sharpchin/stripetail grouping, tiger, canary and yellowtail rockfish were found largely associated with or near boulder habitat.

Our study suggested that there may be diurnal effects on the relative survey abundance for a number of rockfish species. For canary, unidentified juvenile rockfish, unidentified adult and rosethorn rockfish we found higher survey abundance during day light hours compared with nighttime. For sharpchin/stripetail rockfish, we found highest abundance at dawn and dusk. However, due to the low number of observations for many other rockfish or other groundfish species it was difficult small to draw conclusion. Yelloweye rockfish, tiger rockfish, yellowtail rockfish, lingcod, sculpin and unidentified flatfish density was variable and without apparent diurnal pattern.

Visual survey methodology has a number of advantages and disadvantages for surveying rockfish, which have been well chronicled in this study and elsewhere. Some of the disadvantages include: 1) difficulties in fish identification, particularly for small fish or fish with cryptic coloration, 2) the potential for attraction or repulsion from the submersible, 3) variation in detection due to habitat type; for example, due to reduced visibility when the submersible maneuvered off bottom to avoid large boulders, or the failure to detect fish hiding behind boulders, 4) possible bias in collecting length measurements and 5) the limitation of the technique to quantifying the density of benthic species found in close proximity to the bottom. The advantages of the technique include the ability to: 1) sample in habitats that are inaccessible to other survey methods, 2) observe in-situ fish behavior, and 3) observe the distribution of fish and fish-habitat associations on a fine scale. It is also particularly valuable where additional mortality is not compatible with conservation for species and/or for species poorly sampled by trawl gear, such as yelloweye rockfish.

Given limited funding, expense is a major consideration in developing any groundfish survey. We found that costs associated with this survey were at least five times more expensive than the traditional longline survey methods for surveying the same nine study sites (IPHC rockfish stations) that were examined in this study. In the future, however, these costs could be substantially reduced by employing smaller vessels and crew than that used in this survey. This approach has been previously demonstrated to be effective by WDFW which recently completed several small-vessel ROV surveys near the San Juan Islands in Puget Sound. It is unclear how effective this approach would be in coastal waters given more extreme weather conditions and survey depths are greater than 60 fathoms. If no-take surveys are required we should must consider exploring less expensive ROV survey approaches and/or other no-take survey methods such as self-releasing pots.

This study has demonstrated that visual transect surveys could provide a unique no-take alternative method for estimating rockfish biomass in habitats not accessible to conventional survey tools. Whatever survey method is applied it is clear that relatively large-scale no-take surveys are needed to assess bottomfish densities in habitats that are not accessible to trawl survey gear. The low density and patchy distribution of yelloweye and many other rockfish species must be taken into consideration for developing a meaningful abundance time series that will be responsive to changes in abundance and useful to population dynamics models. Further study among several study sites and habitats will be required to better inform development of survey methods and measure the degree of possible bias associated with diel movement and avoidance behavior. Additionally, research that provides insight into the seasonal and/or social behavior patterns associated with prey or mating will be necessary to fully understand or interpret abundance estimates. Standardization will be required for any bottom tending survey gear such as video, setlines, pots or trawl. Because most groundfish species are habitat-specific in their distribution, careful survey design will be necessary to ensure precise and unbiased estimates of abundance. If direct observation surveys such as the present study were conducted on a routine basis, a time-series of yelloweye rockfish density data could be used to develop an index of the trend in abundance. Such an index would be indispensible information that could be incorporate into a demographic model of the yelloweye rockfish population for stock assessment analysis.

3. Stock assessment on data poor fisheries *(Contact: Yuk Win Cheng 360-902-2689, chengywc@dfw.wa.gov)*

MacCall (2009) proposed a depletion–corrected average catch (DCAC) method to estimate the sustainable yield of data-poor fisheries. The distribution and the expectation of sustainable yield from this method is currently estimated and bias corrected from simulation, requiring assumptions for total catch of the time series, and the independent normal distributions of relative decline in abundance, tuning adjustment, and natural mortality rate. In the proposed analytical DCAC method, uncertainty stemming from variation in the annual catch series is incorporated into the DCAC method to correct the estimates of sustainable yield uncertainty. It can correct the bias of the estimate of sustainable yield analytically without simulation. The distribution and expectation of sustainable yield are derived from a Taylor series approximation. Both DCAC simulation and the proposed analytical method results agreed well with each other in two examples from redfish and widow rockfish fisheries. Variation in annual catch does not affect the DCAC expectation but does affect the probability density of sustainable yield distribution. An advantage of the proposed method is that it can identify the proportion of the variance from each random variable. The proposed method can assist stock assessment experts in developing reasonable assumptions for the distribution of natural mortality. Thus, it can help fisheries scientists better understand the DCAC method and develop statistically defensible assumptions for managing data poor fisheries.

Publication:

Cheng, Y.W. 2011. Correcting bias and estimating uncertainty in sustainable yields from the depletion-corrected average catch (DCAC) method, WDFW research report series, in press.

4. Forecasting method on data poor recreational fisheries in Pacific Coast *(Contact: Yuk Win Cheng 360-902-2689, chengywc@dfw.wa.gov)*

For numerous, small, data-poor recreational and commercial fisheries in Washington State, and similar fisheries around the world, there is a need for alternative, low cost stock assessment and catch forecasting tools to enable fisheries management performance indicators to be developed.

Seasonal autoregressive integrated moving average (SARIMA) models are proposed to model the monthly catch of six data-poor and one data-rich recreational rockfish fisheries off the coast of Washington State. The forecasting results of the black rockfish catch in 2009-2011 agree with the forecasting results of existing abundance forecasting trends from Stock Synthesis II model. Both black and blue rockfish fisheries monthly catches are significantly ($P<0.05$) correlated with previous monthly catch, as observed from the fitted autoregressive parameters. Monthly catch from fisheries on all seven rockfish species are affected by the previous catch within the same year, as observed from the fitted moving average parameters. Yellowtail and blue rockfish fisheries catches are affected by the number of boat trips, but this is not true for fisheries on the other five species. The estimated seasonal moving average parameters imply that both copper and yellowtail rockfish fisheries are difficult to rebuild if they are over-exploited. Comparison of the annual forecasted catch based on SARIMA and traditional time series models shows that monthly catch should be used to model with SARIMA if data is available. From the model validation results, SARIMA model can be an alternative, low cost and reliable forecasting tool for both data rich and poor fisheries.

