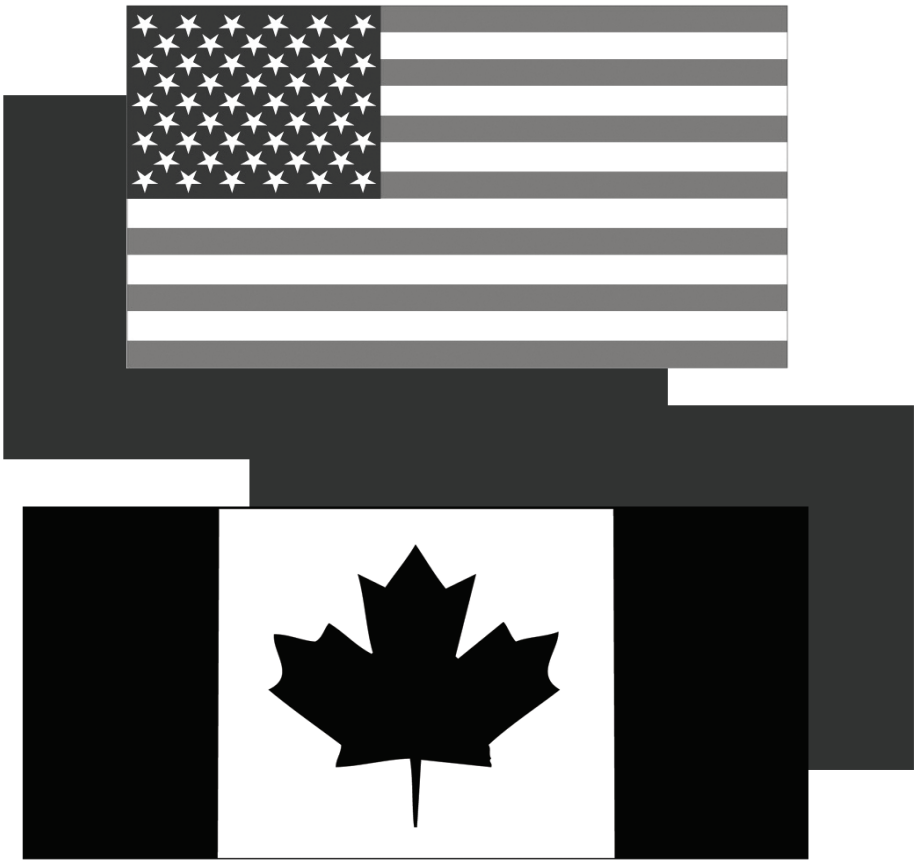
Report of the Technical Sub-committee of the Canada-United States Groundfish Committee

Forty-fifth Annual Meeting of the TSC
May 4-5, 2004
Captain Whidbey Inn
Coupeville, Washington



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

Compiled by the Pacific States Marine Fisheries Commission

A. 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

B. 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. Significant were the concerns expressed in 1962 by the TSC over the development of foreign fisheries and recommendations for stock assessments. TSC-coordinated Canada-U.S. research on Pacific Ocean perch provided the basis or 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.

TABLE OF CONTENTS

C. Executive Summary

The Technical Sub-committee of the Canada/US Groundfish Committee (TSC) met May 4-5, 2004 in Coupeville, Washington. Representatives from the Canadian Department of Fisheries and Oceans, NOAA Fisheries (National Marine Fisheries Service), Pacific States Marine Fisheries Commission, the Pacific Fishery Management Council, Alaska Department of Fish and Game, Washington Department of Fish and Wildlife, and the Oregon Department of Fish and Wildlife attended. Tom Jagielo (Washington Department of Fish and Wildlife) served as Chair, and Mark Wilkins NOAA Fisheries and Dave Clausen NOAA Fisheries served the Secretary duties.

During the 2004 meeting, the TSC exchanged information on research, stock assessment and management activities conducted during 2003 and work planned for 2004. The agency reports and TSC working group reports have been collated in the accompanying document. The report contains additional information that scientists and managers may find useful including agency publication and staff lists.

D. Minutes of the Technical Sub-committee

Forty-fifth Annual Meeting of the Canada- United States Groundfish Committee
May 4-5, 2004
Whidbey Island, Washington

Day 1 Tuesday, May 4, 2004

I. Call to Order – Tom Jagielo, Chair, called the meeting to order at 9:25am, May 4.

II. Appointment Secretary – Mark Wilkins and Dave Clausen will share Secretary duties

III. Introductions – Attendees introduced themselves:

Tom Jagielo	Chair, WDFW, Montesano
Bill Barss	ODF&W, Newport
Steve Parker	ODF&W, Newport
Tory O'Connell	ADF&G, Sitka
Michael Schirripa	NMFS, NWFSC, Newport
Mark Wilkins	NMFS, AFSC, Seattle
Dave Clausen	NMFS, AFSC, Auke Bay
Delsa Anderl	NMFS, AFSC, Seattle; 2002-2004 Care Chairperson
Stephen Phillips	PSMFC, Portland; US Parent Committee representative
Dan Waldeck	PFMC, Portland
Rick Stanley	DFO Canada, PBS, Nanaimo
Kim West	DFO Canada, Vancouver; Canadian Parent Committee representative

IV. Approval of 2003 Report – A draft Report of the 2003 TSC Meeting was presented to the group by Stephen Phillips. Stephen walked us through the draft of the 2003 report, pointing out sections that need further work. It was decided to delete catch tables from now on, since those data are available elsewhere more easily. Members were asked to review the document and bring any changes to Stephen's attention. Approval was deferred until later.

V. Approval of 2004 Agenda – No changes were made to the draft agenda circulated prior to the meeting and it was approved as the working agenda (attached as Appendix 1).

VI. Working Group Reports

A. Committee of Age Reading Experts (CARE):

Delsa Anderl, CARE chair, reported on the recently held CARE biennial meeting in Seattle. A written report was submitted to members (attached as Appendix 2).

CARE has 3 sub-committees: Glossary, Manual and Web Page, and Charter
Manual now has chapters on rockfishes, lingcod, and hake. Discussed Jake's study on sectioned Greenland turbot, Jenn Menkel's lead/radium, pollock validation (which sparked a discussion about Kris Munk's disagreement with other agencies' criteria for pollock).

Michael Schirripa discussed a paper he presented at the CARE meeting about the sample sizes needed in otolith exchanges between agencies to determine if significant age differences exist between the agencies. His results indicated that for short-lived species, optimum size of the exchange was about 100 otoliths; for long-lived species, optimum size was about 200 otoliths. Delsa noted that most of the past exchanges have usually been less than this amount, and these guidelines could therefore result in more work for age readers. Other TSC attendees mentioned that it would be unfortunate if the need for larger sample sizes in the exchanges were to result in less overall exchanges being made. Others suggested that smaller exchanges could still take place to make sure that very large or persistent differences in ageing were not occurring, but age readers should keep in mind that the larger exchanges recommended in Michael's report would be needed to detect smaller differences in ageing between agencies. Several TSC attendees commended Michael on the utility of this paper.

The discussion about pollock centered on the exchange of 840 otoliths between AFSC, PBS, and ADFG. The baseline ages assigned by AFSC ranged from 1-8 yr. ADF&G reads ranged 1-28 yr. Radiometric ages determined by AFSC were slightly younger than the AFSC ages, yet the ADFG reader still strongly defends the criteria she used. The CARE was unable to resolve the discrepancy at their April 2004 meeting.

M. Wilkins: Are ages from both agencies used in the stock assessment? Apparently they are supplied to the stock assessment author and applied as he sees fit.

T. O'Connell: If an agency is part of CARE, does that agency commit to agree to the criteria developed by consensus of the CARE? Yes, provided there is a consensus, however the CARE wasn't able to resolve it at the meeting. Pollock agers will need to have their managers address the issue. CARE sought guidance from the TSC as to whether TSC should intervene on the issue.

R. Stanley: Bomb carbon dating may be useful to help resolve the pollock criteria discrepancy.

M. Schirripa or B. Barss: Are tag data available that might be used to help resolve the discrepancy? Answer was apparently not.

T. O'Connell: Perhaps M Dorn needs to decide whether to use ADFG ages or to request structures collected by ADFG be turned over to AFSC to be aged.
TSC will draft a recommendation to acknowledge CARE's statement of the impasse. Rick S was tasked to draft the recommendation.

D. Anderl: presented the Age Structure Exchange table and requested guidance on what fields should/should not be included. For example, should it include detailed information on how to calculate % agreement?
Discussion on this matter favored presenting the basic information about the exchange without the statistics, but adding a hyperlink to the record leading to a more detailed report of the exchange. MW was tasked to draft a recommendation from TSC to CARE conveying this advice.

R. Stanley: Was Moss Landing Marine Lab represented at the CARE workshop? Apparently they were invited but were unable to attend this time.

M. Schirripa: Is darkblotched rockfish aged at AFSC? He asked because Jennifer Menkel is having trouble with this species.

D. Anderl: Two AFSC agers, Charles Hutchinson and Craig Kastelle, are working with Jennifer on this species.
Discussion: More workshops, perhaps species-specific ones, would help resolve some of the thornier issues. Perhaps a workshop could be tacked onto the Sablefish Symposium planned for late winter 2006. Possible sources of funding should be explored. T. O'Connell was tasked to draft a recommendation from TSC to PC that would encourage MLML staff to participate in the CARE workshops. The group also discussed MS's paper about appropriate sample size for otolith exchanges, which was presented at the CARE workshop. TJ commended it as a good piece of work presenting a valuable documentation of a power test. It shows that exchanges of 20% of the structures are sometimes overkill, though the same level can sometimes be inadequate. DA pointed out that it really depends on the purpose of the exchange. For instance, the sample size needed to detect a difference of 30% would be much smaller than that needed to detect a 3% difference.

B. Pacific Whiting Working Group

The Pacific Whiting Working Group's report consisted of a November 21, 2003, press release announcing an agreement by US and Canadian negotiators on 74:26% allocation, respectively, for the next decade. The agreement should be implemented after the 2004 season. DW commented that WC groundfish management is moving to a 2-year cycle. He added that recent assessment information shows that whiting was never overfished after all; however it is projected to reach the overfished level again by 2006. The main constraint on the fishery now is the widow rockfish bycatch.

T. Jagielo: How is the scientific review of the assessment going to be done?

D. Waldeck: Stacy Miller, the new Stock Assessment Review (STAR) coordinator at NWFSC, is the one to ask about that.

M. Wilkins: How often will the NWFSC be conducting acoustic surveys of the whiting resource? Scheduled every other year.

M. Schirripa: Suggested that Working Group continue to monitor developments pertaining to whiting assessment and management. The group agreed to this suggestion.

C. Sablefish Working Group Report

Michael Schirripa presented this report. An initial working group meeting, with 20-25 attendees, took place during the Western Groundfish Conference in Victoria this past February. A symposium steering committee was selected, and it was decided it would not be feasible to hold the symposium immediately after the next Western Groundfish Conference. Instead, a date in the late 2005 - early 2006 period was suggested for the symposium. The AFSC in Seattle was proposed as a venue for the symposium, as this would result in a considerable savings in travel for many attendees and also save money because Center's big conference room could be used instead of renting a private hall. At the Victoria working group meeting, Michael had discussed that he envisioned a five day symposium, with two days of presentations, two day of workshops, and one day of summary.

A lengthy discussion of the sablefish symposium then followed amongst the TSC attendees. Delsa Anderl suggested that since the CARE meeting is scheduled for April 2006, it might be good to not have the sablefish symposium too close to this date. It was noted that the 2006 Western Groundfish Conference will probably be in February, so that month also would not be appropriate for the sablefish symposium. Finally, Michael Schirripa suggested that the second week of January 2006 might be the best date for the symposium. It was mentioned that hotel rates are often low during this period, and that it might therefore be possible to negotiate a good package deal for symposium attendees. The length of the symposium was then discussed. Delsa suggested that only one day of workshop may be needed, and Mark Wilkins noted that a full five-day symposium running Monday through Friday would require participants to travel on Sunday and Saturday. This could preclude some individuals from attending. After further discussion, the consensus reached was that the symposium should be 3 ½ days long: Monday would be a travel day, Tuesday and Wednesday would be for presentations, Thursday for workshops, Friday morning a symposium summary, and Friday afternoon for travel.

Michael Schirripa reported on what the category topics had been in the past two sablefish symposiums and asked for some feedback as to what sessions should be planned for the new symposium. Stephen Phillips cautioned that, based on what he has experienced recently, aquaculture groups and possibly NGO's might demand a sizeable chunk of time at the symposium. The TSC participants all agreed that the symposium should emphasize science, not policy.

There was some discussion as to how the proceedings from the symposium might be published. Tory O'Connell said she would check on what the cost would be, if any, for the ADF&G Journal to publish the symposium results as a special issue.

Then TSC group then discussed the text for a recommendation from the TSC to the Parent Committee in support of the planned sablefish symposium, also recommending that Michael Schirripa should be appointed working group chair for this symposium.

D. Other Working Group Reports

Rick Stanley presented a brief wrap-up of the 2004 Western Groundfish Conference. The Halibut Commission has agreed to be the repository for leftover money from the conference that will be carried over to the next conference.

Rick Stanley also discussed how an informal bottom trawl working group has been meeting for the past couple of years. Participants from Canada DFO, the NWFSC, and the AFSC have all been part of these meetings. Rick suggested that this informal group become an official working group under TSC auspices. The TSC agreed that a recommendation to this effect should be drafted from the TSC to the Parent Committee, and Rick volunteered to write the recommendation.

VII. Other Topics

A. IJFA Funding

Stephen Phillips briefly stated that IJFA monies are being managed by Dave Colpo of PSMFC. Funds are going to Washington (Tom Jagielo of WDFW), Oregon, and California.

B. Age Validation

1. Updated list of species and techniques:
Delsa Anderl handed out two printouts from spreadsheets that summarized CARE ageing methods, one sorted by species and the other by agency. These tables are on the CARE website.

2. Review prioritized list of species:
Mark Wilkins suggested that stock assessment authors should be providing species priority guidelines for age validation, not the TSC. It was noted that during last year's TSC meeting, Delsa Anderl and Mark Wilkins agreed to track down the last available priority list of species that needed age validation. However, this was not done. Michael Schirripa mentioned that if more than one agency was interested in age validation for a species, TSC support might be helpful. After further discussion, Tom Jagielo proposed that this agenda item (Review of prioritized list of species) be deleted from future TSC agenda, and the meeting attendees agreed with this.

C. Marine Reserves

Dan Waldeck discussed marine reserves on the U.S. west coast from California to Washington. Off central California, the Monterey Bay Marine Reserve has developed "Action Plans". One plan deals with protection of benthic habitat, and another concerns prohibition of possible krill fisheries. Off Washington, the Olympic Coast Marine Sanctuary has started work on establishing marine reserves. Dan also discussed that a NOAA MPA Institute (MPA = Marine Protected Area) has been set up in Santa Cruz, and the Institute is starting a working group that will integrate MPAs with fishery management.

Steven Parker discussed marine reserves off the Oregon coast. There is a five-year development plan to use marine reserves for research purposes, but politically, marine reserves appear to be on "the slow track" at present.

Kim West presented information on 89 new rockfish conservation areas that were established in British Columbia by Canada DFO as of April 1, 2004. There is a large range in size of the individual areas. The areas are no-take for any gear that could conceivably catch rockfish, which includes salmon sport fishing. The regulations call for the areas to be closed on an annual basis. Most are in inside waters of Georgia Strait between the mainland and Vancouver Island. Tory O'Connell asked if rockfish quotas were dropped commensurate with the area covered by the rockfish conservation areas. Kim replied that no they were not, but overall rockfish quotas have been decreased in general.

Tory O'Connell reported on marine reserves in Alaska. There have been no formal proposals for ADF&G reserves in state waters. In waters under Federal jurisdiction, the North Pacific Fishery Management Council will vote in June on proposed "Habitat Areas of Particular Concern" (HAPCs). Most of these are on Gulf of Alaska seamounts or in areas documented to have growth of *Primnoa* coral.

D. Genetics and Stock Structure

R. Stanley provided an update on the status of the TSC's effort to assemble a data base of genetic samples that various west coast researchers have in hand. He reported that when researchers were approached with the idea of adding their tissue holdings to the data base, the most reaction was that they didn't want to advertise what their holdings were. Rick concluded that it was not worth the effort to follow up on the idea further and the effort was abandoned.

E. Marine Aquaculture

T. O'Connell stated that she was firmly against this idea, but was concerned that the US Government is promoting it and avoiding the public process. She is concerned about the dire consequences, particularly as they relate to halibut and sablefish. It's hard to understand why someone would choose to ranch an already viable fishery species.

S. Phillips: PSMFC has stated that they don't want to see NMFS go down the marine aquaculture road. NOAA has a bill to authorize and promote offshore aquaculture. Connie Mahnken, now retired, was a force behind this move. Linda Chavez has picked this up where Mahnken left off.

Cod is coming on line and will be followed by tilapia pens near S California oil rigs. PSMFC is on record as not supporting this effort but recognizes that it is coming.

T. O'Connell voiced concern that this is being done in back rooms and undercutting the fishing industry. The TSC expressed that they would like to be kept up to date on how this develops and decided to retain this as an agenda item at future meetings. SP is in tune and will follow developments and keep the TSC briefed on them.

VIII Review of Agency Groundfish Research, Assessment, and Management

A. Agency Overviews

T. O'Connell: People are retiring or leaving for federal jobs. The agency has too many boats and has cut 30% of the skiffs. Cheryl Dressel (a former graduate student of Brenda Norcross at the University of Alaska Fairbanks) will be taking over Dave Carlile's old job of biometrician for SE Alaska groundfish.

D. Clausen: ABL has hired Dana Hanselman as a permanent employee to work on groundfish stock assessment. Dana recently received his PhD. from the University of Alaska Fairbanks. Also, Pat Malecha, who had been working with Bob Stone and Jon Heifetz on effects of fishing on the benthic habitat, has left ABL's groundfish program to work with the salmon program at ABL.

M. Wilkins: The NOAA ship Oscar Dyson was launched on October 17, 2003. The centerboard of the NOAA ship Miller Freeman was damaged in April when it struck a rock and sheared off the boot of the board with all the transducers on it. Repairs will be made soon and the delays won't affect the ship's schedule too much. REFM division has now mounted a program of field research under the name of the Fisheries Interaction Team (FIT). FIT projects include research on Atka mackerel in the Aleutian Islands and a cod pot survey in the Bering Sea.

R. Stanley: Described COSEWIC and its effects on driving forces behind research. Working closely with Simon Frasier University, the University of British Columbia is getting involved in local fishery issues.

K. West: New people: Terry Bonney will be working on sablefish & halibut management.

R. Stanley: Integrated management is coordinating among gear types to minimize wastage. This involves a commercial industry caucus where recommendations have to be by consensus to proceed. The process seems to be working and moving forward.

T. Jagielo: Jack Tagart retired and his position was filled by Teresa Tsou, who brings quantitative skills and is an ADMB programmer. Farron Wallace now sits on the NPFMC SSC while Tom sits on the PFMC SSC.

B. Barss: ODF&W has a new Nearshore Planning Group. Cyreis Schmitt has been hired as a nearshore policy assistant. David Sampson has returned and will resume doing some of the stock assessments for the PFMC. He will also serve on the NPFMC SSC. The shore-based hake fleet implemented video monitoring and is operating under an Experimental Fishery Permit featuring full retention of the catch. Bill will be retiring this summer and Steve Parker has been chosen to carry the TSC torch for ODF&W in the future.

M. Schirripa: The most important development at the NWFSC is that the bottom trawl survey of the West Coast is being done (including shelf and slope) for the first time this year. Actually two surveys will be done. They will replicate the AFSC's triennial bottom trawl survey as well as conducting their own combination shelf/slope survey. This is being done in an effort to tie together the old and new time series and to carry forward the triennial series of data points for stock assessment purposes. Because of this extraordinary effort on trawl surveys, the sablefish pot survey and some other projects were cancelled. He mentioned a longline and rod/reel survey off southern CA.