Publication

Cheng, Y.W. 2011. Predicting the catch of data-poor recreational rockfish fisheries off the coast of Washington State using SARIMAX models, WDFW report series, under external review.

5. Aging method of spiny dogfish *(Contact: Yuk Win Cheng 360-902-2689, chengywc@dfw.wa.gov)*

North Pacific spiny dogfish (S*qualus suckleyi*, Girard 1854) are aged with annuli count on the second dorsal spine. As this spine grows, enamel at the distal tip is worn away producing a zone of missing annuli. Sixty-seven male and 115 female dogfish specimens were randomly selected from captured specimens taken off the Washington coast in 2005-2006 and their fork lengths measured and spines taken. For the second dorsal spine from each specimen, five measurements were recorded. These measurements permit the estimation of the missing annuli count before the "no wear point" based on the known statistical distribution of annuli count after the "no wear point." Three diameter measurements were then modeled with nonlinear mixed effects (NLME) models that treated the number of missing annuli count as random effects. Resulting models were compared against Ketchen's (1975) "no wear point" method. The estimated missing annuli count and the measured spine base diameter fits well with the assumptions of an existing von Bertalanffy growth curve for this species. Ketchen's method produced an apparent underestimate of the mean missing annuli count for all dogfish with spine diameter at the no wear point less than 1.2 mm and greater than 4.6 mm. The NLME models provide an alternative method to estimate the missing annuli count of north Pacific spiny dogfish based on both sound biological and statistical properties.

At present, we have implemented the proposed statistical aging methods of the mussing annuli count in North Pacific spiny dogfish on all the data since 2005.

Publication:
Cheng, Y.W. 2011. Modelling the missing annuli count in North Pacific spiny dogfish (S*qualus suckleyi*) by nonlinear mixed effects models, International Journal of Applied Mathematics and Statistics, *in press*.

6. Inverse prediction in length-length conversion *(Contact: Yuk Win Cheng 360-902-2689, chengywc@dfw.wa.gov)*

Inverse prediction is a common method used in ecology, marine fish stock assessment, forest research, and many other biological fields. It is unlikely, however, that inverse prediction is unbiased if data is not available for refitting. I propose an inverse prediction method to estimate the linear regression coefficient in the absence of an intercept, along with 95% confidence intervals. The proposed method uses the linear regression estimate, its standard deviation, and basic data statistics. The proposed method provides results closer to actual known values and can also estimate the variance of the slope of inverse regression.

The proposed method has been used to obtain the fork length and total length conversion of spiny dogfish.

Publication:
Cheng, Y.W. 2010. Inverse prediction for fish length-length conversion, Fisheries Research, 106:112-114.

7. Stereological sampling protocol *(Contact: Yuk Win Cheng 360-902-2689, chengywc@dfw.wa.gov)*

Stereology is a spatial version of sampling theory. It was initially developed in biology and materials science as a quick way of analyzing three-dimensional solid materials from information visible on a two-dimensional plane section through the material. Stereological methods are almost “assumption free”. This means we do not need know the spatial distribution of habitats within the target survey area. In addition, it may be bias, inaccurate or change with time. Examples from Monte Carlo integration of a surface with points generated by random and systematic sampling are given. Extension to high dimensions, e.g., the spatial and diurnal scale in fisheries and salmon redd survey, are provided. Comparison of the assumptions and restrictions of fishery and stereological survey samplings are discussed. Edge effect and bias correction are illustrated with fishery examples, IPHC longline rockfish survey and groundfish bottom travel survey. With the combination of stereology and other existing survey methods, e.g., stratified sampling or adaptive sampling, it can provide extra unbiased spatial survey designs that can help fishery managers and scientists to reduce the transportation cost and staff time.

This new proposed has been applying to Pacific euchelon and Puget Sound rockfish ROV sampling.

Publication:

Cheng, Y.W. 2011. An alternative sampling approach for spatial fishery survey based on stereology. *In* Quinn, T.J., II, Ianelli, J.N., Cadrin, S.X., Wespestad, V., and Barbeaux, S.J. Report on a Workshop on Spatial Structure and Dynamics of Walleye Pollock in the Bering Sea, Seattle WA, July 2009. NOAA Processed Report, in press.

8. Collection of juvenile rockfish *(Contact: Yuk Win Cheng 360-902-2689, chengywc@dfw.wa.gov)*

Some populations of rockfish (*Sebastes*) species in the Puget Sound have been listed as Species of Concern by the State of Washington or under the US Federal Endangered Species Act, but very little is known about juvenile rockfish settlement and abundance trend, or their interaction with other fish species in Puget Sound. For fishery managers to develop management practices that accelerate the recovery of over-fished areas they need an understanding of the spatial and temporal trends in juvenile rockfish distribution and abundance as well as cost-effective recruitment monitoring techniques.

In 2005, a pilot experiment was conducted by the Washington Department of Fish and Wildlife to collect juvenile sea cucumber *(Parastichopus californicus*). The collector (Cheng and Hillier, 2011) is made of a commercial of oyster cultch bag filled with Pacific oyster (*Crassostrea gigas*) shell. Accidentally, we collected 11 juvenile rockfish and their sizes ranged from 45 m to 70 mm. From the collection results, it is clear that location, depth, and substrate influence the settlement of juvenile rockfish. The proposed collector can be used as a cost effective tool to define rockfish nursery areas and in addition, oyster shells can possible be used to enhance rockfish habitat. Further experimental design was suggested to test the effectiveness of different type of collectors.