Since 2004 is an off-year for stock assessments, there are three workshops being conducted among assessment staff: one on Data (Seattle July 26-30), one on Recreational Fisheries (Santa Cruz June 29-30), and one on Modeling (Seattle October 25-29). Rick Methot has developed Stock Synthesis 2 in AD Model Builder. NWFSC is looking to fill a visiting stock assessment scientist position (1-2 years) to help broaden the expertise of the staff.

D. Waldeck: Bill Robinson is leaving the NW Regional office to take over the new Western Pacific Region. Bill Fox has replaced Mike Tillman as the Science Director at the SWFSC. John Hunter (SWFSC) retired.

At the end of the day on Tuesday, the group discussed progress on draft recommendations, with feedback to authors.

B. Multispecies Studies

AFSC - Mark Wilkins mentioned that the Benthic Habitat group of the RACE Division has grown in size over the past few years and is now an important component of RACE.

Canada DFO - Rick Stanley said the Hecate Strait study is winding down now that funding for this project is gone.

NWFSC - Michael Schirripa discussed that Jean Rogers has published a report on her best effort at estimating catches off the U.S. west coast for 10 important species of rockfish for the years 1965-76. In the past, obtaining good estimates of these catches has been a recurrent problem, and there has been no single source to go to for this information. Hopefully, now that this report has been written, this problem will not be re-visited.

Pacific Fishery Management Council - Dan Waldeck noted that the U.S. Ocean Council report has just been released. This report is supposed to provide guidance for U.S. government ocean policy in future years. The report emphasizes that ecosystem management will have to be used more.

ODFW - Bill Barss stated that ODFW has ended its supervision of the ageing unit in Newport. The PSMFC is now the new supervising agency. Also, ODFW has a new mandatory logbook for nearshore commercial fishermen, who consist mostly of hook-and-line and one pot fisherman.

C. By Species

1. Pacific Cod

Canada DFO - Rick Stanley discussed problems with Pacific cod in Hecate Strait. Previously, the low abundance of cod in the area resulted in closure of the fishery. Fishermen funded a recent trawl survey to see if the cod had rebounded, and the results did indicate that cod seem to be increasing. Rick noted a general problem in B.C. is that every time there is a crisis; fishermen frequently want to respond with doing a survey. The end result is often uncoordinated or non-standardized short-term surveys whose data are difficult to interpret.

AFSC - Delsa Anderl reported on a new method of "toasting" cod otoliths. Using this method, agers from the AFSC, Canada DFO, and ADF&G all agree on the pattern of the first three years of growth.

2. Nearshore Rockfish

T. O'Connell: Alaska Longline Fishing Association (ALFA) has requested an experimental fishery permit from the Council for a hook-and-line fishery on Pacific Ocean perch (POP). One longliner, using off-bottom longline, and one troller, using dinglebar gear, may be involved. Target species include POP as well as dusky, yellowtail, silvergray, sharpchin, and harlequin rockfish.

B. Barss: ODFW is now putting much more emphasis on assessment and research of nearshore rockfish.

R. Stanley: Lynn Yamanaka's research strategy for inshore rockfish will be presented soon at a PSARC meeting. They are moving increasingly toward strategic documents to guide their research.

3. Shelf Rockfish

ADF&G - Tory O'Connell discussed that, for the first time, an estimate of the sport catch of yelloweye rockfish is available for Central Southeast Outside Area around Sitka. The sport fishery appears to be taking about one-half of what is taken by the commercial fishery. Because of this large sport catch, there may be no directed commercial fishery for yelloweye in this area in the future. She asked others how their agencies dealt with sport catch removals.

M. Schirripa: If recreational catch isn't in the assessment model, it doesn't enter into the equation.

PFMC - Dan Waldeck added that accounting for the sport catch of groundfish off the U.S. west coast is a real problem for the Council.

Canada DFO - Rick Stanley said that bocaccio has been declared "threatened" in B.C. waters. This is the first groundfish in B.C. that has been so designated. This action came as a result of Canada's "Species at Risk Act", which is only two years old.

4. Slope Rockfish

ADF&G - Tory O'Connell discussed that funding has become available for an experimental hook-and-line fishery for Pacific Ocean perch, and yellowtail, silvergray, and dusky rockfish in SE Alaska. Trawling, which is the usual method for catching these fish, has been prohibited in this area for a number of years. Two vessels are currently involved in this experiment and have received an experimental fishing permit from the North Pacific Fishery Management Council. The vessels will use dingle-bar gear (modified trolling gear) and off-bottom longlines. "Shrimp flies" to simulate euphausiids will be used on the gear to catch the fish. First delivery is scheduled for today (May 4), so Tory does not yet know how this experimental fishing will turn out.

Day one of meeting ended at 5 pm

Day 2 May 5, 2003

The group reconvened at 9:30 am on Wednesday. The first order of business was to recognize Bill Barss for his long association with the TSC. Stephen Phillips presented him with several rather dapper pieces of PSMFC emblazoned clothing, ensuring that he'll be recognizable as a retired fishery biologist all over the Northwest!

4. Slope Rockfish (continued)
ADF&G - Tory O'Connell mentioned that there is now no directed fishery for slope rockfish in SE Alaska state waters. This regulation was passed at last year's Board of Fisheries meeting.

M. Wilkins: Recent AFSC bottom trawl surveys have added routine collection of Simrad ES60 echosounder data to the list of data collected during the survey. Echo data is collected continuously, whether vessels are sampling stations or running between stations. Researchers hope to be able to augment trawl survey data with the echo data by correlating echo density with fish density, initially during trawl sampling, but extending that to areas between trawl stations.

5. Thornyheads
R. Stanley: Industry wants to pay for a thornyhead trawl survey charter in northern B.C. Therefore, it appears that DFO may be moving in the direction of coast-wide deepwater trawl surveys. The objective of these surveys is to determine indices of abundance rather than absolute biomass estimates.

6. Sablefish
T. O'Connell: Work is moving ahead on a project with PIT tags. They have been encountering difficulties with an antenna with a circular design, much to the surprise of the manufacturer. They are having better results with another antenna with a stick-type design. ADF&G plans to PIT tag 9,000 sablefish this year.

M. Schirripa: Several new studies are being done during the NWFSC's pot survey activities. Blood samples are being taken to determine levels of stress (Michael Davis, NMFS/AFSC). This is the first time that this has been accomplished. The results indicated that stress induced in laboratory studies was duplicating that which was found in the field samples. They are also using a bathythermograph to monitor temperature and pressure parameters during retrieval of the gear.

7. Flatfish
M. Wilkins: AFSC scientists are completing descriptions of maturation for a variety of flatfish species in Alaska to improve parameters in the stock assessment models and to move some of these species to higher "tiers" in the NPFMC's criteria for determining overfishing levels and ABCs.

M. Schirripa: An "edge analysis" was done for Dover sole age validation and the results of this study were reported at the Western Groundfish Conference in February.

8. Lingcod
T. Jagielo: The west coast lingcod assessment and rebuilding plan were recently updated. The 1999 year class has turned out to be a big one for this species. The northern part of the population is looking good (rebuilt) and the southern part is improving, as well. The industry is pretty pleased with these results. The assessment is available on the PFMC website.

Steve Parker: Had some questions about the PFMC website and contents of the SAFEs archived there pertaining to historical catch and optimum yield.

B. Barss: Age structures from sport-caught lingcod are being stockpiled because nobody has the expertise to process or age them. Tom Jagielo offered to have WDFW agers read them.

9. Pacific Whiting
R. Stanley: DFO is doing no work on hake presently.

M. Schirripa: Researchers are analyzing growth increments in an attempt to relate them to oceanographic conditions. He also reported on a study on oceanographic factors affecting whiting recruitment. This research is similar to what he has done previously for sablefish. Whiting recruitment appears related to Ekman transport and sea surface temperature.

Steve Parker: Hake harvest is being constrained by widow rockfish bycatch. Last year the widow bycatch was low, for no apparent reason. ODFW has people characterizing tow-by-tow bycatch rates from 5 years of data (approx 20,000 tows) from different sectors of the fishery. He told about some rare events of large bycatch, including a 100 t widow bycatch in 2002 and another offshore tow with 80 t. Analysis of shoreside deliveries showed that about 5 tows accounted for about 60% of the total bycatch.

10. Walleye Pollock
No discussion.

11. Dogfish (sharks, in general, and skates were also discussed under this agenda item.)
M. Schirripa: A student at the UW has been collecting dorsal spines to age dogfish. CITES has listed the species, based mostly on its status in the Atlantic.

T. O'Connell: ADFG has instituted an annual bag limit of 1 dogfish.

D. Clausen: ABL's Dean Courtney will be starting a dogfish tagging study this year in Yakutat Bay. He also mentioned that last year Dean began an archival tagging study of Pacific sleeper sharks in SE Alaska. Dean is planning this year to again tag sleeper sharks with archival tags in this area.

R. Stanley: DFO's Sandy McFarlane started tagging big skates last year, and that he has been getting many returns.

Steve Parker: Skates are being targeted to some degree by commercial trawlers in Oregon.

M. Wilkins: Skates are being fished around Kodiak, also.

T. O'Connell: Skates have been separated out from the "Other Species" category for assessment purposes in the GOA.

M. Wilkins: Mentioned the work that Jerry Hoff (AFSC, RACE) is doing on the distribution, abundance, etc. of various species of skates for his PhD. Also mentioned taxonomic work that Jay Orr and Duane Stevenson are doing with academic colleagues.

M. Schirripa: An OSU student (Josie Thompson) is working on ageing vertebrae from skates (and sharks?).

R. Stanley: Sandy MacFarlane published a paper on ageing technique for elasmobranches (see p. 16 of DFO report).

D. Clausen: Dean Courtney has planted some archival tags in (on?) sleeper sharks.

12. Pacific Mackerel and Sardines

D. Waldeck: There will be a new mackerel assessment available in May, which may be adopted by the PFMC in June. The mackerel harvest guidelines have been lower the last two years (10-12 thousand tons), but the market (primarily in Europe) is not large. There is a Stock Assessment Review (STAR) panel meeting June 4 to review an assessment of coastal pelagics.

The sardine allocation is becoming an issue and the fishery is expected to be quite active. The Sardine Forum is still alive and well. It provides an excellent forum for exchange of ideas, results, and concerns. SWFSC continues to promote it strongly.

13. Other Species

M. Wilkins: AFSC taxonomists are collecting many new, undescribed species using a "snail bag" mounted below the footrope of the survey trawl in the Gulf of Alaska and Aleutian Islands bottom trawl surveys. This small mesh bag is attached to the footrope of the net to collect small invertebrates and fish that would not otherwise be caught. Previously, it had been assumed that the snail bag did not have any effect on the fishing characteristics of the trawls. However, in 2000 the bag was seen causing a reduction in the effective width of the trawl used in the annual Bering Sea slope survey by 2 m. Initial observations suggest that the bag does not have an effect on the width of the same trawl (though rigged with different ground gear) used in the Gulf of Alaska and Aleutian Islands surveys (Nor'Eastern trawl), but additional research on this is being conducted. Snailfish and eelpouts have been among the new species captured with this method.

R. Stanley: Bocaccio has emerged in Canadian waters as a non-targeted species that has the potential to shut down many fisheries on commercial species due to its bycatch.
B. Barss: Record catches of hagfish were seen in 2003 on the order of 1 million pounds.

D. Other Related Studies

D. Clausen: ABL will be using the submersible *Delta* again this summer to conduct further research on coral and sponge distribution and abundance in the Aleutian Islands as part of an 'effects of fishing' study. Because the maximum depth for the *Delta* is 350 m, the study will also use the remotely operated vehicle *Jason* for observations in waters beyond this depth down to 3,000 m.

Dave also mentioned that the NPFMC has recently started to become more concerned with catch, assessment, and management of non-target species. The Council has established an ad hoc technical working group on non-target species. Fishermen are concerned that restrictions on the take of non-target species could result in the closure of targeted fisheries.

R. Stanley: Raised an issue that has come up with DFO's Policy Review Committee concerning data access and confidentiality. The Canadian industry now pays for data collection in the form of observers, industry surveys, etc. DFO scientists have established joint operating agreements with academia (Simon Frasier Univ. and Univ. of British Columbia), which have been eager to help DFO conduct stock assessments. The industry also contracts with consultants to analyze the data. DFO and the industry co-own the data, but once it's made available to other parties (academia or contractors); the NGOs are asking why it can't be made available to them. Do the NGOs have rights to it?

There was quite a good discussion of this dilemma. Rick explained that Canada has an Access to Information Act analogous to the US's Freedom of Information Act. Several others mentioned that their agencies are also confronted with this problem. For example, Dave Clausen said that environmental groups have been asking for detailed haul specific catch data on corals from the AFSC's observer and trawl survey databases. One of the problems at the AFSC and NMFS Alaska Region is that no formal written policy exists on confidentiality of data, which leaves the confidentiality issue subject to individual interpretation. Rick Stanley concluded that the direction all this is heading is toward increasing release of information, which may make fishermen reluctant in the future to share information with researchers.

On another subject, Rick asked about the AFSC studies using calibrated bottom contact sensors for detailed studies of the quality of bottom contact by survey trawls. Mark referred him to Ken Weinberg, who's been doing that work.

Steve Parker: Pointed out that relative landing limits in the DTS (deepwater trawl for **D**over, **T**hornyheads, and **S**ablefish) don't correlate well with the relative CPUEs of those species. The regulations are being rationalized by "averaging" the catch. This is being investigated under an

Experimental Fishery Permit for two vessels. The limits work fine under a given management regime, but become infeasible when the regime changes.

R. Stanley: Related general success with an individual vessel quota (IVQ) alternative. It is being worked on by a student of Ray Hillborn's at Harbor Branch.

D. Clausen: Bob Stone is spending time in the Aleutian Islands this summer with the JASON ROV and a submersible working on habitat studies of corals and sponges (see p. 27-28 AFSC report).

IX. Progress on 2003 Recommendations

A. CARE TO TSC

1. **On tracking progress towards ratification of the agreement on harvest shares for Pacific hake between Canada and the US:** The group discussed the progress, which holds hope for agreement, but has not been ratified yet.

2. **On formation of a working group on sablefish, whose first task will be to scope the need for and develop the terms of reference for the third international sablefish workshop:** Michael Schirripa convened a discussion group on the need for said workshop in February 2003 at the Western Groundfish Conference. There was general agreement that the workshop was needed and a steering committee was established.

3. **On discontinuing the TSC's Sardine Working Group:** The function of the Working Group has been taken over by the tri-national committee for sardines mentioned in the recommendation. Therefore, the Working Group was dissolved.

B. TSC to Parent Committee

1. **On urging the Parent Committee to encourage Canada and the US to ratify harvest shares of Pacific hake:** Sufficient progress has been made on this front to warrant dropping this annual recommendation.

2. **On recommending that a workshop be held to discuss sablefish survey methods and the feasibility of survey calibration:** TSC members agreed that this objective would be addressed adequately by the upcoming sablefish workshop or symposium.

3. **On encouraging further binational collaboration of research and management of transboundary species:** The TSC agreed that more collaboration has occurred, but we should continue to encourage this type of activity.

C. TSC to CARE - (none)

X. 2004 Recommendations

A. CARE to TSC

1. Delsa Anderl, the representative of CARE to the TSC meeting, inquired whether monies were available to fund species-specific workshops for agers working on particular species. Such workshops might constitute interim meetings of subgroups of CARE in between the regularly scheduled biennial meetings. This matter was discussed and acted upon with a recommendation from TSC to the Parent Committee (see item C.4. below).

B. From TSC to Itself

1. TSC acknowledges notification by CARE of the differences observed when comparing ADFG pollock ageing results to those of AFSC. TSC was advised by CARE that attempts to reconcile the differences in criteria were not successful at the 2004 meeting. TSC notes that resolution of the ageing discrepancies, if needed, will require direct focus by pollock assessment staff.

C. TSC to Parent Committee

1. The TSC notes that researchers at Moss Landing Marine Laboratories (MLML) conduct significant age validation work. Given the multinational and multi-agency membership and purpose of CARE, it would be beneficial to have a MLML representative as a regular member of CARE. The TSC requests that the Parent Committee write a letter to Dr. Gregor Cailliet at MLML explaining the history of CARE, the importance of MLML participation, and encourage regular attendance by MLML at the biennial CARE meeting.

2. The TSC recommends that the parent committee support and endorse the continued effort towards planning the Third International Sablefish Symposium as discussed at the 2004 TSC meeting. Dr. Michael Schirripa is the working group chair of this effort. A letter of support from the Parent Committee directed to the NWFSC/FRAM Division Chief (Dr. Elizabeth Clarke) could help facilitate this effort.

3. TSC notes the ongoing annual inter-agency meetings, as well as data and information exchange, related to the design, execution, and analysis of bottom trawl surveys. TSC recommends the creation of a trans-boundary bottom trawl survey working group, to include representatives of the NMFS groups at the NWFSC and AFSC, and DFO, as well as any other interested party.

4. The TSC discussed the request from CARE to support interim travel to hands-on-only, species-specific workshops between regularly scheduled biennial meetings. The TSC requests the PC consider seeking funds to accommodate this request.

D. TSC to CARE

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

XI. Appointment of 2004/2005 TSC Chair

The 2004-2005 TSC Chair will be Rick Stanley.

XII. Schedule and location of 2005 Meeting

The 2005 TSC meeting will be held somewhere in British Columbia on May 3-4.

XIII Adjournment

The meeting was adjourned at approximately 12:00 am, Wednesday, May 5, 2004.

APPENDIX 1. - Working Agenda of the 2004 TSC Meeting.

Agenda
Forty-Fifth Annual Meeting of the TSC
May 4-5, 2004
Whidbey Island, Washington

I. Call to Order (9:00 am; 5/4/04) – Tom Jagielo, Chair
II. Appointment Secretary
III. Introductions
IV. Approval of 2003 Report
V. Approval of 2004 Agenda
VI. Working Group Reports
  A. Committee of Age Reading Experts (CARE)
  B. Pacific Whiting Working Group
  C. Sablefish Working Group report)
  D. Other

VII. Other Topics
  A. IJFA Funding
  B. Age Validation
    a. Updated list of species and techniques
    2. Review prioritized list of species
  C. Marine Reserves
  D. Genetics and Stock Structure

VIII. Review of Agency Groundfish Research, Assessment, and Management
  A. Agency Overviews
  B. Multispecies Studies
  C. By Species
    a. Pacific Cod
    2. Nearshore Rockfish
    3. Shelf Rockfish
    4. Slope Rockfish
    5. Thornyheads
    6. Sablefish
    7. Flatfish
    8. Lingcod
    9. Pacific Whiting
    10. Walleye Pollock
    11. Dogfish
    12. Pacific Mackerel and Sardines
    13. Other Species

D. Other Related Studies
E. Other Items

IX. Progress on 2003 Recommendations
A. From TSC to Itself
B. From TSC to Parent Committee
C. From TSC to Care

X. 2004 Recommendations
A. From TSC to itself
B. From TSC to Parent Committee
C. From TSC to CARE

XI. Appointment of 2004/2005 TSC Chair
XII. Schedule and location of 2005 Meeting
XIII. Adjourn ~ 12:00 p.m. 5/5/03

E. Parent Committee Minutes

FORTY-FIFTH ANNUAL MEETING OF THE CANADA-U.S. GROUNDFISH COMMITTEE

The meeting was adjourned at approximately 12:00 am, Wednesday, May 5, 2004.

Minutes of the 46th Annual Meeting
of the
Canada-US Groundfish Committee
(aka "Parent Committee")

I. Call to Order

Chair Stephen Phillips, PSMFC, the US representative, called the meeting to order at 12:25, Wednesday, May 5, 2004. Ms. Kim West, DFO Canada, represented Canada.

Also in attendance: Tom Jagielo (WDFW and 2003-4 TSC Chair), Mark Wilkins (NMFS, AFSC Seattle), Dave Clausen (NMFS, AFSC Auke Bay Lab), Delsa Anderl (NMFS, AFSC Seattle)

II. Appointment of Secretary

Mark Wilkins appointed Secretary

III. Approval of Agenda

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

IV. Adoption of May 2003 meeting minutes

The minutes were adopted as presented.