Publication:

Cheng, Y.W. and Hillier, L. (2011). Use of Pacific oyster *Crassostrea gigas* (Thunberg 1793) shell to collect juvenile sea cucumber *Parastichopus californicus* (Stimpson 1857), *Journal of Shellfish Research*, 30:1-5.

9. Study of Eulachon Smelt (Thaleichthyus pacificus) off the coast of Washington State to Determine Bycatch Reduction Strategies in the Shrimp Trawl Fishery (*Contact: Lorna Wargo 360-249-1221, Lorna.Wargo@dfw.wa.gov*)

In 2010, the National Marine Fisheries Service listed the southern DPS (Distinct Population Segment) *Thaleichthyus pacificus*, also known as “eulachon” as threatened under the Endangered Species Act. Bycatch of eulachon in commercial fisheries, including the Washington ocean shrimp (*Pandalus jordani*) trawl fishery was identified as a moderate threat to the eulachon population. Bycatch rates of eulachon in the Washington ocean shrimp trawl fishery are unknown. Limited data exists for eulachon bycatch in the Oregon and California shrimp trawl fisheries through their participation in the National Marine Fisheries Service’s West Coast

Groundfish Observer Program, and from Oregon evaluations of biological reduction devices (BRD).

Landings in the Washington ocean shrimp trawl fishery have declined over the past two decades, however, the fishery has provided a relatively stable opportunity compared to other commercial trawl fisheries during this time. Management of the shrimp trawl fishery is achieved through a fixed season with rules governing mesh size, shrimp size, and BRD's. The trawl fleet operates out of two coastal ports and supports processors in each. The average annual total direct value of the fishery is about $3 million and whereas, the average direct value to individual fishers was about $60K up to 2000, since then the average has been over $100K per fisher due to the declining numbers of participants. In 2008, the direct value per fisher was approximately $200K. Closing the data gap will allow fishery managers to better understand and estimate bycatch in the shrimp trawl fishery. This information is important to ensure conservation needs for eulachon and other species are met while reducing the potential for lost fishing opportunity.

Specifically, this project seeks to determine the rate of catch of non-targeted species including eulachon in the Washington ocean-shrimp trawl fishery and collect eulachon for biological and genetic sampling.

Observers will be deployed from Westport and Ilwaco, Washington to observe onboard Washington licensed shrimp trawl vessels engaged in routine commercial fishing activity. For each trip during the fishery season, Washington licensed shrimp trawlers will be required to notify WDFW at least 24-hours in advance of leaving port. A dedicated cell phone will be used for this purpose and monitored by the project assistant. The project lead will schedule observer coverage for selected vessels. Since the number of active vessels can vary considerably weekly and monthly, selection for observer coverage will be on an opportunistic basis. Observers will be deployed on vessels in the order that notification is received and cycle through the fleet within constraints posed by over-time schedule limits, safety concerns or other factors.

Data will be collected to allow stratification by a variety of characteristics. Data collected by observers will include fish ticket numbers for each trip; and for each tow: location, depth, vessel speed, start and end time, estimated total catch weight, weight of discard by category, species composition of discard categories, weight of shrimp retained, weight of fish retained by category, catch of prohibited or protected species, and biological and genetic samples of eulachon**.** To the extent possible, at-sea data collection protocols will follow those outlined in the NMFS West Coast Groundfish Observer Program Manual.

To date, the project lead and four observers have been hired, undergone training and are ready to be deployed. Preseason meetings, one an Ilwaco and one at Westport were held with shrimpers to review project objectives and requirements. The pink shrimp fishery season opened April 1, but due to inclement weather and an initial strike by shrimpers for a better price, no fishing has yet occurred from Washington ports.

C. Coastal Groundfish Management *(Contact: Corey Niles, 360-249-1223, Corey.Niles@dfw.wa.gov), Intergovernmental Resource Management*

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.

Committee of Age-Reading Experts

2010 Committee Report

Prepared for the Fifty-second Annual Meeting of the Technical

Subcommittee of the Canada-USA Groundfish Committee

3-5 May 3-5 2011

Prepared by

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CARE 2010 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. There was no meeting in 2010.

Report Period
This report covers the work period 01 January – 31 December 2010. However, to promote timely reporting of work and recommendations occurring during the recent CARE workshop (April 2011), a separate Executive Summary of the 2011 CARE workshop is included in Appendix I.

B. CARE Subcommittee (Working Group) Reports

1. CARE Manual/Glossary Committee-Kamikawa, 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.

During 2010, two new sections for the manual were drafted by CARE members. B. Campbell produced a section on quality assurance/quality control procedures and Forsberg produced one on age determination of halibut.

2. CARE Website – Short (Co-chair & webmaster), Atkins (Co-chair)

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/.

Substantial work was completed on the CARE website in 2010:

2.1 The CARE Charter page was updated on the website. New sections (CASE Invoice Protocol, Edit Log) and Appendices A (CARE meetings minutes format), B (CARE annual report to the TSC) and C (CASE invoice for sample exchanges) were added. An additional appendix "Precision Test Statistics and Formulation" is yet to be drafted. In addition, the Charter's introduction page was revised to include an Index with links to enhance searching the Charter contents.

2.2 The Vice Chair, Rosenfield, chased down almost all missing CASE invoices for the exchanges listed on the websites' Structure Exchanges page carried out from 2006 – 2009. Short updated the exchange table with the missing CASE invoices and updated the page by adding links that connect to the CASE invoice for each exchange. Once the 2006-2009 CASE invoices were updated Rosenfield searched for age data resulting from exchanges 1998 – 2005, before CASE invoices existed. She has been successful in recovering some of these historical data which were transferred to CASE invoices and were updated to the Exchanges Table.

3. Charter Committee – Munk, MacLellan, 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 function of CARE and the responsibilities of its officers and members. The committee is responsible for facilitating changes and updates to the Charter.

The committee was not active in 2010.

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 is now mostly available found on the CARE website in the Structure Exchanges table.

There were three age structure exchanges initiated in 2010 and one exchange that started out in late 2009 that was concluded in 2010. Species exchanged were sablefish, Pacific whiting, Pacific ocean perch and lingcod.

D. Recommendations CARE ~ TSC

Recommendations are made by both CARE and the TSC to CARE during their meetings. Some recommendations may take more than one cycle to complete.

CARE did not initiate any new recommendations in 2010 because they did not meet that year. TSC made a recommendation to CARE in 2010 that would not be addressed until the CARE meeting in April 2011.

Status of 2010 or previous pending recommendations are summarized below:

1. 2006 Recommendations

1.1. CARE to CARE: Proposed changes to the original Summary of Age Reading Methods Table are mostly complete. The Species Aged Table is currently posted on the website and updated annually. The "detail" links to a page that provides the following information: agencies, species they have aged, how many they aged each year as well as the general location of stocks, age structure used, ageing method and if any validation has occurred.

2. 2008 CARE to CARE

2.1. CARE posted a disclaimer and citation to their website.

3. 2009 CARE to CARE

3.1. Members were encouraged to check the CARE forum on a regular basis to continue the trial to assess its usefulness. Atkins reported that use was not high in 2010. To cut down on time spent deleting spam accounts the forum membership was locked down so that new members could only be created by an administrator.

3.2. CARE proposed that a focus for the 2011 meeting be digital imaging. The membership was poled for input on the agenda in 2010. The agenda is planned to include a focus on image presentations, demos and discussions to review software, hardware, image taking protocols, annotation and storage options.

3.3. CARE submit a poster to IOS 2009: CARE successfully assembled and presented a poster regarding CARE history, accomplishments and activities.

3.4. Charter updates: Charter updates were accepted by the membership at the 2009 meeting. These (minor wording, Charter Edit log & Appendices: A. CARE meeting minutes format, B. CARE annual report to TSC & C. CASE invoice samples) have been posted to the website. Appendix D "Precision Test Statistics and Formulation" is yet to be written. The Charter's website introduction page has been revised to clarify & make contents easier to access by adding an index & links. No advancement was made to the recommendation to add a Working Group section to highlight their purpose and current activities with a link to a past achievements "archive" to the website.

3.5. Posting all CASE invoices to the website: All 2006-2009 CASE's have been posted on the CARE website that can be accessed by links on the Structure Exchanges Table. A search for pre-2006 exchanges to add CASE invoices to the table has turned up some additional CASE's to link to historical exchanges.

3.6. The Manual/Glossary Committee: The committee put forward an ambitious recommendation to review the current CARE manual and that any changes or updates be submitted to the CARE Manual Committee Chair by April 2010. The suggestions were also 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. No updates were forwarded by that April 2010. However, two new sections were drafted (halibut & QA/QC) in late 2010/early 2011 to present at CARE 2011.

3.7. The Sablefish Working Group: As recommended, the group conducted an exchange of AFSC known-age samples (15 fish) to test lessons learned from the CARE 2009 mini-workshop. A report on the results was completed and was circulated to participating agencies. The group was unable to meet in 2010.

2009 CARE to TSC (none made)

2009 TSC to CARE (none made)

2010 TSC to CARE

1. Recognizing the value of carbon dating and other potential uses of archived ageing material, TSC recommends that CARE examine the feasibility of preparing an on-line summary of the material that is archived by each of the west coast groundfish research agencies. This recommendation was added to the CARE 2011 agenda for discussion.

APPENDIX I

EXECUTIVE SUMMARY
2011 CARE Workshop

This Executive Summary of the recent 2011 CARE Workshop is appended to the '2010 CARE Annual Report to the TSC' in order to promote timely reporting of work that would otherwise not be reported till 2012, and to facilitate work and action to occur over the remaining year.

<u>Overview</u>
The 2011 CARE Workshop was held 11-14 April at Sand Point, Seattle, WA, USA at the Alaska Fisheries Science Center, hosted by Anderl/Helser and the Age and Growth program staff. A total of 38 individuals representing eight agencies attended (Table 2). An agenda from this workshop follows under Appendix I-A. This was an active and productive workshop, highlighted by the addition of one day to the front end of the general meeting to convene a Sablefish Working Group mini-workshop. Discussions took place regarding varied topics such as imaging, CARE's mandate and the usefulness of the CARE forum. There were six scientific presentations, notable accomplishments made by the working groups, participation by more/new CARE members in working groups and finally nominations to administration positions. There were no Recommendations made by CARE to the TSC, however, there were five Recommendations made by CARE to itself. CARE constructed a reply to the TSC to CARE 2010 recommendation.

Working Groups and Reports
There were four working groups active prior to/during and reporting at the Workshop. The same four (Website, Manual/Glossary, Charter, Sablefish) will be active during the next rotation.

1. Manual/Glossary Committee (<u>Kamikawa</u>, Goetz, Campbell, Russ, Failor)
   Goetz reported on Kamikawa's behalf and undertook the committee chair duties during the 2011 meeting. New participants in the committee are B, Campbell, Russ and Failor. Two new draft sections for the manual, halibut ageing by Forsberg and Quality assurance/Quality control by B. Campbell, were submitted. These will be reviewed by the committee and sent out for approval by the membership. During the meeting the CARE Chair asked the committee to review the 2009 CARE to CARE recommendation. The recommendation stands. The rockfish section was reviewed during the meeting and updates/revisions were identified. Goetz will take care of these revisions which will include a baked otolith section by Russ. The committee plans to work on the following new species additions to the manual: a hake section by McDonald and CDFO members, a lingcod otolith section by ADFG-Juneau members and a skate section by Matta, Gburski, Thompson & Russ. The age validation section was reviewed by Kastelle who agreed to provide minor revisions and updates. Goetz offered to draft a section on ergonomics. The committee generated a CARE to CARE recommendation for 2011.