V. Progress on 2003 Recommendations from TSC to Parent Committee

A. Negotiations regarding harvest shares of Pacific hake: The committee noted that an agreement had been reached, although both nations have yet to ratify it. ***Status: Completed.***

B. Sablefish survey methods and calibration: Planning for another International Sablefish Symposium in 2006 is progressing and will include the topic of survey methods. ***Status: Progressing nicely***.

C. Continuation of bi-national collaboration and cooperation: The committee noted that scientists from both nations continue to work collaboratively on research and management issues pertinent to transboundary stocks. ***Status: Being done.***

VI. Progress on 2003 Recommendations from Parent Committee to TSC

None had been made.

VII. Progress on 2003 Recommendations from Parent Committee to Itself

A. Seeking ways to enhance participation at TSC by various agencies: The committee noted that the PFMC was represented by Dan Waldeck in 2004, which added a lot of new dimensions to the meeting. Diana Stram (NPFMC) contacted Stephen, sending regrets that she couldn't attend this year, but wishes to receive information about future meetings. ***Status:*** ***Doing what we can.***

VIII. 2004 Recommendations from the TSC to the Parent Committee

A. The TSC notes that researchers at Moss Landing Marine Laboratories (MLML) conduct significant age validation work. Given the multinational and multi-agency membership and purpose of CARE, it would be beneficial to have a MLML representative as a regular member of CARE. The TSC requests that the Parent Committee write a letter to Dr. Gregor Cailliet at MLML explaining the history of CARE, the importance of MLML participation, and encourage regular attendance by MLML at the biennial CARE meeting.
ACTION: The Committee will send MLML a letter as described from Al MacDonald and Randy Fisher.

B. The TSC recommends that the parent committee support and endorse the continued effort towards planning the Third International Sablefish Symposium as discussed at the 2004 TSC meeting. Dr. Michael Schirripa is the working group chair of this effort. A letter of support from the Parent Committee directed to the NWFSC/FRAM Division Chief (Dr. Elizabeth Clarke) could help facilitate this effort.
ACTION: The Committee will send Dr. Clarke a letter as described from Al MacDonald and Randy Fisher.

C. Re: trawl survey committee: TSC notes the ongoing annual inter-agency meetings, as well as data and information exchange, related to the design, execution, and analysis of bottom trawl surveys. TSC recommends the creation of a trans-boundary bottom trawl survey working group, to include representatives of the NMFS groups at the NWFSC and AFSC, and DFO, as well as any other interested party.
ACTION: The Committee concurs and authorizes the TSC to form this new working group.

IX. 2004 Recommendations Parent Committee to Itself

None made.

X. Other Business

A. The Parent Committee thanks Mark Wilkins for hosting this year's meeting and Tom Jagielo for chairing said meeting and thanks Mark for recording minutes.

B. The Parent Committee notes that this is the last meeting that Bill Barss will represent ODF&W, as he will be retiring in the fall. They thank Bill for his many years of attending TSC meetings.

XI. Meeting Location

Rick Stanley will arrange the 2005 meeting, which will be held somewhere in British Columbia May 3-4.

XII. Adjournment

There being no further business, the meeting was adjourned at 12:40 pm.

F. Agency Reports

Report of the Technical Sub-committee of the Canada-United States Groundfish Committee

Agency Reports

AGENCY REPORTS

FISHERIES AND OCEANS, CANADA
British Columbia Groundfish Fisheries and Their Investigations in 2003

May 2004

Prepared for the 45th Annual Meeting of the Technical Sub-committee of the Canada-United States Groundfish Committee
May 4-5, 2004.
Whidbey Island,
Washington, U.S.A.

Compiled by

R. D. Stanley
Fisheries and Oceans Canada
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Nanaimo, British Columbia
V9T 6N7

REVIEW OF AGENCY GROUNDFISH RESEARCH, STOCK ASSESSMENT, AND MANAGEMENT

A. Agency overview

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

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

Stock Assessment (StAD)	Mr. T. Perry
Marine Environnent and Habitat Science	Dr. J. Pringle
Ocean Science and Productivity	Mr. R. Brown
Aquaculture	Dr. J. Pringle

Section Heads within the Stock Assessment Division are:

Groundfish	Mr. Jeff Fargo
Shellfish	Mr. Jim Boutillier
Salmon	Dr. Chuck Parken
Conservation Biology	Dr. Chris Wood
Applied Technologies	Mr. Mark Saunders

Groundfish research and stock assessments are conducted primarily in the Groundfish Section of the Stock Assessment Division. Groundfish ageing and acoustics work is currently done in the Applied Technology Section. The Canadian Coast Guard operates DFO research vessels. These vessels include the W.E. Ricker, J.P. Tully and Neocaligus.

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

Trawl, sablefish (trap and hook-and-line), and halibut (hook-and-line) fisheries continue to be managed with Individual Vessel Quotas (IVQ). IVQ's 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. Specific management issues are addressed below when appropriate. Management plans can be viewed on the website http://www.pac.dfo-mpo.gc.ca/ops/fm/mplans/mplans.htm.

Managers are currently engaging industry in discussions to address issues associated with groundfish conservation and management of the commercial fishery. In particular, DFO and the various fishery sectors (geartypes) are working towards an integrated fishery plan.

B. Multispecies or ecosystem models

No update is currently available

C. By species

1. Pacific cod

No update is currently available

2a. Rockfish - offshore

i. Research programs

The third of three surveys for longspine thornyhead *Sebastolobus altivelis* along the west coast of Vancouver Island was conducted Sept 5-20, 2003) under the direction of the Canadian Groundfish Research and Conservation Society (CGRCS). As in 2002, the survey was conducted aboard the F/V Ocean Selector, Dave Clattenberg skipper.

The 2003 thornyhead survey covered 21 area-depth strata and completed 74 tows, 67 of which were useable for estimating biomass. Overall, 96 taxonomic groups were identified. Additionally, a total of 444 biological samples were taken for 18 fish species, yielding 16,100 specimens (16,089 lengths, 3,751 weights, and 3,752 otolith pairs). The top six species accounted for 86% of the total catch weight (24,924 kg): sablefish *Anoplopoma fimbria* (5,755 kg, 23%), roughscale rattail *Coryphaenoides acrolepis* (4,432 kg, 18%), longspine thornyhead (3,579 kg, 14%), shortspine thornyhead *Sebastolobus alascanus* (3,046 kg, 12%), Dover sole *Microstomus pacificus* (2,368 kg, 10%), and pectoral rattail *Albatrossia pectoralis* (2,293 kg, 9%). The time trends of bootstrapped swept-area biomass indices for each of these six species (Fig. 1) show no significant detectable change in abundance. Presumably, a few more years of surveys will be needed before any population changes are evident.

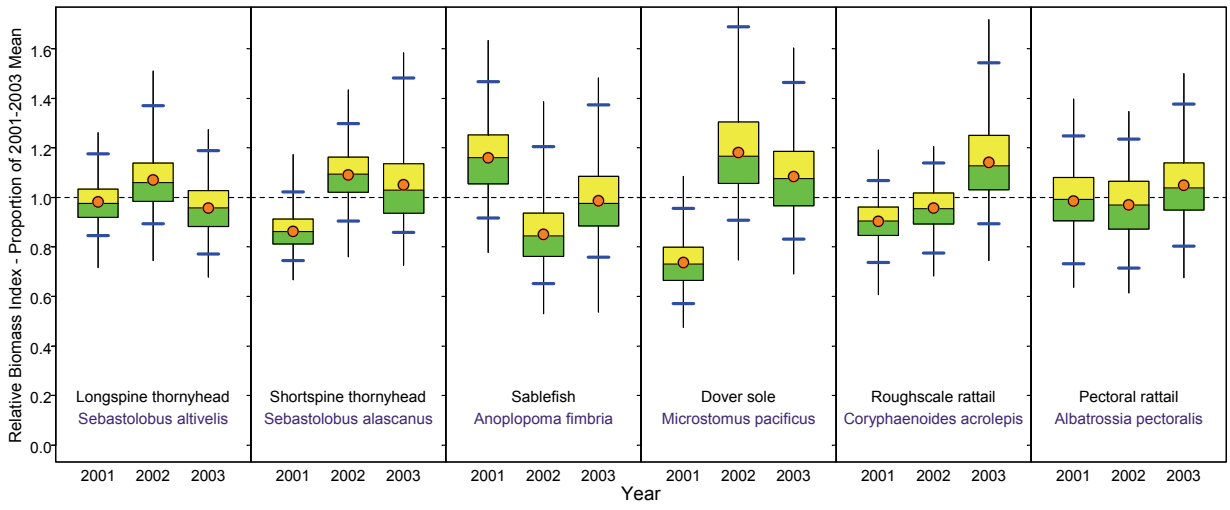

Figure 1. Bootstrapped swept-area biomass indices for the six major species caught in the longspine thornyhead survey (2001-2003), based on 1000 bootstraps per year. Estimates were stratified only by three depth zones (500-800m, 800-1200m, 1200-1600m). Also shown: the moment estimate of the mean (orange dot), and the 95% confidence interval after bias-correction and acceleration (blue horizontal lines).

ii. Stock assessment

No stock assessments were done for slope rockfish in 2003.

The five new management regions for longspine thornyhead were retained in 2003 (Fig. 2). The Flamingo area remains closed to any directed fishing for longspine thornyheads. The Triangle region acts as a *de facto* refugium due to very steep bathymetry. Table 1 reports historical catch in the new longspine management regions. Table 2 details the biological sampling activity in the primary regions since 1996.

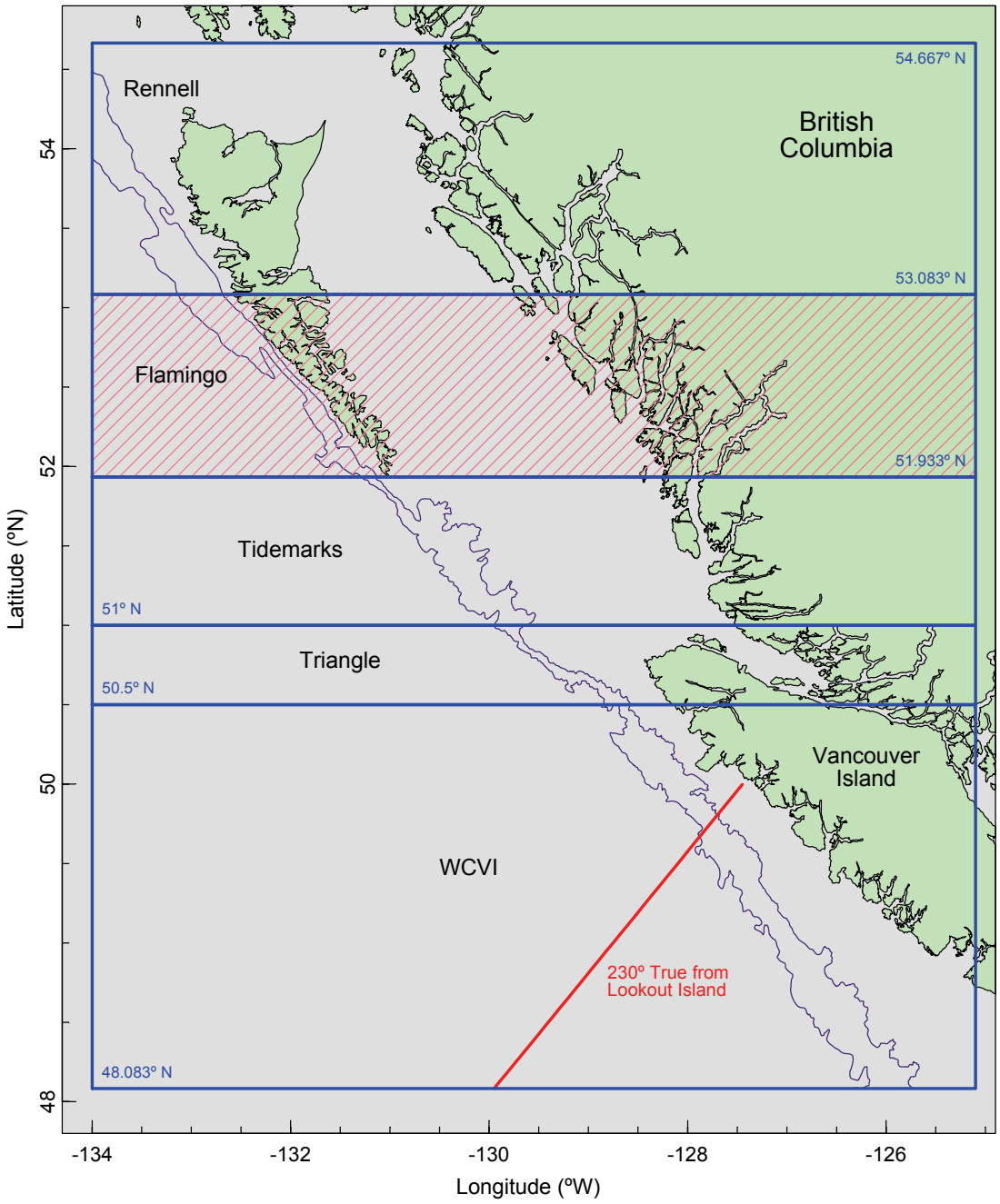

Figure 2. Management regions for the longspine thornyhead fishery (blue boundaries) in effect since 2002. During 2000-2001 the only boundary was a line (red) 230° true from Lookout Island. Prior to 2000, there were no spatial limits on the fishery. Longspine thornyhead habitat is approximated by the bottom area between the 500 m and 1,600 m isobaths. The Flamingo region is closed to directed fishing on longspine thornyheads.

Table 1. Longspine thornyhead catch (t) in the current management regions (for this species) applied across all years since 1996. The boundaries delimiting these areas are illustrated in Figure 1 and correspond to lines of latitude – WCVI (48° 05′ N to 50° 30′ N); Triangle (50° 30′ N to 51° 00′ N); Tidemarks (51° 00′ N to 51° 56′ N); Flamingo (51° 56′ N to 53° 05′ N); Rennell (53° 05′ N to 54° 40′ N). Unless otherwise noted, fishing years run from April 1 to March 31. Values of 0 indicate catch < 0.5 t.

Fishing Year	WCVI South	WCVI North	Triangle	Tide-marks	Flamingo	Rennell	Unknown	Total
1996[1]	862	1	<0.5	3	<0.5	1	10	877
1997[2]	291	<0.5	<0.5	<0.5	<0.5	1	0	293
1997	564	1	<0.5	8	<0.5	2	1	577
1998	823	<0.5	<0.5	6	<0.5	9	1	840
1999	732	160	0	1	<0.5	19	1	913
2000	389	286	0	85	<0.5	144	5	909
2001	351	105	0	49	1	144	<0.5	650
2002	428	38	0	75	<0.5	116	13	670
2003[3]	167	40	0	75	0	70	22	374

[1] Fishing year: Feb 15, 1996 – Dec 31, 2003
[2] Interim period: Jan 1, 1997 – Mar 31, 1997
[3] Catches only for Apr 1 – Oct 15, 2003

Table 2. Summary of commercial samples taken from the longspine thornyhead fishery (1996-2003).

Fishing year	WCVI			Tidemarks			Rennell		
	Samples	Lengths	Otoliths	Samples	Lengths	Otoliths	Samples	Lengths	Otoliths
1996[1]	8	653	100						
1997	16	1,967	425						
1998	127	21,631	916						
1999	222	33,811	1,094				6	726	0
2000	665	28,744	12,248	130	2,943	2,689	220	5,772	3,420
2001	135	19,946	3,671	19	2,582	403	48	7,227	891
2002	128	21,598	2,280	15	2,294	398	55	9,032	735
2003[2]	70	10,708	984	12	2,435	0	36	5,123	484

[1] Fishing year: Feb 15, 1996 – Dec 31, 2003
[2] Apr 1 – Dec 31, 2003

iii. Research activities for 2004

Based on the pending 2004 longspine assessment, DFO is considering recommending thornyhead surveys of the Tidemarks and Rennell management regions. This will be discussed with the Canadian Groundfish Research and Conservation Society in June. The target species will be the two thornyhead species, with sablefish, Dover sole, and deepsea sole *Embassichthys bathybius* as secondary targets.

The Queen Charlotte Sound synoptic survey will continue in 2004, targeting the 5AB (central BC coast) region between 50 and 500 m. This includes a fair amount of slope rockfish habitat especially that of Pacific Ocean perch *Sebastes alutus*.

2b. Rockfish – shelf

i. Research Programs in 2003

Collaborative ageing work with researchers in Germany on otolith shape analysis and the Moss Landing Marine Laboratory in California on C^{14} dating is in press. DFO Staff also participated in a widow rockfish working group meeting with U.S. National Marine Fisheries Service (NMFS) and Washington Department of Fish and Wildlife staff. U.S. staff is contemplating indexing widow rockfish abundance by generating a time series of acoustic estimates of persistent shoals in five locations along the U.S. coast.

ii. Stock assessments in 2003

Canadian shelf rockfish stock assessment activities concentrated on preparation of a stock assessment report on bocaccio rockfish (*S. paucispinis*) for BC waters (Stanley et al. 2003). This work re-examined a stock assessment presented two years earlier. That document had provided the basis for a proposed listing of bocaccio as "Threatened" in Canadian waters. This designation was inferred mainly from the apparent decline in abundance off Vancouver Island since 1980 as indicated in a NMFS bottom trawl survey.

The update paper summarizes the available information on the stock status of bocaccio (*Sebastes paucispinis*) in B.C. waters. It updates information on catch, CPUE, and survey indices where appropriate, from the previous PSARC document (Stanley et al. 2001). In addition, given the importance of the results from the NMFS triennial and West Coast Vancouver Island (WCVI) shrimp surveys with respect to stock status, it provides more comprehensive analyses of these data to communicate more accurately the degree of certainty around the point estimates and the inference of a decline in abundance. The document notes the strong evidence of a significant decline in relative abundance from the early 1980's off the southwest coast of BC but also recent stability in the same indices and provides two management directions for consideration. Considering that the only remedial action available for managers is to control catches, Option #1 endorses capping catches at current levels provided existing indices do not decline. Option #1 might also be adopted as an interim measure until a more complex catch reduction strategy can be implemented. Option #2 endorses reducing catch to an arbitrary target level. A significant reduction in catch may be possible through implementation of a voluntary avoidance program, possibly in conjunction with regulatory disincentives to catch bocaccio. However, the document emphasizes that the available assessment information is not adequate to predict how much a given reduction in catch will affect the population nor able to provide specific advice on the amount of reduction required. The choice between options is dependent on the degree to which the southern BC area reflects all BC waters, and whether the higher relative abundance recorded in the early 1980's is indicative of the long term average abundance or reflects peak levels resulting from periods of good recruitment. This uncertainty in the interpretation of the available

abundance indices, along with their low precision, means that it is presently not feasible to reliably estimate stock status for British Columbia bocaccio.