2. Website Committee (Short, Atkins)
Short reported on work completed 2009 through to the 2011 meeting. The CARE citation and disclaimer have been added to the website. The Charter page had been updated with an index to link to Charter sections and includes a number of minor word changes and additions: Edit log and Appendices A, B & C. The structure exchange and Species Aged tables have been updated. Some agencies still need to provide Short with their 2010 species aged information. Still to be added to the website are updates for the Species aged table (2010) and all of the exchanges made in 2010. Short indicated that for security reasons and to fix some bugs CARE should consider updating the version of Joomla used to manage content of the system and submitted a CARE to CARE 2011 recommendation to that effect.

3. Charter committee (Munk, MacLellan, Goetz)
MacLellan reported for Munk that the committee was not active in 2010. MacLellan said that she would be stepping down from the committee and called for some new members to come forward. None did. MacLellan and Goetz met to discuss a CARE to CARE 2009 recommendation to identify and describe ongoing Working Groups in the Charter so that new members would understand the purpose of each group and promote membership. They suggested that perhaps the website might be a better platform for this information and would forward the discussion to Munk for further thought and present a recommendation at the next CARE meeting in 2013.

4. Sablefish Age Readers Ad hoc Working Group (MacLellan, B. Campbell, Charles, Gillespie; Anderl, Brogan, Kautzi; Munk, Niel, Hilwig, McNeel; McDonald, Cavanagh)
MacLellan reported that the group was very active since the 2009 meeting working towards completing the original three work objectives stated in 2008 and the 2009 mini-workshop agenda. An AFSC known-age sample (n=15) was sent to each agency with the exchange starting at the end of 2009 and was completed in early 2010. The results were analyzed & distributed to the group. Generally, all agencies had a tendency to under-age. The CV's calculated for each lab showed that the greatest age differences from known ages were highest with NWFSC (19.42%) followed by ADFG (16.48%), CDFO (11.74%) and AFSC (6.22%).

Instead of meeting in 2010, the group organized a virtual WebEx meeting on the 22nd March 2011 to make some focused headway towards completing the 2009 agenda. There were 15 participants from the four agencies. Further analytical results for otoliths measured in 2008 & new results for the 2009 exchange were presented and discussed. And, the results of the known-age exchange were reviewed.

Measurement project: Turns out there is no difference in size of the 1st year for the one year old otoliths sent by each agency. However, the ADFG zero age otoliths were smaller than other agencies. The thinking is that this may be a catch year issue associated with El Nino's. This needs further investigation.
2009 exchange: Was analyzed for the first time comparing ages against average age. It showed that there was a general tendency for NWFSC to age younger,

ADFG to age older & that CDFO & AFSC were closer to the average age. May do further analysis.

WebEx meeting: Focused in on procedure & pattern issues and reviewed otoliths, some known-age. The group discussed various pattern types and how to apply criteria to standardize. Known-age/not otoliths and/or their images were reviewed with agencies giving feedback on their interpretations for growth pattern issues such as juvenile years, grouping vs. splitting, older patterns and transition zones. The WebEx was a great tool that allowed each agency to annotate simultaneously to see how each group was interpreting patterns. However, all agreed that nothing is better than having the otolith in front of you to manipulate and view under your own scope, but this was a good 2nd best. Feedback was solicited from each group for an agenda of day 1 of CARE 2011.

Age Structure Exchanges (Vice-chair: Rosenfield)
Rosenfield reported on exchanges for 2009-2010 and activities aimed at updating past exchange information. An updated summary of the exchanges is covered in Table 1. There were nine exchanges in 2009 of which seven occurred before the 2009 CARE meeting and two after. Before the meeting there were: four sablefish exchanges from the Sablefish Working Group (ADFG-Juneau, AFSC, CDFO and NWFSC), one Pacific whiting (NWFSC, CDFO) exchange and two Pacific cod exchanges (AFSC, ADFG-Kodiak). Post meeting, there were two exchanges: a Pacific Whiting (CDFO, NWFSC) and a known-age sablefish exchange (AFSC, CDFO, NWFSC, ADFG-Juneau) that was initiated late 2009 and completed in early 2010. There were three age structure exchanges initiated and completed in 2010. Species were Pacific whiting (CDFO, NWFSC), Pacific ocean perch (WDFW, CDFO) and lingcod (ADFG-Juneau, ODFW). With respect to updating the Exchanges Table, almost all 2006 to present CASE invoices are now available on the website. Some of the pre-2006 CASE invoices are also available, but Rosenfield recommended that the next Vice-chair continue to try and track down more.

Business Session Highlights and Discussion:
Demonstrations: There were four demonstrations available for CARE members to sign up for: Forum (Atkins), imaging (Anderl), micro-milling (Kastelle) and elasmobranch vertebrae staining (Matta, Gburski). No one signed up for a Forum demonstration but several members did ask Atkins to create an account for them. Anderl worked with ten members (B. Campbell, MacLellan, Rodriguez, Hillier, Wells, Pollak, Russ, El Mejjati, Failor, McDonald) to demonstrate AFSC's soft/hardware used for imaging. The demonstration included information on Photoshop (image manipulation, hot keys, macros, annotation, layers, stitching, scale bars) and Portfolio (image storage). Six members (Russ, Pollak, Failor, Wells, Rodriguez, Thompson) attended Gburski and Matta's demonstration showing their staining technique for vertebrae. The stained-thin-section method was applied to big skate, *Raja binoculata*, longnose skate, *Raja rhina*, and Alaska skate, *Bathyraja parmifera*. Vertebral thin section removal from whole vertebrae was described. Thin sections were decalcified, stained, destained, soaked in glycerin, and slide mounted. Both untreated and stained thin sections were examined under a dissecting microscope for comparing preparations. Kastelle demonstrated AFSC's new micro-mill hard/software to nine members (Rodriguez, Hillier, Sizemore, Wells, Atkins, Gibbs, B. Campbell, MacLellan).

Agency reports: ADFG-all sites (Hilwig), WDFW (L. Campbell), AFSC (Helser), ODFW (Thompson), NWFSC (McDonald), IPHC (Forsberg) and CDFO (MacLellan) provided reports summarizing and updating agency activities, staffing, organization, new species and projects since the 2009 meeting.

Scientific presentations:
Six PowerPoint presentations were given: New CDFO groundfish age data sheet (MacLellan), Preliminary age validation of Pacific cod using stable oxygen isotopes (Kastelle), AFSC imaging system & its uses (Anderl), Digital reference collections via Photoshop (Wischniowski), Management of AFSC images (Short) and Digital camera & AFSC new micromill (Kastelle).

Discussion - three discussion topics of note:

1. There was considerable discussion surrounding a concern raised that CARE was not following its mandate. The conclusion by the members present was that this was not the case. They cited many current activities that they felt exemplified CARE's mandate of "documenting and standardizing methods used to age groundfish". It was agreed that CARE members were expected to participate in activities as their agency/work allowed. Members felt that the website, and information posted on it, was an efficient way to record CARE/member information and that it was a very useful tool that was not overly time consuming for CARE members to maintain. Newer members found the website to be particularly helpful. Longer term members recognized it as a permanent home for relevant CARE information that would otherwise be lost if left at individual member agencies.

2. The three year trial period for the CARE Forum was up and members discussed its usefulness. The Forum was not receiving heavy traffic, but some members felt it had been useful. The moderator and members felt that it still had potential to grow. In the future the forum could be used for discussions between multiple people, keeping things more organized than numerous e-mails back and forth. It could be a good way to disseminate information to CARE members when access to e-mail may be limited or unavailable. Along that vein, e-mails sometimes change and those keeping lists find themselves faced with "bounced" message issues; being able to post important information to the forum as well as to the regular mailing list gives the opportunity for those with invalid or changed e-mails to still access the information. The moderator indicated that the Forum did not require a lot of effort to maintain. Other options, such as Facebook, were briefly discussed. CARE members voted to continue supporting the Forum for one more rotation.

3. Imaging was the focus for the 2011 CARE meeting. Discussion on software (image editing, tagging, metadata, archiving), hardware and image taking protocols were facilitated through the PowerPoints presented by Anderl, Wischniowski, Short and Kastelle. Anderl followed up with demonstrations to a large number of members regarding AFSC imaging procedures and protocols. Photoshop was recommended as a standard for CARE members and exchanges. Imaging was recognized as a powerful tool for exchange and documentation (publication, training, reference collections) but

members clearly stated that imaging could not be substituted for actual scope work. Scopes provide superior flexibility when viewing ageing structures permitting readers to manipulate lighting and structure angles as needed to more accurately present and view growth patterns.

Administration nominations:
New officers will begin their duties as of 01 July 2011 for a two year rotation. They are:
CARE Chair: Sandy Rosenfield (WDFW)
CARE Vice-chair: Elisa Russ (ADFG-Homer)
Secretary: Chris Gburski (AFSC)

Workshop and Hands-on Session Highlights and Discussion:
A total of 27 readers reviewed 12 species. Members of the Sablefish Working Group spent several sessions together reviewing known-age otoliths from AFSC to calibrate application of criteria. Several elasmobranch agers worked together to look at thin sectioned skate vertebrae that had been stained. Some Pacific ocean perch readers gathered to review different methods of preparing otoliths and how otolith growth patterns might differ between Alaska and the West Coast. A group met to discuss new dogfish spine training opportunities. One group reviewed techniques, i.e., transect sites used to prepare otolith samples for LA-ICPMS (Laser ablation inductively coupled plasma mass spectrometry). Geoduck ageing and validation methods were discussed by another group.

Recommendations C.A.R.E.~TSC

Status of 2010 or previous pending recommendations are summarized below.

2006 Recommendations
CARE to CARE: Proposed changes to the original Summary of Age Reading Methods Table are mostly complete. Addition of a publication reference list, collated from agencies by El Mejjati for the 2011 meeting, to the website page was discussed. The Website Committee will work towards this in the next rotation.

2009 CARE to CARE
1. Members were encouraged to check the CARE forum on a regular basis to continue the trial to assess its usefulness. Atkins reported that use was not high in 2010-11. To prevent spam, forum membership can only be created by the administrator. Atkins will create the account for the user now.
2. CARE proposed that a focus for the 2011 meeting be digital imaging. The 2011 agenda focused on image presentations, demos and discussions to review software, hardware, image taking protocols, annotation and storage.
3. CARE submit a poster to IOS 2009: Complete.
4. Charter updates: Most aspects are complete. Addition of Appendix D "Precision Test Statistics and Formulation" to the Charter was discussed by Charter members and recommended that this information was best incorporated within the new Quality Assurance section of the CARE Manual. They need to find an author. No advancement has been made to add a Working Group section to the Charter to highlight their purpose and current activities with a link to a past achievements "archive" to the website. Charter

members present at the 2011 meeting discussed this and suggested that maybe this information might be better located somewhere else on the website other than the Charter. The committee needs to discuss further and make a recommendation to the next CARE meeting in 2013.

5. Posting all CASE invoices: Completed 2006 to present. Pre-2006 exchange invoices still require some work by the next Vice-chair.
6. The Manual/Glossary Committee: Put forward an ambitious recommendation to review the current CARE manual and that any changes or updates be submitted to the CARE Manual Committee Chair by April 2010. Two new sections were produced (halibut & QA/QC) that were presented to the committee for review. The committee produced a 2011 CARE to CARE recommendation to address the rest of the 2009 recommendation.
7. The Sablefish Working Group: The group met via WebEx in March 2011 and subsequently met the day before the general 2011 CARE membership for a mini-workshop to complete the original 2008 objectives and the 2009 mini-workshop agenda. The 2011 mini-workshop completed their agenda (Appendix I-B) that included a quick review of the WebEx meeting, sketched out an outline for a documentation process in the workshop and reviewed age determination issues with an aim to: 1) confirm/identify issues, 2) define boundaries & limitations of criteria & how they are applied and 3) to establish standards to encourage consistency between agencies. The group agreed that in the next rotation they would: 1) focus first documentation efforts towards updating the current manual sablefish section after which 2) they would consider pursuing publishing in an outside technical format. The group was tasked with reviewing and editing the documentation from the 2011 mini-workshop by end of May 2011, reviewing the current manual sablefish section with an eye towards updating, posting demonstrative images for figures on the FTP sight established for the WebEx and considering another WebEx meeting if deemed necessary.