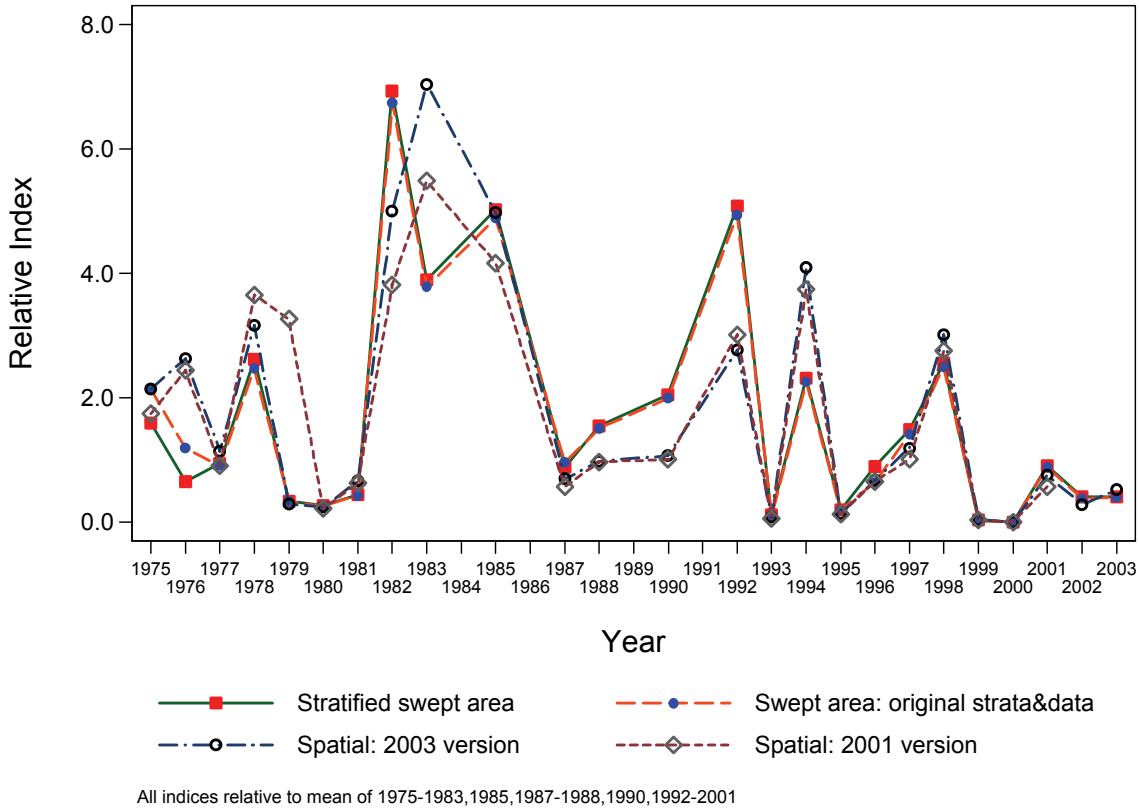

Figure 3. Comparison of a range of biomass indices using the WCVI shrimp trawl survey data: a) swept area using the stratification that was adopted by Starr et al. 2002; b) swept area using the original survey stratification and without dropping any tows; c) a recalculated spatial shrimp index and d) the original spatial index used in 2001

iii. Research activities planned for 2004

No direct work on shelf rockfish is planned for 2004.

2c. Rockfish – inshore

i. Research programs in 2003

In May 2003, the second half of the inshore rockfish longline survey in the upper west coast of Vancouver Island and the lower west coast of the Queen Charlotte Islands was completed. This survey, together with a September 2002 survey, will be compared with similar surveys conducted in the same areas in 1997/98. The survey focuses on yelloweye rockfish (*Sebastes ruberrimus*) and involves two vessels fishing at four survey sites, both in the fall and the spring. Survey catch rate and biological data will be reviewed for seasonal and annual differences and compared with the fishery removals from each area.

A third technician, funded jointly by the Pacific Halibut Management Association, Canadian Sablefish Association, and DFO's inshore rockfish program, collected biological samples and catch data, from species other than halibut (*Hippoglossus stenolepis*), during the International Pacific Halibut Commission Area 2B setline survey conducted from May to August 2003. One hundred and seventy sets were completed in depths up to 250 M. Redbanded (*S. babcocki*) and yelloweye rockfishes were the dominant rockfish species taken on the survey. Rockfish to halibut catch ratios were highest in central portion of B.C. from the southern end of the Queen Charlotte Islands to the northern end of Vancouver Island but were generally low at 0.02 kg rockfish/kg halibut per skate (overall median). Preliminary simulation results indicate that if an annual catch rate index is collected, it will be useful to track abundance trends for redbanded and yelloweye rockfishes by 2009.

Underwater towed camera trials were conducted over 5 days in June 2003 in the Strait of Georgia, Statistical Areas 17-19. Fourty-two transects were conducted from 10 to 65 M. Habitat types and fish species were assessed. Puget Sound (*S. emphaeus*), quillback (*S. maliger*) and copper rockfishes (*S. caurinus*) were the most commonly seen rockfish during the survey. Low visibility due to the seasonal phytoplankton bloom hampered the survey in some areas but overall this technology is useful for monitoring and assessment of shallow water reef fishes and their habitat.

Longline research surveys were conducted in the Strait of Georgia, Statistical Areas 12 and 13 during August and September 2003. Eighty longline sets were completed from 40-100 M. Quillback and yelloweye rockfishes were the dominant rockfish in the catch. Other commercial species caught included spiny dogfish (*S. acanthias*), Pacific cod (*Gadus macrocephalus*), sablefish (*Anoplopoma fimbria*), halibut and lingcod (*Ophiodon elongatus*). Preliminary simulation results indicate that with 80 sets each year, the catch rate index will track trends in abundance for quillback rockfish in 9 -10 years. Increasing the number of sets to 120 will decrease the time to reliably track trends in abundance to 4 - 5 years. The ability of the survey to track yelloweye rockfish trends is not as good as that for quillback rockfish.

A visual survey was conducted in the Strait of Georgia in September 2003 using the AQUARIUS submersible (Nuytco Research). Nineteen dives and 38 transects were completed in nine dive days. Seven of the transects conducted in the Gabriola Reefs and Active Pass areas were designed to verify habitat maps developed by the Pacific Geoscience Centre (Natural Resources Canada), using multibeam backscatter, bottom grabs and seismic data and to quantify rockfish densities by habitat type. The remaining 32 transects were conducted in Areas 15 and 16 and were designed to replicate similar dives completed in 1984 using the PISCES IV submersible. Determining the area swept by the surveys is difficult but the preliminary results show a decline in abundance over the 19 years separating the surveys.

In collaboration with Dr. Sean Cox from Simon Fraser University, preliminary work on a genetic tagging experiment was conducted in a Rockfish Conservation Area in the Strait of Georgia. Specialized "hooks" were developed to sample fish flesh at depth and release the fish before

returning to the surface. Genetic fingerprinting techniques were used to identify the fish to species and determine individuals. Initial test fishing resulted in 373 sample hooks collected on 4 sample dates. Approximately 50% of the samples contained enough tissue to use in the species identification and fingerprinting analyses. Of these, 82% of the fish were quillback rockfish, 30% were copper rockfish, 1% was yelloweye and 1% was other unknown fish (no previous genetic identification). Analysis of individual identity showed that four quillback rockfish were sampled twice on the same sample date (blind experiments) and one quillback was resampled on two separate sampling dates. This genetic tagging technique is expensive, $20 per hook; however, it appears to show promise as a viable tagging method for rockfishes.

ii. Stock assessment

No stock assessments were conducted in 2003.

iii. Management actions for 2003

After a year of public consultations, 89 Rockfish Conservation Areas (RCAs) were implemented for the 2003 fishing year. RCAs are to protect rockfish and fishing activities that are likely to catch rockfish are prohibited (http://www-comm.pac.dfo-mpo.gc.ca/pages/release/p-releas/2004/nr018_e.htm).

Activities permitted within the RCAs include First Nations' harvests for food, social and ceremonial purposes. Recreation fishing for invertebrates by hand picking, crab and prawn fishing by trap and smelt by gillnet. Commercial fishing of invertebrates by hand picking; crab and prawn by trap; scallops by trawl; salmon by seine or gillnet; euphausiids and groundfish by mid-water trawl; opal squid by seine; herring by gillnet, seine and spawn-on-kelp; sardine by gillnet, seine and trap; and smelt by gillnet. All other fishing activities are prohibited.

iv. Research activities planned for 2004

DFO will continue to coordinate and compile the catch composition and sample data collection for the non-halibut catch on the IPHC setline survey in 2004. The total cost of the third observer and additional vessel costs have been transferred to industry.

A repeat of the longline survey in the Strait of Georgia Areas 12 and 13 will be conducted between August 23 and September 10, 2004. Information on the annual variability of this survey will enhance the design of future surveys. Further simulation work is being conducted with 2000 set budgets over a 20-year time frame. The trade-offs of conducting annual surveys of 100 sets versus less frequent surveys with more sets is being investigated under various assumptions of process error and population trajectories.

A submersible survey using visual methods to assess rockfish abundance is planned for September 24 to October 11, 2004 in the Strait of Georgia. This survey is designed to develop habitat assessment methodology and assess stock status for inshore rockfish. Rockfish density estimates by habitat type may be expanded using habitat maps to a biomass estimate over an area

much larger than that surveyed by submersible. Habitat maps are being developed with the Pacific Geoscience Centre (Natural Resources Canada) using multibeam backscatter, bottom grab and seismic data. The submersible project is a joint project with the Washington Department of Fish and Game.

Further development of a rockfish conservation areas (RCAs) strategy is planned and will involve the investigation of a spatial model based on bathymetric data to identify habitat areas of 'high complexity'. These 'high complexity' areas, identified through the model, will be overlain with all available fishery data to assess the potential of using 'high complexity' areas, as well as fishery data, as surrogates for rockfish habitat. These areas will also be compared with the 89 RCAs implemented in 2004 for the protection of rockfish and may provide a methodology for the identification of additional RCAs.

A project is planned cooperatively with Simon Fraser University to develop simulation models to explore 1) genetic tagging as a new method for monitoring abundance and fishing mortality both inside and outside closed areas and 2) optimal spatial and temporal distributions of genetic tagging effort that maximise information for scientific evaluation and assessment of closed areas while minimising research survey costs.

3. Sablefish

i. Research programs in 2003

The annual longline trap survey was conducted under charter in the fall of 2003 aboard the fishing vessels Viking Star (standardized survey) and Ocean Pearl (tagging survey). Standardized sets were conducted at nine localities spatially dispersed along the B.C. offshore coast and at four selected mainland inlet localities. The offshore localities were selected because they include areas fished by commercial vessels and are located about 60 nm apart such that normal weather conditions would permit all localities to be occupied within a 30-day period. Historical depth stratification used since 1990 was retained, except the deepest depth stratum was dropped in favour of a new shallow 50 to 150-fm stratum. In general, there has been little replication of sets within each stratum. However, in 2002 three replicates were conducted within each depth stratum at three of the nine survey localities. The fishery independent catch rate index time series started in 1990 was extended by conducting 64 standardized sets. A total of 7,515 sablefish were sampled for biological measurements and otoliths (2,620 otolith pairs) and 40 tagged sablefish were recovered. Nineteen tagging sets conducted within the survey localities resulted in the release of 8,808 fish at the point of capture and the recovery of 155 tagged fish. A second component of the survey conducted in the inshore waters of Hecate Strait and associated inlets resulted in the release of 4,407 tagged sablefish.

A new stratified random survey was introduced as a pilot project in 2003. The B.C. coast was stratified into 5 spatial and 3 depth strata and 5 trap gear sets (75 sets in total) were randomly positioned within each stratum. Sablefish were tagged and released, standardized catch rate data collected, and biological samples were obtained. After a period of overlap, the intent is to

replace the existing protocols for tagging and standardized indexing with the stratified random design.

ii. Stock assessment in 2003

Sablefish stock assessment and management in British Columbia is conducted cooperatively by Fisheries and Oceans Canada (DFO) and the Canadian Sablefish Association (CSA). The cooperative relationship is formalized under the auspices of a Joint Project Agreement (JPA) to:

- Ensure the proper management of the commercial sablefish fishery.
- Conduct necessary scientific research to assess the health and sustainability of the sablefish resource and assess ecosystem impacts.
- Provide adequate funding and resources.
- Carry out all other activities deemed necessary to support the fishery including enforcement, at-sea monitoring, maintenance of data systems, and provision of scientific advice to fishery managers and the industry.

An assessment of sablefish was presented in January 2004 (Haist et al. 2004). The assessment of stock status relied on the interpretation of trends in four stock indices that relate to the trap vulnerable component of the British Columbia (B.C.) sablefish population. No stock reconstruction is available due to the absence of age data since 1996 and unresolved difficulties in the modelling of tag recovery data. Sablefish were last assessed using an age-structured population dynamics model that integrated tag recovery information in 2000. Three indices are in terms of catch per unit effort (CPUE) and the tagging index is expressed in biomass units:

Standardized commercial trap CPUE (1990-2003). Trap fishery catch rates (kg/trap) for the north coastal area declined from 1991 to 1998, prior to the mandatory adoption of escape rings. Subsequent to 1998 the four-year trend indicated a decline, with a historical low in 2001 and improvement in 2002 in agreement with the standardized survey trend. Catch rates increased substantially (63%) in 2003. The south coastal area catch rates initially increased and then declined from 1992 through 1998. Subsequent to 1998, the four-year trend was relatively flat. No south coastal estimate was available for 2003 due to the lack of trap fishing in the first half of that year.

Nominal commercial trap CPUE (1979-2002). Recent coast wide CPUE (kg/trap) is near levels experienced in the early 1980s. The peak of nominal trap CPUE during the early 1990s was consistent with a similar pattern observed for the Gulf of Alaska, though slightly lagged. Catch rate estimates for 2003 were not available due to very limited trap fishing early in the year. This time series is not standardized and coincides with a period of change in fishery management practice.

Standardized survey CPUE (1990-2003). Coast wide results for 2003 show substantially increased catch rates (numbers per trap) in both the north and south coastal areas. The historical trend shows a general decline in CPUE from highs in the early 1990s. Beginning in the mid

1990s the rate of decline in the north slowed and entered a period of relative stability through to 2000. The 2001 survey resulted in the lowest CPUE estimates in the time series. The northern catch rate improved in 2002 relative to 2001 and was comparable to those observed in the mid 1990s. The 2003 CPUE estimate was the highest in the time series. Catch rates in the south exhibited a continuous decline from the mid-1990s to 2002, but showed significant improvement in 2003 largely due to improved catches in the three shallow depth strata.

Tag-recovery estimates of vulnerable biomass (1991-2002). Estimates of trap vulnerable biomass derived from trap fishery tag recoveries declined from a high in 1993 through to 1998. Estimated biomass remained at low levels from 1998 through 2002, with a historical low in 2001 in agreement with the commercial and standardized survey time series. Trap vulnerable 2003 biomass was not estimated due to the lack of commercial trap effort after February of 2003.

There was general agreement among the trends in stock indices that sablefish vulnerable to trap gear experienced a decrease in abundance from (relatively) high levels in the early 1990s to low levels in the mid 1990s (Figure 1). The rate of decline slowed markedly in the mid-1990s for both stock areas. For the north stock area, a period of relative stability occurred in the mid 1990s until 2001 when historically low catch rates were observed for the commercial trap fishery and the standardized survey. Standardized survey catch rates for the north improved in 2002, and were comparable to those observed in the mid 1990s. There was substantial improvement in 2003 survey catch rates to a level similar to highs observed in the early 1990s. The pattern of tagging model estimates of vulnerable biomass was generally consistent with the trends indicated by the commercial catch rate and standardized survey series.

A biomass dynamics model used to integrate stock indices allowed estimation of annual production parameters that represented the net changes in biomass resulting from fish growth, recruitment, immigration, emigration, and changes in trap vulnerability. A Bayesian approach, based on the Markov Chain Monte Carlo (MCMC) algorithm was used to estimate the joint posterior distribution of the biomass dynamics model parameters. The biomass dynamics model was used to project trap vulnerable stock biomass and production trends over the 2003 to 2008 period for a range of potential future catch levels. Each simulation held the annual catch fixed over the projection period. Long term (1000 year) simulations were conducted for no-catch scenarios to provide estimates of the distribution of unfished trap vulnerable biomass. The long-term simulations suggested that if switching between equal-length periods of good and poor production occurred; the biomass would fall below 19,000 t about 5 percent of the time and was considered a level that should not lead to conservation concerns.

The performance measures evaluated for the assessment were relative to the trap vulnerable biomass in 2002 and to the 5th percentile of the distribution of unfished trap vulnerable biomass, $B^{0.05}$=19,000 mt:

The *probability* that vulnerable stock biomass is above 19,000 mt at the end of the projection period, $P\left(B_{2009} > B^{0.05}\right)$; The *probability* that vulnerable stock biomass is above B_{2002} at the end

of the projection period, $P(B_{2009} > B_{2002})$; The *magnitude* of the expected change in vulnerable stock biomass over the projection period, $E\left(B_{2009} / B^{0.05}\right)$, and The *magnitude* of the expected change in vulnerable stock biomass over the projection period, $E(B_{2009} / B_{2002})$.

Based on the stock indices, the model outputs suggested there is little risk that the TAC levels of up to 6,000 mt will lead to a short-term conservation concern. However, the model projection outputs were strongly influenced by the substantial increase observed in the 2003 standardized survey and northern trap fishery indices relative to results in 2002.

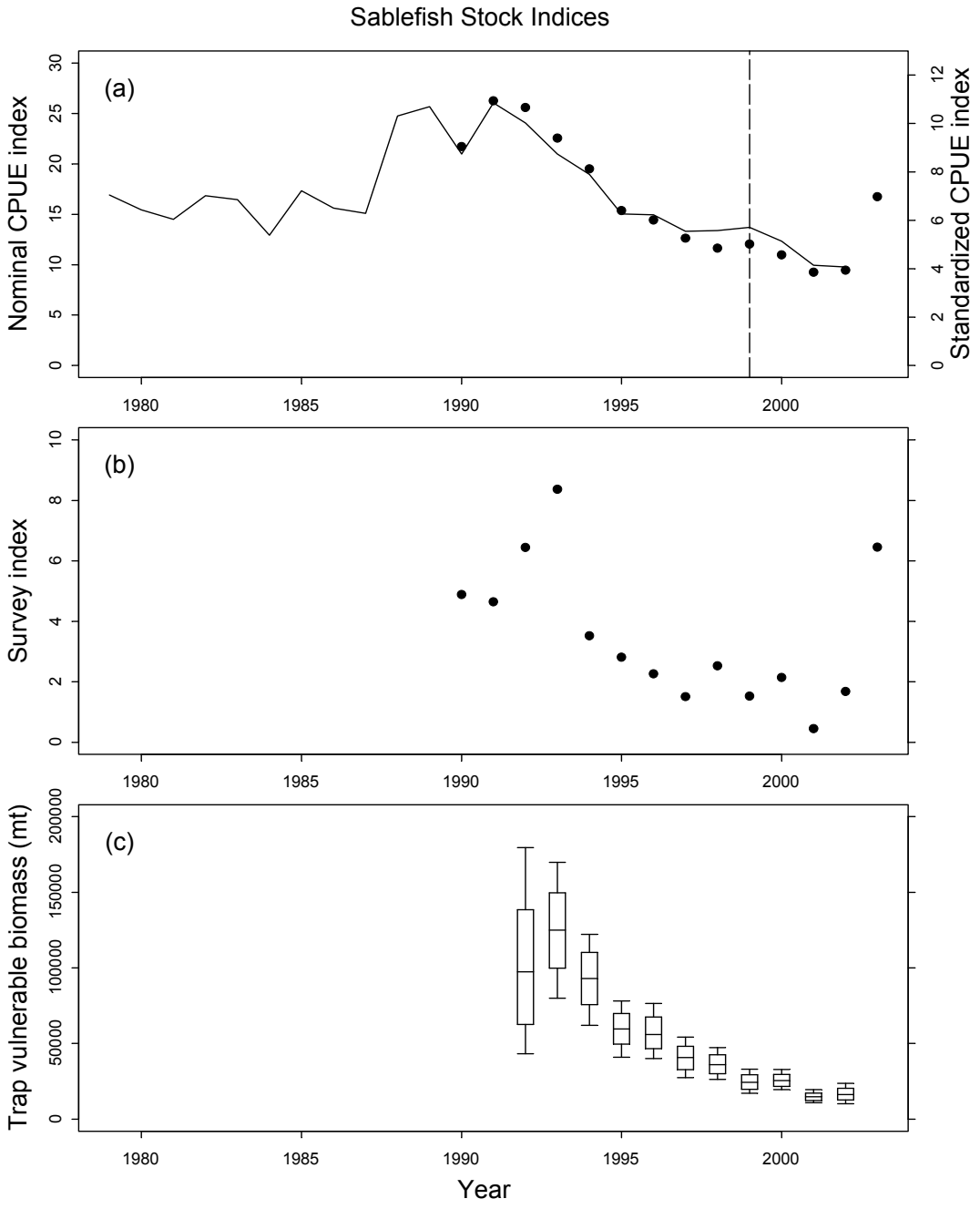

Figure 1: Coast wide stock indices: (a) nominal trap fishery catch rates (solid line) and standardized trap fishery index (filled circles), (b) standardized survey index abundance, and (c) tagging model marginal posterior distributions of trap vulnerable biomass. The dashed vertical line in panel (a) indicates the inception of trap escape rings.

iii. Research activities planned for 2004

Routine ageing of sablefish has not been conducted in BC since 1996, although structures have been collected annually. Plans for 2003/2004 include continued work on diagnosing the reasons for observed differences between burnt-section and thin-section otolith preparations and continued development of stratified random coast wide tagging and stock indexing survey is planned. The annual research and stock assessment survey is planned for the fall of 2004.

4. Flatfish

i. Research programs in 2003

A multispecies trawl survey was conducted in Hecate Strait in 2003. The objective of the survey was to obtain fishery independent data on flatfish assemblages in this region. Biological samples were collected for arrowtooth flounder *(Atheresthes stomias*), Dover sole (*Microstomus pacificus*), English sole (*Pleuronectes vetulus*), flathead sole (*Hippoglossoides elassodon*), petrale sole (*Eopsetta jordani*), rex sole (*Errex zachirus*), rock sole (*Pleuronectes bilineatus*), Pacific sanddab (*Citharichthys sordidus*), butter sole (*Pleuronectes slopes*), Starry flounder (*Platichthys stellatus)* and sand sole (*Psettichthys melanostictus*). The relative abundance indices for flatfish species in Hecate Strait were updated for future assessment work. Rock sole and English sole abundance has increased over the last three years and remains above the 50 year average for both species.

ii. Stock assessment in 2003

A petrale sole stock assessment was conducted in 2003 (. Three types of analysis were used: 1) estimation of mortality rates using life history characteristics; 2) Analysis of CPUE for fishery independent surveys and commercial data for estimation of trends in abundance; and 3) Estimates of biomass and yield using a delay-difference model. Results from the three available trawl surveys indicate that there has been a significant increase in biomass over the last three years. The regression models fitted to the commercial catch and effort data also show an increasing trend over the last three years. The estimate of F based on survey age composition information in 2000 was well below the best estimate for M (0.2). Delay difference model runs indicate that current biomass is at or above B_{msy}. The delay-difference model runs indicate that the current catch level of 479 t (the bycatch cap level set by DFO management) is well below a safe level of harvest for the coming fishing year. The PSARC sub-committee recommended raising the cap by 25% for the 2004-05 fishing season.

iii. Research activities for 2003

Future research and stock assessment work on flatfish in Hecate Strait will be covered by the Hecate Strait ecosystem project (HecStEP). A multi-species groundfish survey of Queen Charlotte Sound conducted in the summer of 2003 will provide biological data and fishery

independent abundance indices for arrowtooth flounder, Dover sole, English sole, flathead sole, petrale sole, rex sole, rock sole in that area.

5. Hake

i. No research was directed on hake (*Merluccius productus*) in 2003, nor planned for 2004,

6. Elasmobranchs

i. Research programs in 2003

An examination of potential age determination methods for big skate was completed (*Raja binoculata*). Vertebral centra sectioned longitudinally, immersed in ethanol, stained with crystal violet and enhanced with a thin layer of mineral oil produced the best results. Age compositions were produced and growth curves estimated. The method appears appropriate for age determination of big skate and the production of growth rates and productivity for input into ecosystem models. The method was also utilized on centra of Longnose skate with good results.

A tag/recapture program to examine stock discreteness of big skate was initiated in 2003. A total of 1,800 skates and 366 skates ranging in length from 49 to 199 cm, were tagged and released in Hecate Strait and Queen Charlotte sound respectively in March 2003. A further 1400 skate were tagged and released in Queen Charlotte Sound in August 2003.

ii. Stock assessment in 2003

No assessments were conducted on BC elasmobranches.

iii. Management

There are no directed fisheries allowed for sharks (excluding spiny dogfish, *Squalus acanthias*) in BC waters; therefore sharks are bycatch only. There is no immediate concern regarding the bycatch of sharks in BC fisheries, therefore no specific recommendations are made. However, the bycatch should be monitored by species and area in order to ensure that future productivity of BC sharks is not compromised.
Recent increases in directed catch of skate prompted management to examine options for the 2002/2003 and subsequent fishing years. This resulted in a catch "cap" of 850 t on Hecate Strait big skate in 2002/03, which was continued in 2003/04.

iv. Research activities planned for 2004

The tag/recapture program for Hecate Strait/Queen Charlotte Sound big skates to examine stock delineation initiated in 2003 will be continued in 2004

7. Lingcod

i. Research programs in 2002

The nest site affinity study was completed and was published as a primary paper. Lingcod abundance surveys were initiated in the Strait of Georgia in 2003: hook and line for juveniles and adults, bottom trawl for young of year, and dive survey for juvenile and adults. An archival tagging program was conducted to examine the seasonal distribution of lingcod (adults vs. juveniles; males vs. females) in the Strait of Georgia.

ii. Stock assessment

Offshore - No assessment was conducted on offshore lingcod stocks in 2003.

Inshore - No assessment was conducted on Strait of Georgia lingcod stocks in 2003. The Strait of Georgia remains closed to all commercial and recreational fishing.

iii. Research activities planned for 2004

Lingcod abundance surveys will be continued in the Strait of Georgia in 2004. Larval and post-larval surveys will be initiated to address the spatial limitations for lingcod dispersion in the Strait of Georgia. Community dive surveys for lingcod and rockfish densities, coupled with egg mass surveys will be sponsored by DFO in the upcoming year. A lingcod management framework will be completed in 2004 outlining rebuilding targets and management options for the Strait of Georgia population.

D. Other related studies

1. Statistics and Sampling

i. Database work in 2003

Principal Statistics and Sampling activities in 2003 included the ongoing population of the groundfish biological database (GFBio). This database now includes about 5,600,000 specimens. Data entry activities continue to concentrate on input of current port sampling and observer biological data and recent research cruises. When time is available, the database is backfilled with research cruise data collected before 1997. This past year involved a considerable effort in the entry of historic sablefish research cruises. Approximately 50% of the person year dedicated to Groundfish Statistics and Sampling was committed to assisting in data uploads of the trawl observer data and providing catch data summaries. The groundfish trawl fishery continues to be covered by 100% dockside and virtually 100% observer coverage. These observers also provided 646 length/sex/age samples and 351 length samples in 2003. Port samplers provided 220 samples with ageing structures (length/sex/age/weight) and 11 without structures (length/sex/weight).

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

ii. Field work in 2003

Stat/Sampling staff organized and led the 2003 QCSd bottom trawl survey (Stanley et al. 2003). The survey conducted 239 usable tows in depths of 50-500 m from July 3-August 9 on board the commercial trawler the F/V Viking Storm. The survey was jointly conducted and funded by the Canadian Research and Conservation Society and Fisheries and Oceans Canada. The objective of the survey, which will be conducted at regular intervals, is to provide long term indices of relative abundance for most fish species affected by bottom trawling. The indices would not only reflect populations in the survey area but, since it covers the core area of the coast, could provide an indicator of coastwide abundance of many species for which other information is not available. The tactical intent of the first year was to test whether the survey could generate acceptable precision at a reasonable cost.

Results indicate that if the survey were repeated in its current design it could meet its primary objective and would cost approximately $312,000/y. It will also provide a research platform that will contribute essential biological samples, and oceanographic information. The document recommends that the survey be continued with minor modifications that can be identified with additional analyses of the 2003 results.

iii. Proposed field work for 2004

Stat/sampling staff will lead the 2nd year of the QCSd bottom trawl survey and initiate the 1st year of a similar survey off the west coast of Vancouver Island (WCVI) in 2004. The WCVI survey will follow the design of the QCSd survey. Staff is also planning to provide a Strategic plan for longterm surveys.

APPENDIX 1. REVIEW OF CANADIAN GROUNDFISH FISHERIES

1. Commercial fisheries

All catch figures for 2003 are preliminary. Canadian domestic trawl landings of groundfish (excluding halibut) in 2003 were 110,746 t, an increase of 13% above the 2002 catch. The main cause for the rise in landings was the increase in landings of Pacific hake. The major species in the trawl landings were Pacific hake (62%), Pacific Ocean perch (6%), pollock (5%), yellowtail rockfish (4%) and turbot (4%). Principal areas of trawl production were 3C (57%), 5B (10%), 4B (8%), 5A (5%) and 3D (5%).

Canadian landings of groundfish caught by gear other than trawl in 2003 totaled 8,685 t. Sablefish landings by trap and longline gear accounted for 2,341 t, approximately 72% by trap gear and 28% by longline gear. Landings of species other than sablefish by longline, handline and troll gear accounted for 6,344 t (72% dogfish, 13% rockfish and 12% lingcod).

2. Recreational fisheries

Each year, Fisheries Management Branch of DFO conducts creel surveys of the recreational angling fishery in the Strait of Georgia. Principal target species are chinook and coho salmon. In 2003 these surveys covered the months of April to September. Provisional estimates of 2003 catches, landings and discards, for this 6-month period were 731 fish for lingcod, 12,657 fish for all rockfish species, 1,237 fish for halibut and 17,709 fish for all other groundfish species, including dogfish, flatfish, greenling, cabezon, herring and ratfish.

3. Joint-venture fisheries

There were no joint-venture fisheries for Pacific hake off southwest Vancouver Island (Area 3C) in 2003.

4. Foreign fisheries

There were no national or supplemental fisheries for Pacific hake off southwest Vancouver Island (Area 3C) in 2003.

APPENDIX 2. GROUNDFISH RELATED REPORTS PUBLISHED BY THE STOCK ASSESSMENT DIVISION IN 2003.

1. Primary Publications

Haigh, R. and J. T. Schnute. 2003. The longspine thornyhead fishery along the west coast of Vancouver Island, British Columbia, Canada: portrait of a developing fishery. North American Journal of Fisheries Management. 23: 120-140.

McFarlane, G. A., J. R. King. 2003. Migration dynamics of Spiny dogfish (*Squalus acanthias).* In the North Pacific Ocean. Fish. Bull. 101: 358-367.

King, J. R., and G. A. McFarlane. 2003. Marine fish life history strategies: applications to fishery management. Fish. Man. and Ecology 10:249-264.

Schnute, J. T. 2003. Designing fishery models: a personal adventure. Natural Resource Modeling 16: 393-413.

Schnute, J. T. and R. Haigh. 2003. A simulation model for designing groundfish trawl surveys. Canadian Journal of Fisheries and Aquatic Sciences. 60: 640-656.

2. Other publications

Haist, V, A. R. Kronlund, and M. R. Wyeth. 2004. Sablefish (*Anoplopoma fimbria*) in British Columbia, Canada: Stock Assessment for 2003 and Advice to Managers for 2004. PSARC Working Paper G2004-01.

King, J.R., G.A. McFarlane and A.M. Surry. 2003. Stock Assessment Framework for Strait of Georgia Lingcod. Can. Sci. Ad. Sec. Res. Doc. 2003/062. 57 p.

McFarlane.G. A. 2003. 2002 Pacific Region State of the Ocean- Report of the Fisheries Oceanography Working Group. Can. Tech. Rep. Fish. Aquat. Sci. 2484:65p.

Schnute, J. T., N. M. Boers, and R. Haigh. 2003. PBS Software: maps, spatial analyses, and other utilities. Canadian Technical Report of Fisheries and Ocean Sciences 2496, 82 p.

Sinclair, A., J. Schnute, R. Haigh, P. Starr, R. Stanley, J. Fargo, and G. Workman. 2003. Feasibility of multispecies groundfish bottom trawl surveys on the BC coast. Canadian Science Advisory Secretariat, Research Document 2003/049.

Stanley, R. D., P. Starr and N. Olsen. 2003 (in press). Bocaccio Update. Canadian Science Advisory Secretariat, Research Document 2003/xxx.

Stanley, R. D., P. Starr, N. Olsen, and R. Haigh. 2003 (in press). Queen Charlotte Sound Bottom trawl survey. Canadian Science Advisory Secretariat, Research Document 2003/xxx.

Surry, A.M. and J.R. King. 2003. Diameter Measurements for Identification of the First and Second Annulus on Dorsal Fin Ray Sections from Lingcod (*Ophiodon elongatus*). Can. Tech. Rep. Fish. Aqu. Sci. 2490. 24 p.

APPENDIX 3. STOCK ASSESSMENT DIVISION GROUNDFISH STAFF IN 2003

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

Alaska Fisheries Science Center of the National Marine Fisheries Service

2004 Agency Report to the Technical Sub-committee of the Canada-US Groundfish Committee

May 2004

Compiled by Mark Wilkins, Tom Wilderbuer, and David Clausen

REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENTS, AND MANAGEMENT IN 2003

A. Agency Overview

Essentially all groundfish research at the Alaska Fisheries Science Center (AFSC) is conducted within the Resource Assessment and Conservation Engineering (RACE) Division, the Resource Ecology and Fisheries Management (REFM) Division, and the Auke Bay Laboratory (ABL). The RACE and REFM Divisions are divided along regional or disciplinary lines into a number of tasks and subtasks. A review of pertinent work by these tasks 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 new AFSC Publications Database (searchable). Lists or organization charts of groundfish staff of these three units are included as Appendices II, III, and IV.

RACE DIVISION

In 2003 the primary activity of the Resource Assessment and Conservation Engineering (RACE) Division continued to be fishery-independent stock assessment surveys of important groundfish species of the northeast Pacific Ocean and Bering Sea. Regularly scheduled bottom trawl surveys in Alaskan waters include an annual survey of the crab and groundfish resources of the eastern Bering Sea shelf and biennial surveys of the Gulf of Alaska (odd years) and the Aleutian Islands and the upper continental slope of the eastern Bering Sea (even years).

Two major bottom trawl surveys of groundfish resources were conducted during the summer of 2003 by RACE Groundfish Assessment Program scientists on the eastern Bering Sea shelf and on the shelf and upper slope of the Gulf of Alaska. Groundfish habitat-related research (previously reported as Trawlex studies) was also continued by RACE scientists under the newly formed Habitat Research Team.

The Midwater Assessment and Conservation Engineering (MACE) Program conducted echo integration-trawl (EIT) surveys of midwater pollock abundance in the Gulf of Alaska during the winter and summer, 2003. Regions included the Shumagin Islands and Sanak Trough in February, Shelikof Strait and areas south and east of Kodiak Island in March, and a feasibility survey in the central/western Gulf of Alaska in June and July.

A distinct highlight of 2003 was the launch of the AFSC's new research vessel, the NOAA ship *Oscar Dyson*, on October 17 in Moss Point, Mississippi. This 209 ft vessel will be one of the quietest research vessels in the world and will be able to conduct hydroacoustic surveys at a

speed of 11 knots. It is still being fitted out in Mississippi and will be delivered to its home port of Kodiak in the early fall. Intervessel calibrations are already being planned between the *Dyson* and the *Miller Freeman*.

For more information on overall RACE Division programs, contact Division Director Dr. Gary Stauffer 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 Observer Program and the following tasks: 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. Richard Marasco at (206)526-4172.

AUKE BAY LABORATORY

The Auke Bay Laboratory (ABL), located in Juneau, Alaska, is a division of the NMFS Alaska Fisheries Science Center (AFSC). In recent years, ABL's Groundfish Assessment Program has been primarily involved with research and assessment of sablefish and rockfish in Alaska and with the study of fishing effects on the benthic habitat. In the past three years, the Groundfish Program has also conducted research to study the interaction between Steller sea lions and prey/predators in Alaska. Presently, the Groundfish Program is staffed by 17 scientists, including 15 permanent employees and 2 term employees. One addition to the program in

2003 was the permanent hiring of Dana Hanselman to work primarily on stock assessment analyses. Dana is completing his Ph.D. from the University of Alaska Fairbanks, Juneau Center for Fisheries and Ocean Sciences, and previously was a National Sea Grant/NMFS Population Dynamics Fellow whose research was cooperative with ABL's Groundfish Program. Four employees in other ABL programs have also been involved with research on groundfish in recent years.

In 2003 field and laboratory research, ABL's Groundfish Program, in cooperation with the AFSC's RACE Division, conducted the annual NMFS sablefish longline survey in Alaska. Other field and laboratory work by ABL included 1) continuation of a study that used a manned submersible to investigate distribution of deep-water corals in the Aleutian Islands; 2) a multibeam echosounder survey of the Albatross Bank fishing grounds in the central Gulf of Alaska to produce detailed bathymetric and habitat maps for these grounds; 3) scuba diving and laboratory studies to determine the resiliency of sea whips to simulated effects of bottom trawling; 4) a series of cruises in southeast Alaska to test the hypothesis that sea lion prey diversity and seasonality are related to Steller sea lion population trends; 5) ongoing scuba diving studies of growth rates of shallow water coral species to help determine effects of fishing on these taxa in Alaska; 6) continued juvenile sablefish studies, including routine tagging of juveniles and a special sonic tagging study of these fish; 7) a genetics study to determine species identification and stock structure of young-of-the-year rockfish from offshore waters of the Gulf of Alaska and eastern Bering Sea; 8) electronic archival tagging of Greenland turbot and shortspine thornyhead during the longline survey; 9) a tagging study of Pacific sleeper sharks in southeast Alaska; and 10) continuing habitat studies of groundfish in nearshore and estuarine areas of southeast Alaska.

Ongoing analytic activities involved management of ABL's sablefish tag database, analysis of sablefish logbook and observer data to determine fishery catch rates, and preparation of five annual status of stocks documents for Alaska groundfish: sablefish, Pacific Ocean perch, northern rockfish, shortraker/rougheye rockfish and other slope rockfish, and pelagic shelf rockfish. In 2003, an age-structured model was used for the first time to assess light dusky rockfish, the major species in the pelagic shelf assemblage. Other analytic activities during the past year were: 1) a continuing study of the use of echosounder signals to stratify trawl surveys for Pacific ocean perch and thereby improve survey precision; 2) an analysis of the relative abundance of Pacific sleeper sharks in Alaska based on longline survey data; and 3) development of a relational database for the longline survey to make the survey's data accessible to other researchers and to fishermen. In addition, Groundfish Program staff spent considerable time working on analyses for two Supplemental Environmental Impact Statements (SEIS): a revised Programmatic SEIS for the Bering Sea/Aleutian Islands and Gulf of Alaska Groundfish Fishery Management Plans and a new SEIS for essential fish habitat in Alaska.

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

B. Multispecies Studies

1. Research

Bering Sea Crab/Groundfish Bottom Trawl Survey - RACE

The annual crab-groundfish demersal trawl survey of the eastern Bering Sea shelf was completed from June 2- July 22, 2003. A total of 395 stations were sampled, covering nearly 500,000 km^2 from inner Bristol Bay to the shelf edge and from Unimak Pass to 62° N near St. Matthew Island. The chartered vessels F/V Aldebaran and F/V Arcturus were used for the 11th consecutive year. This also marked the 22nd survey of the 'standard' time series of consistent area, gear, and general sampling protocol.

Preliminary biomass estimates for major species indicated relatively little change from 2002 except for walleye pollock and arrowtooth flounder. Walleye pollock showed a dramatic increase from under 5 million tons in 2002 to 8.5 million tons in 2003. Arrowtooth flounder increased from about 355,000 tons in 2002 to 550,000 tons in 2003. The lack of winter ice cover in the eastern Bering Sea has had an apparent dramatic effect on bottom temperatures. The average bottom temperature for the 2003 survey was 3.81°C, the highest ever seen during the standard time series.

Nineteen additional stations were sampled in inner Bristol Bay and along the Alaska Peninsula to continue our look at improving yellowfin sole biomass estimates. After the standard survey, one vessel was used for gear experiments to estimate the escapement of skate species under the footrope and to find out what effects differing warp lengths between sides has on footrope height. The other vessel was used on the shelf edge and upper slope to investigate combined trawl and hydroacoustic methods on rockfish.

For further information, contact Gary Walters, (206) 526-4143.