2009 CARE to TSC (none made)

2009 TSC to CARE (none made)

2010 TSC to CARE

1. Recognizing the value of carbon dating and other potential uses of archived ageing material, TSC recommends that CARE examine the feasibility of preparing an on-line summary of the material that is archived by each of the west coast groundfish research agencies. This recommendation was added to the CARE 2011 agenda for discussion.

There was much discussion regarding this recommendation. A group was assembled that included representatives from most all CARE agencies. Most are custodians to extensive and historically long term collections. The challenges and effort to post inventories on the website were discussed. It was recognized that sample inventories could lead to positive and productive collaborations. However, sample security, management of requests for use, agency ownership and keeping the inventory updated were issues of concern. For reference, the CDFO provided a nationally accepted document that included management protocols for physical samples and considerations for requests to use archival collections.

Initial CARE Reply to TSC to CARE 2010 Recommendation

With regards to "…examining the feasibility of preparing an on-line summary of the material that is archived by each of the west coast groundfish research agencies":

Most agencies do not have publicly accessible age data sample inventories now, except AFSC. CARE recognizes that there are advantages and disadvantages associated with making inventories public. A CARE portal, the website, may be a possible platform to identify inventories. CARE requests clarification on what data the TSC envisions would be made available on said inventory. Then CARE members would consult their agencies regarding the TSC recommendation and will formulate a reply by year end.

2011 CARE to CARE

1. Manual Working Group: We recommend that CARE continue revision and expansion of the CARE manual to include sections on hake, lingcod otoliths, skates, age validation, and updated rockfish ageing information. In addition, we recommend that a section on ergonomics be added. These additions or revisions should be submitted to the CARE Manual Committee lead by Betty Kamikawa by April 2012 for committee review. The Manual Committee will submit all changes and updates to CARE for consideration at the 2013 CARE workshop. The CARE manual committee will review the halibut and QA/QC sections that were submitted at the 2011 CARE meeting and distribute final drafts to the CARE membership for final review and addition to the manual by the end of 2011.
2. Forum Working Group: We recommend that the Forum continue for another cycle.
3. Website Working Group- the CARE Website Committee recommends updating the CARE website content management system from JOOMLA version 1.12 to version 1.5 to remain current with technology for security and bug fixes. Update should be completed as time allows before the CARE 2013 meeting.
4. Recommendation to CARE members to review the method and validation species information on the species info website page to assess how current their information is and report updates or changes to Jon Short by the end of April, 2011. Reintroduce into the biennial meeting agenda that each agency updates this information.
5. CARE recommends that the effect of long term storage of otoliths and other age structures be a topic on the CARE 2013 agenda.

APPENDIX I - A

C.A.R.E. Agenda
(Committee of Age Reading Experts)
Canada-US Groundfish Committee
11-15 April 2011
AFSC, Sand Point, Seattle, WA, USA
Traynor Room

Monday, 11 April [9am-5pm]

Sablefish working group Mini-workshop agenda (to be determined)

Tuesday, 12 April

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

II. Host Statement

1. Welcome statements & host info: safety/security orientation, refreshments, social, etc (Thomas Helser)

III. Introductions

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

IV. Approval of 2011 Agenda

V. Working Group Reports [9 -9:30 am] Activity since CARE 2009 (5 min each).

1. TSC Meeting 2010 and 2009 & 2010 CARE reports (Shayne MacLellan)
2. CARE Manual (Betty Goetz)
3. Age Structure Exchanges (Sandy Rosenfield)
4. Charter Committee (Shayne MacLellan)
5. Website (Jon Short)
6. Forum (Nikki Atkins)

VI. CARE & TSC recommendations: [9:30 – 10 am]

1. Pre-2009 CARE to CARE status
2. 2009 CARE to CARE status.
3. 2010 TSC to CARE
4. New for CARE 2011? Craft through out meeting for Thurs am.

---Break --- 10 – 10:15 am ---

VII. Agency reports [10:15-10:45 am] (~3 min each) – No PowerPoints please - brief update (staffing, organizational, new species/projects etc.).

1. ADFG – (Kris Munk summarize all sites)
2. WDFW – (Lance Campbell)

3. AFSC – (Thomas Helser)
4. ODFW – (Josie Thompson)
5. NWFSC-PSMFC (Patrick McDonald)
6. California/MLML – (?)
7. IPHC (Joan Forsberg)
8. CDFO (Shayne MacLellan)

VIII. Topics for Discussion/New Business [10:45 – 11:30am]

1. Symposia/Conferences since CARE 2009 meeting & upcoming 10 min
2. Is CARE moving away from its mandate? (Kara Hilwig) 15 min
3. Discussion to assess Forum usefulness & future (Nikki Atkins) 15 min
4. Non-agenda items?

--- Lunch --- 11:30am -12:30 p.m. ---

IX. Scientific PowerPoint Presentations [12:30 -1:45pm]

1. New CDFO groundfish age data sheet (Shayne MacLellan) 10 min
2. Preliminary age validation of Pacific cod using stable oxygen isotopes (Craig Kastelle) 15 min
3. Digital reference collections via Photoshop (Steve Wischniowski) 15 min
4. AFSC imaging system & its uses (Delsa Anderl) 15 min
5. Management of AFSC images (Jon Short)
6. Digital camera & AFSC new micromill (Craig Kastelle) 5 min

X. Workshop Focus - Digital Imaging Topics for Discussion: [1:45 - 3:00pm]

1. Software – editing, tagging, metadata, archiving
2. Hardware
3. Image taking protocols

---Break --- 3:00 – 3:15pm ---

XI. Working groups & Hands-On Workshop [3:00 – 5:00pm]

1. Working Groups: Meet, discuss & formulate written recommendations through out rest of workshop. Prepare for Thursday morning & provide hard & digital copy to Chair.
2. Hands-On Workshop: Sign up for scope station space & time. Start on scope work.