Spatial and temporal patterns in Bering Sea invertebrate assemblages

Invertebrate bycatch recorded during the annual RACE Division groundfish trawl surveys in the eastern Bering Sea (1982-2002) was examined to (1) characterize benthic habitats by invertebrate communities, and (2) detect temporal and spatial changes in community structure. These analyses will provide a better understanding of the eastern Bering Sea benthos and may also provide a basis for designing an experimental system to systematically study mobile fishing gear impacts. Consistently in almost every survey, two major groups of stations were found partitioned along either side of the 50 m isobath. Exceptions to this pattern are seen in 1982, 1988, and 1999, when the partition broke down and merged all stations essentially into one homogeneous group (1998 saw a contraction of the coastal cluster). The validity and significance of the possible 'anomalous' pattern is under investigation as is the utility of the two-group pattern for systematic studies of fishing gear effects. Trends and patterns in the biomass and spatial distribution of the invertebrate fauna are also being analyzed in relation to

environmental variables and to the abundance and distribution of associated managed species.

For further information please contact Cynthia Yeung, (206) 526-6530.

Gulf of Alaska Biennial Groundfish Bottom Trawl Survey - RACE

The 2003 biennial bottom trawl surveys of Gulf of Alaska (GOA) groundfish resources were conducted from May 20 through August 9. Prior to establishing a biennial schedule in 1999, the RACE Division had surveyed GOA groundfish resources triennially since 1984, with preliminary work in 1978 and 1981. The earlier surveys covered waters out to 500 m depth, but extended deeper only in 1984 (to 825 m) and 1987 (to 750 m). Since 1999, GOA triennial surveys have been designed to cover the continental shelf and slope between 170°W long and Dixon Entrance out to the 1,000 m depth contour. While the 1999 survey succeeded in sampling the entire area, the 2001 survey area was reduced due to the Division's increased survey responsibility in other areas under limited funding. The 2001 survey area did not include the area east of 147°W long., nor did it extend deeper than 500 m. The 2003 survey covered the entire geographic extent, but the outermost depth stratum (700-1,000 m) was omitted because vessels were unable to fish that deep (insufficient wire length).

Sampling was conducted aboard three chartered commercial trawlers (*Sea Storm*, *Gladiator*, and *Northwest Explorer*), progressing E to W on the shelf and slope to the U.S.-Canada border in SE Alaska. Of the 880 attempted standard survey tows, 809 were successfully completed, ranging in depth from 13 m to 667 m. The primary objective of the biennial groundfish surveys is to build a standardized time series of data to assess, describe, and monitor the distribution, abundance, and biological condition of various GOA groundfish stocks.

When looking at changes since the last survey in 2001, we can only compare abundance estimates in the central and western subareas (W of 147°W long.) shallower than 500 m. In that area, the most abundant species in 2003 were, in order, arrowtooth flounder, Pacific halibut, walleye pollock, Pacific Ocean perch, Pacific cod, and flathead sole. Since 2001, the estimated abundance of all of these species except Pacific Ocean perch increased: arrowtooth flounder by 87% to 2,540,000 t, halibut by 50% to 518,000 t, pollock by 84% to 387,000 t, cod by 10% to 283,000 t, flathead sole by 56% to 239,000 t. The abundance estimate of Pacific Ocean perch declined by 47% to 356,000.

We can compare abundance estimates from the entire survey area between 2003 and 1999 except for species that occur commonly in the deepest stratum (700-1,000 m), such as grenadier. Over the entire GOA survey area, arrowtooth flounder was by far the most abundant species with a total biomass estimate of over 2.8 million t, a 124% increase over the 1999 estimate. Nearly 78% of its biomass was from the central GOA survey subarea. The second most abundant species was Pacific halibut with a biomass estimate of 634,000 t, an 8% increase since the 1999 survey, with 66% of its biomass coming from the central subarea. POP ranked third in abundance at 457,000 t, down 37% from 1999 with 62% of its biomass occurring in the central GOA. Pollock ranked fourth in abundance at 425,000 t, a 33% decrease since 1999, with 50%

and 41% of its biomass coming from the western and central GOA, respectively.

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

Recruitment Processes

The mission of the Recruitment Processes Program of AFSC's RACE Division is to understand how environmental variability affects the recruitment success of Alaska's living marine resources. Understanding these processes will lead to better prediction tools and more accurate predictions of recruitment. Most of the research is based on the paradigm that variability in recruitment to harvestable stocks is set early in the animal's life (first year) and is the result of processes strongly influenced by the physical and biological environment in which the early life history stages occur. Within the program are multiple research projects under programs sponsored by the NOAA Fisheries-Oceanography Coordinated Investigations (FOCI), the NOAA Steller Sea Lion Research Program (SSLRP), the North Pacific Research Board (NPRB) and NOAA (Coastal Ocean Program) Global Ocean Ecosystem Dynamics (GLOBEC). FOCI and GLOBEC are collaborative research projects between two NOAA Line Offices: NMFS and Oceans and Atmospheric Research (OAR). OAR's representatives are physical oceanographers and atmospheric scientists from the Pacific Marine Environmental Laboratory. One objective of these coordinated investigations is to improve the timeliness information used by management for decisions on optimal harvest levels, by providing recruitment forecasts during the first year of each new year-class.

FOCI's principal focus has been recruitment processes of walleye pollock. In recent years, however, the group has expanded its research to the early life histories of arrowtooth flounder, cod, Alaska plaice, forage fish (age-0 pollock, capelin, eulachon, Pacific sand lance), and larval transport mechanisms of offshore spawning flatfish (arrowtooth flounder and halibut). New research was begun to use molecular tools to identify and examine genetic diversity within populations' pollock, cod, and rays. Archived list of 2003 cruises and cruise reports can be obtained electronically (http://www.pmel.noaa.gov/foci/operations/2003/fieldops03.html).

Lists of publications and reports can be viewed either from the AFSC publications web page (http://www.afsc.noaa.gov/Publications/publications.htm) or the FOCI web page (http://www.pmel.noaa.gov/foci/focipubn.shtml).

In 2004 the Recruitment Processes Program and their partners at PMEL will begin a new program, Climate Regimes and Ecosystem Productivity. This program will allow them to shift from a single-species focus to a more formal ecosystem perspective to help meet NOAA's challenge for ecosystem-based management.

For further information, contact Dr. Jeff Napp, (206) 526-4148.

Fisheries Behavioral Ecology Program - RACE

The Fisheries Behavioral Ecology Program conducts experimental research designed to understand the role that behavior plays in regulating distribution, abundance growth, and survival of fish species and their interactions with fishing methods and gear. The goal of the Program is to provide the critical information needed to improve survey techniques, to improve predictions of population abundance and survival, and to conserve populations of economically significant marine resource species and their habitats. Research conducted during 2003 continued under long-term research themes related to bycatch stress and basic studies in fish ecology relevant to the performance of fishing gear, definition of essential habitat, and recruitment processes.

Experimental bycatch studies

Bycatch studies in the Fisheries Behavioral Ecology Program fall into two main categories: 1) the fate of fish which are discarded after their arrival on the deck, and 2) the fate of fish which escape trawl gear at depth through cod-end meshes. In studies related to discards, an attempt has been made to understand the key principles which control mortality, integrating analysis of behavioral and physiological assays along with observed mortality. Recent work with sablefish and Pacific halibut have shown that 1) capture and environmental stressors interact to magnify behavior impairment and morality; 2) susceptibility to stress and mortality is species specific and strongly influenced by fish size; and 3) mortality may be delayed, such that it is difficult to estimate through traditional approaches which capture and hold fish aboard vessels or in net pens in the field. The presence of higher levels of mortality in smaller fish indicates that the practice of highgrading in fisheries is counter productive for stocks and should be restricted. Obvious behavior impairment was observed even in fish that were exposed to minimal stressor intensity. Recovery of behavior to control levels occurred within 24 h. The magnitude of behavior impairment was correlated with stressor intensity and was a good predictor of delayed mortality in fish that had sustained physical injury from capture. Discarded fish have behavior impairment that makes them more susceptible to predation after release and this is probably an additional source of delayed morality that is not presently being measured in field studies. The correlations between injury from fishing gear, environmental factors, behavior impairment, immuno-suppression and delayed mortality are presently being investigated in greater detail.

Performance of fishing gear

Capture of fish with baited fishing gear (e.g., longlines and traps) for both prosecution of a fishery and stock assessment depends upon feeding motivation, movement patterns, and sensory capabilities in the target species as well as the design of hooks and other gear. In 2003, the Fisheries Behavioral Ecology Program completed experiments to determine how changing environmental variables influence responsiveness of Pacific halibut and sablefish to baits. Halibut were tested under varying conditions of fish density in large laboratory tanks, and it is now clear that capture rates of halibut will be density-dependent in a non-linear function because of social facilitation in feeding motivation. Sablefish were tested under varying conditions of water temperature (2-8°C) and food deprivation. Responsiveness to bait was strongly effected

by both variables with temperature having the largest effect. Reduced sensitivity to olfactory cues, lower swim speed, lower attack frequency, and increased time to attack baits combine to reduce sablefish catchability. Experiments are currently underway to test the effects of temperature on responsiveness to baits in halibut. Population sizes based upon baited gear surveys can be greatly underestimated in conditions where environmental variables such as light, temperature, and fish density reduce feeding motivation and/or locomotion.

Efficiency of trawl gear relies upon fish herding in response to the approaching gear. In flatfish trawls the sweeps stimulate fish to move inward towards the mouth of the trawl, where they subsequently tire and fall back into the meshes. However, this herding response may rely upon fish being able to see and respond to the approaching gear. Northern rock sole, Pacific halibut and English sole were examined in a 35 ft long flume tank to determine how ambient illumination influences their behavioral response to the benthic disturbance associated with the approach of a sweep or footrope. Infrared illuminators and video cameras allowed for behavioral observations on fish reactions as a simulated sweep/footrope approached them. Preliminary analysis for the experiment shows that under conditions where fish can see the approaching gear, they lift off the bottom in advance of the sweep and initiate herding behavior. In darkness, the fish are more often struck by the gear, and when they did respond, typically rose into the water column, letting the gear pass beneath them. This suggests that the sweeps on bottom trawls may be relatively ineffective at stimulating herding behavior in flatfish at night or at great depth, influencing catch rates.

Habitat studies

During 2003, analysis was completed for field trials in Oregon and Alaska designed to test the efficacy of a towed camera sled compared with diver surveys and fine-meshed survey trawls for quantification of density and habitat associations of juvenile flatfishes and other demersal species. The analyses indicate that the towed camera yielded significantly higher counts for age-0 flatfishes than the trawls, and density estimates equal to or better than diver surveys. The camera sled can be used to cover great distances at relatively low cost and provides a permanent record for surveying both fishes and habitat features.

Given success with the camera sled, surveys for juvenile flatfishes were conducted in three flatfish nursery locations near Kodiak Island in 2003. Intensive surveys were conducted in the center of the nurseries for spatially-explicit interpretation of distribution patterns, while more extensive surveys were employed for analysis of broad-scale habitat associations. Video data on fish abundance and surface features of the habitat are being combined with grab samples to quantify characteristics of the sediment and geographic information systems for spatial analysis. This field study will continue into 2005; however, it is already apparent that soft bottom habitat is not uniform and juvenile flatfishes are not distributed randomly.

Experimental laboratory studies conducted during 2002-03 showed that preferences by juvenile Alaskan flatfishes for benthic habitats with emergent structure can be their reduced vulnerability to predation in such habitats. During 2003, a field experiment was conducted to test responses by

flatfishes to habitat complexity in a flatfish nursery ground. This was done by enhancing tracts of bare sand seafloor near Kodiak with shell. Age-0 yr northern rock sole exhibited an unexpected decrease in abundance compared with adjacent unaltered tracts. In contrast, larger (age-2+ yr) rock sole were more abundant in the shell tracts. This raised the possibility that age-0 fish were avoiding the shell because of the presence of larger, potentially threatening flatfish. Subsequent laboratory studies confirmed that larger age-1 rock sole demonstrated a much stronger preference for emergent structure, i.e. shell, than did age-0 rock sole. Furthermore, age-0 rock sole were shown to actively avoid a variety of large flatfish, including age-1 rock sole, age-1 halibut and age-4+ starry flounder. This combination of field and laboratory experiments demonstrated two important considerations relative to fish habitat preference and definition of essential fish habitat. First, preferences for different types of habitat change with fish size or age. Second, a holistic understanding of habitat requires knowledge not only of fish response to structural components of habitat, but also relative to biotic components, such as the abundance of potential predators.

Growth and behavior of flatfishes

Seawater temperature can have a profound impact on fish growth, energy allocation, and behavior, all of which can affect variation in recruitment to a fishery. During 2003, an experiment was completed on the compensatory growth response of halibut to a thermally induced growth reduction. It was demonstrated that increased growth rate was accomplished through reduction lipid energy storage. Reductions in metabolic costs did not contribute to rapid growth as growth-compensating fish were more active than controls suggesting a possible trade-off between rapid growth and predation risk. In another experiment the relationships between feeding behavior and digestive physiology were examined in juvenile halibut at 2, 6 and 10°C. The time required for halibut to locate and consume a meal decreased from several days at 2° to less than 1 minute at 10°C. Unexpected interactions between temperature and food-deprivation period suggested an energy-conserving behavioral response to starvation. An experiment examining the growth and energy storage rates of young-of-the-year rock sole across a range of temperatures was also completed in 2003. Maximum observed growth rates increased from 0.14% in weight per day at 2° to over 1% per day at 13°.

A series of experiments was designed to examine diel activity patterns in northern rock sole at different temperatures. During the day, fish were active exclusively on the sediment surface, whereas at night, fish frequently swam in the water column or at the water surface. At high temperatures, most of the activity occurred during the daytime. At low temperatures, daytime activity was reduced such that night became the dominant activity period.

Two Oregon State U. graduate students were added to the Fisheries Behavioral Ecology Program in 2003, Megan Petrie and Jena Lemke.

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

Age and Growth Task - REFM

The Age and Growth Program of the REFM Division serves as the AFSC's ageing unit for groundfish species. The program consists of a biometrician, age validation researcher, data manager/technician, and 11 age readers. Ages are usually determined from otoliths, but scales, fin rays and vertebrae are sometimes used.

Data provided by the program are used in stock assessment modeling, which contributes to the estimation of the allowable catch of many commercially important groundfish species. These species include walleye pollock, Pacific whiting, Pacific cod, sablefish, Pacific Ocean perch, northern and dusky rockfishes, Atka mackerel, yellowfin sole, rock sole, rex sole, and misc. sole and rockfish species.

Research in the Age and Growth Program in 2003 has focused on the following areas:

1. Craig Kastelle is currently working on the radiometric age validation of walleye pollock break and burn ageing methods.

2. Charles Hutchinson is working on his Masters Thesis which is focused on determining shortraker rockfish ageing criteria by comparing ring counts with radiometric ages. This has proved to be very difficult because the transition zone commonly used to age many species of rockfish has proved very difficult to identify. The bomb carbon age validation of canary rockfish which was performed in collaboration with Jennifer Menkel, Kevin Piner and John Wallace of the NWFSC has been more straightforward.

3. Jake Gregg (a UW contract employee) in collaboration with Delsa Anderl has worked diligently on the ageing of Greenland turbot. They have made considerable progress based on the method of sectioning and staining otoliths.

4. Chris Gburski has taken on the task of ageing skates (big skate, longnose skate, Aleutian skate and Bering skate) using vertebrae. He has traveled to Moss Landing Marine Lab, to consult with Drs. Dave Ebert and Wade Smith and adopt some of their very successful skate ageing methods.

The Age and Growth Program recently hired Dan Foy who comes to us through the University of South Carolina, with a B.S. degree in Marine Science.

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

Resource Ecology and Ecosystem Modeling - REFM

Multispecies, foodweb, and ecosystem modeling and research are ongoing. Documents, symposia and workshop presentations, and a detailed program overview are available on the

World Wide Web. These can be viewed from the AFSC web site at: http://www.afsc.noaa.gov/refm/reem/default.htm.

Groundfish stomach sample collection and analysis

The Resource Ecology and Ecosystem Modeling Task continued regular collection of food habits information on key fish predators in the North Pacific. Collection of groundfish stomach samples is primarily through the RACE bottom trawl and echo-integration/trawl surveys. Additional samples that broaden our spatial and seasonal coverage are obtained through the Observer Program and through coordinated studies with other agencies. In 2003, we collected samples during bottom trawl surveys of the Gulf of Alaska and the eastern Bering Sea shelves. Observers also collected stomach samples during fishery operations from the eastern Bering Sea. In total, 6,883 stomachs were collected from the eastern Bering Sea and 4,238 from the Gulf of Alaska. Laboratory analysis was conducted on 10,469 fish stomachs from the Bering Sea, and 5,420 from the Gulf of Alaska and Aleutian Islands.

Food habits of the important groundfishes in the Aleutian Islands in 1994 and 1997

The stomach contents of 31 species of groundfish were examined from the Aleutian Islands region. Predation on commercially important fish, crab, and shrimp was common. Atka mackerel were the dominant prey fish and were consumed by Pacific cod, arrowtooth flounder, Pacific halibut, Greenland turbot, Alaska skate, whiteblotched skate, great sculpin, and big mouth sculpin. Pollock was another important prey and was consumed mainly by Pacific cod, arrowtooth flounder, Pacific halibut, Alaska skate, and whiteblotched skate. Pollock cannibalism was not found in this study. Myctophids were also an important prey for arrowtooth flounder, Greenland turbot, Pacific Ocean perch, pollock, giant grenadier, shortraker rockfish, and rougheye rockfish. Other forage fish such as Pacific herring, osmerids, and Pacific sand lance were consumed by Pacific cod, arrowtooth flounder, and Pacific halibut. However, each of these species comprised no more than 5% of the stomach contents weight for any predator. Some mesopelagic fish, like bathylagids and viperfish, were found in groundfish stomachs. Tanner crabs were mainly consumed by Pacific cod, Pacific halibut, and great sculpin, but were also eaten by Alaska skate and flathead sole. Pandalid shrimp (which includes all the Pandalus and Pandalopsis species) were important prey of Pacific cod, arrowtooth flounder, shortspine thornyhead, rougheye rockfish, shortraker rockfish, Bering skate, darkfin sculpin, and Aleutian skate.

More information on the diet of the 31 groundfish species examined can be found in Yang (2003). This report includes detailed diet composition data, variation in the diet with predator size, geographic distribution of major prey types, and the size composition of important prey. When applicable, diets of certain species from 1994 and 1997 were compared with those from 1991.

Feeding habits of demersal fish in the Aleutian Islands - evidence of biophysical boundaries

Longitudinal gradients in the feeding habits of Pacific cod, Atka mackerel, pollock and Pacific Ocean perch (POP) were assessed from stomach samples collected from 1982 through 1999. A total of 20,985 stomachs were divided among areas of two-degrees of longitude, from 164° W to 170° E. Sample sizes per predator per two-degree block ranged from 11 to 3,588. Diet composition (percent by weight) by two-degree area was calculated for each predator with major prey items presented in detail and minor prey items (about 20% total) combined into "other prey."

The diet composition of all four predators shifted from east to west. East of Samalga Pass the portion of euphausiids consumed ranged from 50-90% while west of the pass it generally made up 10-50% of the diets. Besides a step-decrease in the proportion of euphausiids at Samalga Pass, there was a declining trend in the diets of POP and Atka mackerel from Samalga Pass to the western Aleutians. Copepods and myctophids contributed most to the remaining portion of the diets to the west for POP, Atka mackerel and pollock, and "other prey" increased in a step fashion toward the west for Atka mackerel and pollock. Pacific cod, east of Samalga Pass, consumed mostly pollock, whereas west of the pass, Atka mackerel became an increasingly abundant component. Squid and other fish contribute <20% to the Pacific cod diet east of Samalga Pass, but are very important west of the pass.

In addition to the shift in diet composition at Samalga Pass, there seemed to be changes in diet occurring further west. The gradients were not necessarily unidirectional, which suggests the presence of another biophysical boundary in the western Aleutians. For example, in the diet of POP, the proportion of myctophids increased substantially west of Buldir Island. Similarly, west of Buldir Island, pollock and Atka mackerel diets increased in shrimp, amphipods and polychaetes (included in "other prey"), and the Pacific cod diet increased in shrimp, west of Buldir Island.

While there is no oceanographic data to confirm this, these changes in diet composition throughout the Aleutians can be viewed as biological evidence of biophysical processes yet to be described in this region.

Seabird fishery interaction research

The AFSC is increasing its emphasis on researching seabird-fishery interactions, and incorporating seabirds into ecosystems models being developed for the Bering Sea and Gulf of Alaska. This increased emphasis is partially in response to several national efforts by NOAA Fisheries to focus more effort on minimizing bycatch through fishing gear improvements, standardized reporting, and education and outreach. These strategies are more fully outlined in the recently published National Bycatch Strategy (http://www.nmfs.noaa.gov/bycatch_images/FINALstrategy.pdf), and more specifically, on seabird bycatch, as noted by the National Plan of Action to reduce seabird bycatch in longline

fisheries (http://www.fakr.noaa.gov/protectedresources/seabirds/npoa/npoa.pdf). This national focus coincides with work that the AFSC has already been engaged in to characterize all components of seabird mortality from commercial fishing operations, and work collaboratively with the fishing industry and the U.S. Fish and Wildlife Service to reduce or eliminate seabird bycatch. This latter issue is being driven by the overlap between distribution of the endangered short-tailed albatross and commercial fishery operations. There have been several mortalities of these endangered seabirds from longline fisheries, and much collaborative work has been completed to date (see Alaska Region webpage http://www.fakr.noaa.gov/protectedresources/seabirds.html). Current priorities include continued work to reduce longline seabird bycatch, investigating the incidence of seabird interactions with trawl third wires, developing options for monitoring halibut fleet seabird bycatch, and developing reporting procedures to ensure the public has access to seabird bycatch rates and the results of various studies being conducted.

Ecosystem considerations in fishery management

The Ecosystem Considerations Section for 2004 was completed as part of the Stock Assessment and Fishery Evaluation (SAFE) Reports which are provided to the North Pacific Fishery Management Council (NPFMC). The final document is available on the AFSC web site at: http://www.afsc.noaa.gov/refm/stocks/assessments.htm. The purpose of the Ecosystem Considerations Chapter is to provide scientists and fishery managers with information on the status and trends of various ecosystem components and to evaluate the effects of climate and fishing on the ecosystem. The use of aggregate indicators, which bring together time series data on climate, fishing and biology, is an important part of the chapter but is still in early stages of development.

New to the Ecosystem Considerations section this year is the addition of status and trend information pertaining to salmon, herring, crabs, and zooplankton. Also new to the chapter is the addition of several community indicators, such as community size spectrum and k-dominance curves, indices of biodiversity, recruitment, and survival. Data gaps still include lower trophic levels, such as phytoplankton, additional zooplankton, and nutrient information.

Stock assessment scientists continued to use indicators from the Ecosystem Considerations section to assess ecosystem factors such as climate, predators, prey, and habitat that might affect a particular stock. Also, information regarding a particular fishery's catch, bycatch and temporal/spatial distribution was used to consider the possible impacts of that fishery on the ecosystem. We are still in early stages of using this type of information in stock assessments. However, we anticipate the information could be used to modify allowable biological catch recommendations or spatial distribution of the catch due to ecosystem concerns, or to target further research that would be needed to quantify ecosystem impacts.

Another new addition to the Ecosystem Considerations section is the Ecosystem Assessment. The strategy used, which is modeled after the framework used for ecosystem impact assessment in the draft Programmatic Groundfish Fisheries EIS (PSEIS), provides a systematic way of

evaluating ecosystem effects of fishing with respect to predator/prey relationships, ecosystem energy flow, and various measures of diversity. This strategy is intended to complete the intent of the Ecosystem Considerations section that has become a regular accompaniment to the NPFMC's Stock Assessment and Fishery Evaluation (SAFE) documents. While the Ecosystem Considerations section provides historical status and trend information for a variety of ecosystem components, the Ecosystem Assessment is intended to provide advice on possible future trends in the ecosystem, using TAC scenarios of the annual TAC-setting Environmental Assessment. This ecosystem assessment will allow us to fulfill TAC EA requirements to annually assess environmental consequences of TACs on the ecosystem. It also helps meet the guidelines of National Standard 2 - Scientific information in the Magnuson-Stevens Act, that specify that the SAFE report should contain information on past, present, and possible future condition of the stocks, marine ecosystems, and fisheries being managed. Lastly, the assessment will provide guidance on possible aggregate effects of fishing that are not captured under single species assessments.

Multispecies and ecosystem models are proposed as tools to provide advice on possible future trends in various ecosystem indicators. Three models are envisioned for future use in this assessment. The first is a multispecies bycatch model employed in the PSEIS, which employs single-species population projections for groundfish targets along with prohibited species bycatch and optimal yield constraints presently operating in the BSAI and GOA groundfish fisheries to provide realistic future fishing trajectories on target species and indicators of the types and amounts of bycatch. Multispecies virtual population analysis and forecasting models provide an age-structured predator/prey assessment on target groundfish species and ecosystem mass balance and biomass dynamics models provide a more holistic view of possible future trends in ecosystem components. Finally, climate is an important aspect of our prediction of the future state of ecosystems. Work is ongoing among NOAA components to develop more real-time assessment of changing climate states and responses of organisms to those changes. These are incorporated into our ecosystem considerations section of the SAFE and will require discussion about how to incorporate climate into our assessment of possible future climate effects on North Pacific ecosystems.

Arctic climate impact assessment

Two center scientists, Pat Livingston (REEM) and Tom Wilderbuer (SSMA) are contributors to an international effort to assess the effects of climate change on the arctic. The Arctic Climate Impact Assessment (ACIA) (http://www.acia.uaf.edu) is an international project of the Arctic Council and the International Arctic Science Committee (IASC), to evaluate and synthesize knowledge on climate variability, climate change, and increased ultraviolet radiation and their consequences. The aim is to provide useful and reliable information to the governments, organizations and peoples of the Arctic on policy options to meet such changes. The National Science Foundation and NOAA are providing funding for the ACIA Secretariat, which is located at the International Arctic Research Center at the University of Alaska Fairbanks. Pat Livingston is a contributor to the assessment on Marine Systems and Tom Wilderbuer is contributing to the chapter on Fisheries and Aquaculture, with contributions focusing on climate change in the

Bering Sea. A workshop was held this spring to bring chapter authors together and to provide a means for synthesizing results from the assessment. The peer-reviewed scientific volume will be completed in 2004.

Ecosystem modeling coordination

Kerim Aydin chaired a week long workshop held for the purposes of coordinating data methodologies for constructing quantitative marine food webs and for evaluating the resulting indicators of trophic flow in an ecosystem context. Participants focused on improving the design of current models of the eastern Bering Sea, the Gulf of Alaska, the Aleutian Islands and the Northern California Current. During this meeting, fish, marine mammal, and plankton data were compared between modeled regions, issues of spatial resolution were resolved, and methods for linking databases were standardized to aid incorporation into the Ecosystem Assessment process on an ongoing basis.

Bering Sea research planning

Pat Livingston and Jeff Napp of the Alaska Fisheries Science Center participated in a 3-day workshop in Seattle as part of a working group that will assist in the development of a Bering Sea research plan. The working group outlined a draft science plan at the 17-19 March 2003 workshop, organized around the central scientific question, "How will climate change affect the ecosystems of the Bering Sea." The ARCUS website provides more details about the planning process, working group members, and progress in development of the science plan at http://www.arcus.org/bering/.

For more information please contact Pat Livingston at (206)526-4242.

Distribution and Habitat of Groundfish in Nearshore Waters of Southeast Alaska - ABL

Scientists at the Auke Bay Laboratory (ABL) Habitat Program continued to assess the distribution, habitat, and behavior of groundfish in nearshore waters of southeast Alaska. In the final year of a 3-year study, eelgrass meadows were sampled for fish assemblages and mapped with GPS at six sites to establish a baseline of information for long-term assessment of biotic change. Two sampling cruises were conducted in 2003: one in winter using a charter vessel and one in summer using the NOAA vessel *John N. Cobb*. Sampling methods included use of a beach seine to capture fish. A total of 44 seine hauls from all sampling periods yielded 58,902 fish representing 45 species. Commercially important species captured included flatfish, Pacific cod, rockfish, salmon, and walleye pollock. Forage fish species captured included Pacific herring and Pacific sand lance. Fish were more abundant in eelgrass in summer than in winter. Studies in 2004 will focus on variation in abundance, size, and diversity of fish assemblages that use eelgrass during the day versus the night.

For more information, contact Scott Johnson at 907-789-6063 or John Thedinga 907-789-6025.

Fish Distribution and Habitat in Southeast Alaska Estuaries - ABL

Scientists in the Auke Bay Laboratory (ABL) Groundfish Program are studying groundfish in southeast Alaska estuaries to determine relationships between fish distribution and environmental conditions. Four sampling cruises were conducted in summer 2003 using the NOAA R/V *John N. Cobb* and a chartered vessel. Fish were captured with nets, and estuarine areas were characterized using two common habitat classification systems, the National Ocean Survey Environmental Sensitivity Index and the Province of British Columbia Shore Zone classification system. To date, more than 50 fish species have been identified in estuaries, including 33 species or species complexes identified for Federal management in Fishery Management Plans of the North Pacific Fishery Management Council. Commercially important species captured include a variety of flatfish, Pacific cod, rockfish, salmon, and walleye pollock.

The goal of this work is to find links between fish assemblages and environmental conditions that can be described with a habitat classification system. The product to date is a Geographic Information System (GIS) that integrates existing relational data on geophysical, biotic, and anthropogenic conditions in a spatial framework. Studies in 2004 will focus on linking fish assemblages to existing habitat types in southeast Alaska estuaries and analysis of how those classifications can be improved as predictors of fish distribution.

For more information, contact Mitch Lorenz at 907-789-6035.

2. Stock Assessment

Status of Stocks and Multispecies Assessment Task - REFM

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

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

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

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

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

3. Management

North Pacific Groundfish Observer Program - REFM

The North Pacific Groundfish Observer Program 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, provide a means for evaluating and developing management strategies by the regional management council and NMFS, and are used in the stock assessment process. Observers play important roles in providing information that is critical to the U.S. fishing industry.

During 2003, no foreign vessels were allowed to catch or process fish in the U.S. EEZ off the coast of Alaska. The Observer Program trained and deployed 701 observers to 325 vessels and 21 shore plants in Alaska. These observers spent 34,371 days collecting data in 2003. The Program is responsible for defining the sampling duties and data collection methods used by observers, training of the observers prior to deployment, debriefing of observers upon their return, and editing and managing the resulting data. The catch data are provided to the Alaska Regional Office to assist in management decisions regarding the catches of groundfish and prohibited species. Data are also collected regarding the operations of the groundfish fishery.

Dr. William Karp was chosen as the new Observer Program director in June, 2003 returning to a job that he knows well. He served as Program leader from 1993 to 1999. Dr. Karp left the Observer Program to take a leadership position within the RACE division of the AFSC. He was replaced by Dr. Dan Ito, who served in the leadership role until December of 2003.

For further information or if you have questions about the North Pacific Groundfish Observer Program please contact Dr. Richard Marasco (206)-526-4172.

C. By species, By Agency

1. Pacific Cod

b. Stock Assessment

BERING SEA/ALEUTIANS

The 2003 stock assessment updates the 2002 assessment by incorporating new catch and survey information. The 2003 EBS bottom trawl survey estimated Pacific cod biomass at 606,000 t, down 2% from the 2002 estimate and near the minimum of the 22 year time series (534,000 t). The Aleutian Islands were also surveyed in 2002 resulting in an estimated biomass decrease of 39% from 2000 which is the lowest value of the time series. The stock assessment model estimates of abundance are almost unchanged from the previous assessment. For example, estimated 2004 spawning biomass for the BSAI stock is 435,000 t, down about 1% from last year's F_{ABC} projection for 2004. The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $_{35\%}$ exist for this stock, and that this stock therefore qualifies for management under tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 422,000 t, 0.39 and 0.47, respectively. The point estimates for $F_{40\%}$, and $F_{35\%}$ are substantially higher than the last two years' values due to different fishery selectivity assumptions made since the 2000 assessment. For example, $F_{40\%}$ was 0.35 in the 2003 assessment and 0.30 in the 2002 assessment.

Pacific cod qualify for management under sub-tier "a" of tier 3 because projected biomass for 2004 is about 1% above *the* $B_{40\%}$ reference level. Fishing at an instantaneous rate of 0.39 is projected to result in a 2004 catch of 297,000 t, which is the maximum permissible ABC under Amendment 56. The ABC for 2004 recommended by the authors is 223,000 t based on a constant catch approach. The 2004 ABC recommendation is the same as the 2002 and 2003 ABC value. The Plan Team concurs with the author's recommendation to set 2004 ABC at 223,000 t, equal to the 2002 and 2003 ABC and 25% below the maximum permissible level. This ABC corresponds to a fishing mortality rate of 0.29, well-below the value of 0.39 which constitutes the upper limit on F_{ABC} under tier 3a.

Estimated spawning biomass declined substantially from 1988 to 1998, was stable from 1998 to 2001, and then increased from 2001 to 2003. There is concern by the Plan Team that Pacific cod abundance may be overestimated due to the assumed values of survey catchability and natural mortality and their interaction with the estimated parameters for growth and dome-shaped selectivity. Trawl catchability is assumed to equal 1, yet estimated age-3+ biomass is much greater than survey biomass because the model's estimate of trawl survey selectivity is sharply dome-shaped implying that significant amounts of large cod are not available to the shelf trawl survey. There is concern that comparison of the 2002 slope and shelf survey length data may not

support this implication, indicating that the dome-shaped selectivity currently estimated for the shelf survey may not be due to large fish residing on the slope at the time of the survey.

The recommended OFL was determined from the tier 3a formula, where fishing at a rate of 0.47 gives a 2004 value of 350,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

In this year's assessment, the assessment authors pointed out that the ABC of BSAI Pacific cod is not allocated by area. Pacific cod is something of an exception in this regard. The same multiplier (1.17) that is currently used to expand the results of the EBS assessment model into BSAI-wide amounts could be used to apportion the Pacific cod ABC between the EBS and AI management areas. If the 2004 ABC is set at 223,000 t, the EBS and AI portions under this approach would be 191,000 t and 32,000 t, respectively. An AI ABC of 32,000 t would be higher than the 2002 AI catch of 30,801 t and thus would not be expected to result in significant new constraints on the existing fishery. However, it would help to constrain future expansion in a precautionary manner until such time as a more rigorous apportionment methodology can be developed. This ABC split may have substantial implications for Pacific cod management and allocation and will be discussed further at next year's September Plan Team meeting before making a recommendation.

GULF OF ALASKA

New to 2003 assessment is an analysis examining changes in fishing patterns for Pacific cod with respect to fishing gear, area, and month for the past five years. For most categories, significant changes were not exhibited. New data were incorporated into this assessment as follows: (a) size composition data from the 2002 and January-September 2003 commercial fisheries; (b) catch data for 2003 including recompiled catch data for 1991-2002; (c) size composition data from the 2003 GOA bottom trawl survey; (d) biomass estimate from the 2003 GOA bottom trawl survey (the 2003 estimate increased 6% from the 2001 estimate); (e) recompiled survey biomass estimates from 1984-2001. This year's base model, using a length-structured Synthesis approach, is identical in structure to all base model assessments used for GOA Pacific cod stock since 1997. Of note was the 29% decrease to the recompiled 1987 trawl survey estimate, resulting in a general decrease in model estimates of stock biomass early in the time series and increased biomass estimates in the recent portion of the time series.

While this stock was managed under Tier 3b in last year's assessment, the increase in absolute current biomass in this year's assessment, places the GOA Pacific cod stock in Tier 3a since the estimated 2004 spawning stock biomass (103,000 mt, an increase of 17% over the 2003 estimate) is greater than the $B_{40\%}$ value of 88,900 mt. Similar to assessments during 2000-2003, the 2004 ABC was set at 87% of the maximum permissible F_{ABC} to compensate for the large uncertainty surrounding the *M* and *q* model parameters. The team concurred with the author's recommendation to set the 2004 ABC at 62,800 t, corresponding to a fishing mortality rate of 0.29. The OFL fishing mortality under Tier3a was set at 102,000 mt, corresponding to a fishing mortality rate of 0.41. The 2004 ABC is apportioned according to the average biomass

distribution in the three most recent surveys; the apportioned ABC values become 22,610 mt Western (36%), 35,800 mt Central (57%), and 4,400 mt Eastern (7%).

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

2. Shelf Rockfish

b. Stock Assessment

GULF OF ALASKA

Pelagic shelf rockfish - ABL

The pelagic shelf rockfish assemblage is comprised of three species (dusky, yellowtail, and widow rockfish) that inhabit waters of the continental shelf of the Gulf of Alaska and that are thought to exhibit midwater, schooling behavior. At certain times, however, some of these fish are caught in bottom trawls. Dusky rockfish is by far the most abundant species in the group, and has been the target of a bottom trawl fishery since the late 1980's. Two varieties of dusky rockfish are seen: an inshore, dark-colored form and a light-colored variety found offshore. The trawl fishery takes the light variety. Recent taxonomic work indicates these two forms are separate species, and a publication presenting this information is currently in preparation by Jay Orr of the AFSC RACE Division.

A major change occurred in this year's assessment for pelagic shelf rockfish in the Gulf of Alaska, as an age-structured model was used for the first time to determine exploitable biomass and ABC for light dusky rockfish, the predominant species in the assemblage. This model is a modified version of the northern rockfish model and was first developed in preliminary form in 2002. In 2003, substantial refinements were made to the 2002 base model, and all available data through 2003 were incorporated. The model estimate of current exploitable biomass for light dusky rockfish is 50,380 mt, and recommended ABC for 2004 based on an $F_{40\%}$ harvest rate (0.123) is 4,000 mt. Exploitable biomass for the three other species in the assemblage (dark dusky, yellowtail, and widow rockfish) is computed using their average biomass estimates for last three biennial trawl surveys in 1999, 2001, and 2003, which equal a total of 7,020 mt. Applying an F=0.75M rate to this value of exploitable biomass yields a recommended ABC of 470 mt. Therefore, for the pelagic shelf rockfish group as a whole, total exploitable biomass is 57,400 mt, and recommended ABC for 2004 in the Gulf of Alaska is 4,470 mt. This ABC is a decrease of nearly 19% compared to the 2003 value.

For more information, contact Dave Clausen at (907) 789-6049 or Chris Lunsford at (907) 789--6008.

3. Slope Rockfish

a. Research

GULF OF ALASKA

Species Identification of Young-of-the-Year Rockfish and Population Genetic Structure of Pacific Ocean Perch Collected in Offshore Waters of the Gulf of Alaska and Bering Sea

Young-of-the-year (YOY) *Sebastes* rockfish were collected as "bycatch" during Auke Bay Laboratory (ABL) Ocean Carrying Capacity surveys of juvenile salmon in the Gulf of Alaska (GOA) in 1998, 2000–2003, and in the Bering Sea in 2002. The YOY rockfish were caught in rope trawls towed near the surface in offshore waters of both regions. These collections are significant because very little is known about the species identification, distribution, habitat, and genetic structure of YOY rockfish in Alaska. Based on a pilot study of species identification with morphological analysis by Dr. Arthur Kendall (retired from AFSC's RACE Division) and with mitochondrial DNA analysis by ABL scientists in cooperation with Dr. A. J. Gharrett of the University of Alaska Fairbanks, Juneau Center for Fisheries and Ocean Sciences (UAF, JCFOS), the majority of the rockfish are Pacific ocean perch (*S. alutus*; POP). Seven other species were also identified: shortraker, rougheye, dusky, darkblotched, widow, and yellowmouth rockfish.