Wednesday, 13 April

XII. Hands-On Workshop [9 am – 5 pm]

1. Hands on scope work
   a. Elasmobranch focus group
   b. All other species
   c. Sablefish working group?

XIII. Demonstrations: [see posted times at meeting]

1. Leica camera demo (Leica rep)
2. AFSC camera demo (Delsa Anderl)
3. Micromill demos (Craig Kastelle)
4. Forum demo (Nikki Atkins)

Thursday, 14 April

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

1. Recommendations 2011
2. Other activities finalization
3. Administration nominations
4. Schedule and location of 2013 Meeting
5. Closing - adjourn

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

1. Hematoxylin staining technique (Chris Gburski) 2 hrs
2. Sablefish Working Group – continue agenda

APPENDIX I - B

C.A.R.E. Sablefish Working Group Mini-workshop DRAFT Agenda
9am – 5pm, Monday, 11 April 2011

1. **Introductions** to any new members of group.
2. Quick review of **WebEx** meeting [9-9:15 am] to set the stage.
3. Sketch out an **outline for documentation**. Decide on end product format. [9:15-9:30am]
4. **Review** identified issues & **document** (secretary needed) as we go along with examples of known-age/not whole & imaged otoliths. Chose images for figures.
   1) Confirm/identify issues.
   2) Define boundaries & limitations of criteria & how they are applied.
   3) Establish standards to encourage consistency between agencies. [9:30am-4:30pm with lunch break]

   Suggested issues:
   - a. Burning technique – is this an issue?
     - i. Discussion
     - ii. Recommendations/actions
   - b. Identifying annuli vs checks
     - i. Juvenile years
       1. Whole surface
       2. ¾ view burnt XS's
       3. Counting axes
     - ii. Transition years (age ~3-10)
       1. Fast/slow-growing patterns
       2. Grouping/splitting
       3. Compressed zones (over/under-bite, sulcus wedges, dark zones)
       4. Counting axes
     - iii. Mature years
       1. Grouping/splitting
       2. Compressed zones (dark zones, etc)
       3. Counting axes
     - iv. Edge
       1. Time of year caught
       2. Counting axes
5. **Wrap up** (recommendations/further action) [4:30-5pm]

Table 1. CARE age structure changes initiated/completed from 2009-2010

CASE NO.	Originating Agency	Coordinator	Cooperator(s)	Date Initiated	Species	Sample n=	No. Readers	Status
09-001	ADFG	J. Niel	CDFO, NWFSC, AFSC	09 Dec	Sablefish	24	4	Complete
09-002	CDFO	S. MacLellan	ADFG, NWFSC, AFSC	15 Jan	Sablefish	24	4	Complete
09-003	NWFSC	P. McDonald	AFSC, CDFO, ADFG	21 Jan	Sablefish	24	4	Complete
09-004	AFSC	D. Anderl	NWFSC, CDFO, ADFG	15 Jan	Sablefish	20	4	Complete
09-005	CDFO	J. Groot	NWFSC	17 Feb	Pacific Whiting	100	2	Complete
09-006	NWFSC	O. Rodriguez	CDFO	15 Nov	Pacific Whiting	100	2	Complete
09-007	ADFG	S. El Mejjati	AFSC	08 Apr	Pacific Cod	13	2	Complete
09-008	ADFG	S. El Mejjati	AFSC	08 Apr	Pacific Cod	20	2	Complete
09-009	AFSC	D. Anderl	CDFO, NWFSC,ADFG	21 Oct	Sablefish	15	4	Complete
10-001	CDFO	J. Groot	NWFSC	14 Jan	Pacific Whiting	100	2	Complete
10-002	ADFG	K. Munk	ODFW,	06 Jan	Lingcod	72	2	Complete
10-003	WDFW	S. Rosenfield	CDFO	24 Feb	Pacific Ocean Perch	22	3	Complete

Table2. Attendees of the 2010 CARE Workshop, 11-14 April 2010, Seattle, WA

Last name	First name	Agency	Location
Anderl	Delsa	AFSC	Seattle
Atkins	Nikki	NWFSC	Newport
Benson	Irina	AFSC	Seattle
Blood	Cal	Retired	Seattle
Brogan	John	AFSC	Seattle
Campbell	Barb	CDFO	Nanaimo
Campbell	Lance	WDFG	Seattle
Cavanagh	Meredith	NWFSC	Newport
El Mejjati	Sonya	ADFG	Kodiak
Failor	Barbi	ADFG	Homer
Forsberg	Joan	IPHC	Seattle
Gburski	Chris	AFSC	Seattle
Gibbs	Linda	IPHC	Seattle
Goetz	Betty	AFSC	Seattle
Helser	Tom	AFSC	Seattle
Hiller	Lisa	WDFG	Olympia
Hilwig	Kara	ADFG	Juneau
Hutchinson	Charles	AFSC	Seattle
Johnston	Chris	AFSC	Seattle
Kastelle	Craig	AFSC	Seattle
Kautzi	Lisa	AFSC	Seattle
MacLellan	Shayne	CDFO	Nanaimo
Matta	Beth	AFSC	Seattle
McDonald	Patrick	NWFSC	Newport
McNeel	Kevin	ADFG	Juneau
Neil	Jodi	ADFG	Juneau
Piston	Charlie	AFSC	Seattle
Pollak	Andrew	ADFG	Homer
Rodriguez	Omar	NWFSC	Newport
Rosenfield	Sandy	WDFG	Seattle
Russ	Elisa	ADFG	Homer
Short	Jon	AFSC	Seattle
Sizemore	Bob	WDFG	Olympia
Thompson	Josie	ODFW	Newport