In 2003, about one-third of the collections were processed for further analysis. Fish were visually separated into POP-type and non-POP-type fish. Tissues from 690 POP-type fish were preserved for genetic analysis. A subset of 152 fish were sampled for future stomach content analysis by Dr. Nicola Hillgruber of the UAF, JCFOS, 198 heads were retained for aging by otolith analysis, and 55 were preserved by Dr. Kendall for morphological analysis. In addition, 73 non-POP-type fish were processed for species identification, and 16 and 15 non-POP-type fish were retained for aging and stomach content analysis, respectively. The size range of all the fish processed was 15–62 mm SL.

Dr. A. J. Gharrett will be taking the lead on determining the extent of POP genetic divergence between year-classes and between geographic locations using microsatellite DNA markers. For the species identification analysis of the non-POP-type fish, ABL scientists in cooperation with UAF will conduct a genetic analysis using mtDNA variation, which Dr. Kendall will supplement with a morphological analysis. This may lead to developing morphological methods for species identification of YOY rockfish. To determine whether the rockfish in these collections are one year-class, i.e. young-of-the-year, the otoliths will be aged by the AFSC REFM Division aging unit in Seattle.

Future examination of the remaining collections would: 1) provide larger spatial and temporal sample sizes for examining POP population genetic structure, and 2) increase the number of non-POP-type fish available for examination and possibly provide a spatial and interannual assessment of species abundance. In addition, new microchemistry techniques of otoliths are

available that may augment population structure analyses.

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

Application of Echosounder Signal to Improve Trawl Survey Precision for Pacific Ocean Perch

Auke Bay Laboratory staff has been examining ways to improve trawl survey design for Pacific Ocean perch, including methods for efficiently increasing sample size and precision. One way to increase sample size with minimal effort is to collect hydroacoustic signals, both during trawl hauls and between hauls. Further evaluation of this technique to improve rockfish survey precision continued during 2001-2003. Echosounder signals were recorded with a Simrad ES60 echosounder during AFSC RACE Division trawl surveys of the Gulf of Alaska in 2001 and 2003 and of the Aleutian Islands and eastern Bering Sea slope in 2002. The 2001-2002 data have been processed and analyzed. A significant but moderate relationship between hydroacoustic backscatter and catch-per-unit-effort was found. The data were then combined with localized catch composition into a predictive model. This model was used to predict catches in the vicinity of trawl tows as an auxiliary variable. These predictions were used in a double sampling design which showed gains in precision. The hydroacoustic data may have utility in post-stratifying random designs or to stratify future surveys. The result of this work is a chapter in press in a book entitled Sampling Rare or Elusive Populations: Challenges and Choices edited by William Thompson.

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

Juvenile Rockfish Habitat and Energetics in the Aleutian Islands

A pilot study was conducted to examine the feasibility of using echosounder data to delineate and map fish habitats in the eastern Aleutian Islands near the Islands of Four Mountains. These data are being processed with QTC View software to generate data necessary to classify the area into seabed types. At each site a sediment sample was taken using a Shipek grab, and underwater video was collected using a drop camera to ground-truth the acoustic data. A second purpose of the study was to initiate techniques to identify links between habitat forming organisms (primarily sponges and corals), rockfish density, and rockfish condition. Energetic content and zooplankton abundance will be compared among sites and treatments to determine the relative benefit to rockfish growth and condition of one site over another. A full-scale version of this acoustic mapping project linking habitat to juvenile rockfish energetics will commence in summer 2004.

For further information, contact Chris Rooper at (206)526-4689.

b. Stock Assessment

BERING SEA AND ALEUTIAN ISLANDS

Pacific Ocean perch (POP)

The present assessment updates last year's assessment, including incorporation of revised 2002 harvest levels, 2002 survey age compositions, and Aleutian Islands fishery length compositions. No new survey information was available from the Aleutian Islands in 2003. 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 130,000 t, 0.048, and 0.057, respectively. Projected spawning biomass for 2004 is 123,000 t, placing POP in sub-tier "b" of Tier 3. The maximum F_{ABC} value allowed under Tier 3b is computed as follows: $_{ABC} = F_{40\%} \times (B_{2004} / B_{40\%} - 0.05)/(1-0.05) = 0.048 \times (123{,}000/130{,}000 - 0.05)/0.95 = 0.045$

Projected harvesting at a fishing mortality rate of 0.045 gives a 2004 ABC of 13,300 t, which is the recommended ABC. ABCs are set regionally based on the 2002 apportionment as follows: BS = 2,128 t, Eastern Aleutians (Area 541) = 3,059 t, Central Aleutians (Area 542) = 2,926 t, Western Aleutians (Area 543) = 5,187 t. The OFL fishing mortality rate is computed under Tier 3b as follows: $_{OFL} = F_{35\%} \times (B_{2004} / B_{40\%} - 0.05)/(1-0.05) = 0.057 \times (123{,}000/130{,}000 - 0.05)/0.95 = 0.054$

Projected harvesting at a fishing mortality rate of 0.054 gives a 2004 catch of 15,800 t, which is the authors' and Plan Team's recommended OFL for the BSAI. The OFL for BSAI is not regionally apportioned. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Northern rockfish

Through 2000, the other red rockfish complex was split into northern/sharpchin and rougheye/shortraker groups in the AI, with a combined "other red rockfish" group for the eastern Bering Sea. In 2002, sharpchin rockfish was moved into the other rockfish complex. In 2003, northern rockfish and shortraker/rougheye rockfishes were separated from the complex (which is no longer used).

The assessment author used an age-structured model for BSAI northern rockfish for the first time, using age data from the Aleutian Island trawl survey. Thus, northern rockfish, which had previously been managed under Tier 5, are now managed under Tier 3 due to the availability of reliable estimates for $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ (26,900 t, 0.059, and 0.070 respectively). Since the female spawning biomass (43,700 t) is greater than $B_{40\%}$, sub-tier "a" would be applicable. Under Tier 3a, the maximum permissible ABC would be 6,880 t, which is the recommendation for the 2004 ABC. The ABC is apportioned between the EBS and AI, with 6,861 t in the Aleutian Islands and 19 t in the Eastern Bering Sea. Under Tier 3a, the 2004 OFL would be 8,140 t for the Bering

Sea/Aleutian Islands combined. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Shortraker/rougheye rockfish

Through 2000, the other red rockfish complex was split into northern/sharpchin and rougheye/shortraker groups in the AI, with a combined "other red rockfish" group for the eastern Bering Sea. In 2002, sharpchin rockfish was moved into the other rockfish complex. In 2003, northern rockfish and shortraker/rougheye rockfishes were separated from the complex (which is no longer used). In 2001, the Plan Team, SSC, AP, and Council recommended separating shortraker and rougheye rockfish species and setting BSAI area-wide ABCs and TACs for 2002. However, NMFS was unable to implement those recommendations because of the difficulty of identifying shortraker and rougheye rockfishes to species. NMFS established separate BS and AI TACs for northern rockfishes and separate BS and AI TACs for the combined shortraker/rougheye rockfishes category. Staff with the NMFS Regional Office and Observer Program has developed a catch accounting program that will be able to identify shortraker and rougheye rockfishes to species for the first time in 2004. The Plan Team continues to support single species management for this complex and recommends separate shortraker and rougheye OFLs and ABCs for 2004.

The SSC has previously determined that reliable estimates of biomass and natural mortality exist for the stocks in this complex, thereby qualifying shortraker rockfish and rougheye rockfish for management under Tier 5. This year's chapter features an assessment model for the first time. At present, the model's chief benefit is that it provides an improved estimate of biomass. In the future, it is possible that the new model will permit management of these stocks in a higher tier. At the present time, the Plan Team recommended that the SSC retain Tier 5 management for these stocks. The Plan Team recommended setting F_{ABC} at the maximum permissible level under Tier 5, which is 75% of M. Accepted values for M for these stocks are: rougheye rockfish--0.025, shortraker rockfish--0.030. The Plan Team agrees with the authors' recommendations of a combined BSAI 2004 OFL and ABC for shortraker rockfish of 700 t and 526 t and a combined BSAI 2004 OFL and ABC for rougheye rockfish of 259 t and 195 t. The management of these small OFLs will be challenging. These species are not targeted but are harvested incidentally in numerous target fisheries. It is not possible to determine whether these species are overfished or whether they are approaching an overfished condition because they are managed under Tier 5.

Other rockfish complex

The BSAI "Other Rockfish" complex formerly consisted of 28 *Sebastes* and *Sebastolobus* species, but now considers only the 8 species that have been caught at least once during AFSC research surveys or appeared in more than 1% of observed fishery hauls between 1990 and 2001. The updated assessment includes catches in the EBS and AI, updated length frequency data and analyses of growth of light dusky rockfish and shortspine thornyheads, and maps and analyses of light dusky rockfish catch in localized areas of the EBS and AI; there are no new survey data for BSAI "Other Rockfish." The authors recommend assigning a separate ABC and OFL to

shortspine thornyheads and leaving the remaining 7 rockfish species within the other rockfish complex. This recommendation was based on the fact that shortshine thornyheads are the most abundant and valuable species in the complex and inhabit deeper regions of the shelf and slope than the others. The authors recommend using Tier 5 criteria to assign separate ABCs and OFLs in the EBS and AI for shortspine thornyheads (using the 5-year survey average for biomass and M=0.07), and using Tier 6 (average catch from 1998-2002) criteria for the remaining species in the "Other Rockfish" complex. While the Plan Team believes that this general approach has promise, the Plan Team did not endorse this method for recommending ABCs and OFLs for BSAI Other Rockfish in 2004 because of the lack of time for review and public comment on the proposal. The Plan Team recommends that the author propose essentially the same method in September 2004 for the 2005 specification process, but with the following changes: the Plan Team recommends that Tier 5 criteria be used to assign separate ABCs in the EBS and AI and a combined BSAI OFL for shortspine thornyhead, and that Tier 6 criteria be used to do the same for the remaining species in the complex; splitting ABCs between areas while assigning a BSAI-wide OFL would be consistent with the management of most other BSAI rockfish species. For 2004 BSAI "Other Rockfish" ABC and OFLs, the Plan Team recommends that the method used last year be retained. The SSC has determined that a reliable estimate of the natural mortality rate exists for this complex, thereby qualifying "other rockfish" for management under Tier 5. The Plan Team recommends setting F_{ABC} at the maximum value allowable under Tier 5, which is 75% of M (0.07), or 0.053. Multiplying this rate by the best estimate of complex-wide biomass gives a 2004 ABC of 960 t in the EBS and 634 t in the Aleutian Islands.

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

GULF OF ALASKA

Previously, the assessments for all species of slope rockfish in the Gulf of Alaska were presented together in a single report in the annual Stock Assessment and Fishery Evaluation (SAFE) document prepared for the North Pacific Fishery Management Council. However, starting in 2003, it was decided to divide the assessments into three separate reports: Pacific Ocean perch, northern rockfish, and shortraker/rougheye and other slope rockfish.

Pacific Ocean perch (POP)

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. A preliminary assessment of uncertainty in the 2002 SAFE (Stock Assessment and Fishery Evaluation) document indicated some potential model specification problems. Because of this, models in the 2003 assessment were evaluated using Markov Chain Monte Carlo simulations to estimate posterior distributions of key parameters. The base model from 2002 is contrasted with four alternative models. The assessment methodology of the recommended model is the same, but the model is more stable and many constraints were reduced or eliminated. The key differences are a new length-age transition matrix and a relaxation of the fishing mortality regularity penalty. Substantive changes of input data for the 2003 assessment include: addition of

1998, 1999, and 2002 fishery ages, 2003 survey biomass estimate, removal of the 1978 fishery size data, and revised weight-at-age. Based on improved fits to the data and more realistic posterior distributions, we recommend that the ABC of 13,340 mt from a new model be used for the 2004 fishery. This ABC is similar to the 2003 ABC of 13,660 mt. The results of the model are essentially the same as in the 2002 SAFE report, with the main features in the new assessment being a much better fit to the data, a similar ABC as 2003, and B_{2004} remaining above $_{40\%}$, with projected biomass decreasing slightly.

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

Northern rockfish

Northern rockfish is the second most abundant rockfish in the Gulf of Alaska. The 2003 northern rockfish assessment used an age-structured model identical to that used in the 2002 assessment. New input data included biomass estimates from the 2003 biennial trawl survey, fishery catch from 2002 and preliminary catch for 2003, age compositions from the 2001 biennial survey and 2002 fishery, and length compositions from the 2003 fishery. Based on the model, the estimated exploitable biomass and recommended 2004 ABC for Gulf of Alaska northern rockfish in 2004 are 95,149 mt and 4,870 mt, respectively. The northern rockfish stock is thought to be decreasing because of recent weak recruitment. Compared with 2003, the 2004 ABC decreased approximately 12%.

For more information contact Dean Courtney at (907) 789-6626.

Shortraker/rougheye and other slope rockfish

As in previous years, the assessments for shortraker/rougheye rockfish and other slope rockfish in the Gulf of Alaska were not based on modeling, but instead relied on biomass estimates provided by trawl surveys. Exploitable biomass for each of these two management groups was estimated by the average biomass in the three most recent biennial trawl surveys, excluding the estimated biomass in the 1-100 m stratum. The 1-100m depth stratum was removed from the estimate because most rockfish in this stratum are small juvenile fish, and thus are not considered exploitable. This results in an exploitable biomass of 73,000 mt for shortraker/rougheye rockfish and 89,460 mt for other slope rockfish. Applying a combination of F=M and F=0.75M rates (depending on the species) to these values of exploitable biomass results in recommended ABC's for 2004 of 1,760 mt for shortraker/rougheye rockfish and 3,900 mt for other slope rockfish. The ABC for shortraker/rougheye was subsequently lowered to 1,318 mt at the December 2004 North Pacific Fishery Management Council (NPFMC) meeting to ensure that shortraker rockfish would not be proportionately overharvested within the group.

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

4. Thornyheads

b. Stock Assessment

GULF OF ALASKA

The same stock assessment model was presented this year as in past years for the thornyhead assessment. Seven alternative models were presented in addition to the base model recommended by the authors for the past three years. To explore model behavior, these models fixed natural mortality rates and selectivities, used different assumptions about length at age, and varied the prior assumption about natural mortality. The best fits to the available data were achieved with the model using the highest prior assumption about natural mortality, M=0.10. This natural mortality rate seems excessively high for a species suspected to have very slow growth and long life, but the result is consistent with the tendency from previous years for the model to estimate relatively high natural mortality rates. The model as currently configured seems unable to reconcile assumptions about length at age and longevity particularly given the small number of length samples from the longline fishery. The problem is ongoing, and is unlikely to be resolved until actual age data is available for use in the model and until length sampling from the longline fishery is improved. The Plan Team supported the use of the model in general but concurred with the authors' opinion that the available data, especially the lack of age information, do not support age structured modeling for this population at this time. The minimal information necessary for future use of an age-structured model for estimating ABC and OFL are: age composition from GOA trawl surveys, age composition from sablefish longline surveys, and improved length sampling from longline and trawl fisheries.

An alternative method for setting ABC and OFL under Tier 5 was introduced this year in response to continued discomfort with the model estimates of natural mortality and other parameters. The average of the two most recent complete GOA trawl survey biomass estimates (1999 and 2003) was used as an estimate of exploitable biomass of 86,200 mt. The ABC was determined by multiplying the exploitable biomass by M=0.03 and 0.75 giving 1,940 mt**.** The corresponding OFL recommendation results in 2,590 mt. The OFL fishing mortality rate under Tier 5 is set equal to the estimate of M, soF_{OFL}=0.03. Area apportionments for thornyhead ABC's in 2004.

Western Central Eastern Total -
407 1,009 524 1,940

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

5. Sablefish

a. Research

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

Sablefish Longline Survey

The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987-2003. The survey is a joint effort involving two divisions of the AFSC: ABL and RACE. It replicates as closely as practical the Japan-U.S. cooperative longline survey conducted from 1978-94 and also samples gullies not sampled during the cooperative longline survey. In 2003, the twenty-fifth annual longline survey of the upper continental slope of the Gulf of Alaska was conducted, along with a similar survey of the eastern Bering Sea. One hundred-fifty-two longline hauls (sets) were completed between 28 May 2003 and 1 September 2003 by the chartered fishing vessel *Ocean Prowler*. Sixteen kilometers of groundline were set each day, containing 7200 hooks baited with squid.

Sablefish (*Anoplopoma fimbria*) was the most frequently caught species, followed by giant grenadier (*Albatrossia pectoralis*), Pacific cod (*Gadus macrocephalus*), and arrowtooth flounder (*Atheresthes stomias*). A total of 86,617 sablefish was caught during the survey. A total of 4,068 sablefish, 535 shortspine thornyhead (*Sebastolobus alascanus*), and 100 Greenland turbot (*Reinhardtius hippoglossoides*) were tagged and released during the survey. Electronic temperature-depth tags were surgically implanted in forty-five Greenland turbot and fifty-five shortspine thornyheads. This is the first time these species have been tagged with electronic tags. Length-weight data and otoliths were collected from 2,045 sablefish. Killer whales (*Orcinus orca*) took fish from the longline at seven stations in the Bering Sea and three stations in the western Gulf of Alaska. These numbers are slightly higher than previous years. Sperm whales (*Physeter macrocephalus*) were common near the vessel in the eastern Gulf and west Yakutat region and were observed taking fish from the line at several stations, which is similar to previous years.

Several special projects were conducted during the 2003 survey. Corals caught on the line were collected for identification and sample preservation. Several specimens of exceptionally rare black coral (*Antipatharia* sp.) were collected. A seabird occurrence study was conducted for the second year. This study is being conducted during several different surveys and hopes to address where and when certain seabird species occur in Alaska waters. In addition, the Alaska Department of Environmental Conservation (ADEC) is conducting a monitoring project for environmental contaminants in Alaskan fish. Fifty specimens of sablefish caught on the longline survey were collected throughout the Gulf of Alaska and Bering Sea and sent to ADEC for contaminants analysis.

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

Longline Survey Web Accessible Database

Scientists from the AFSC in cooperation with Alaska's longline fishing industry have been conducting an annual longline survey to assess the distribution and abundance of major groundfish species inhabiting the upper continental slope in the Gulf of Alaska, Aleutian Islands and the eastern Bering Sea. This survey is aimed primarily at sablefish, and the time series dates back to 1978. Unfortunately, the availability and access of these data by other researchers and by longline fishermen have been limited. Leaders in Alaska's longline fishery who are active in the North Pacific Fishery Management Council have requested that AFSC scientists working at the Auke Bay Laboratory (ABL) develop a relational database of the historical longline survey data which they could access and conduct inquiries from a web site on the internet.

In 2003, an outside vendor was contracted to develop this database containing the existing survey data. Currently the vendor is working on making the database accessible to researchers and longline fishermen through the development of an interactive website. Detailed information such as relative population numbers and abundance estimates have been developed for only sablefish over the entire time series. We hope to expand these data to include all species caught in the survey over the entire time series, which would be valuable for determining population trends for non-target species and provide a long time series for assessing these species. When completed, the web site will be expanded to include this new information in a user-friendly interface readily available to the public.

For more information, contact Chris Lunsford (907) 789-6008 or Michael Sigler at (907) 789-6037.

ABL Sablefish Tag Recovery Program

Processing tag recoveries and administration of the reward program continued during 2003. Total tags recovered for the year are expected to be around 600, which is about the same as last year. One fish at liberty over 31 years and three fish at liberty over 30 years were recovered in 2003. All four were released and recovered in Chatham Strait

Tagging continued on the 2003 sablefish longline survey, with 4,068 adult sablefish tagged and released. An additional 810 juvenile sablefish were tagged and released in St. John Baptist Bay, near Sitka. Database sablefish releases now total 318,851, including 285,365 adults and 33,486 juveniles. There are 25,249 recoveries to date.

Sablefish tagging on Gulf of Alaska seamounts was carried out from 1999 to 2002 in an effort to determine whether fish which travel to the seamounts ever return to the slope. To date, 16 fish from six of the eight seamounts sampled have been recovered on the continental slope, proving that emigration does occur. So far, no sablefish has been recovered on a seamount other than the one where it was released.

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

Archival Sablefish Tags

During the 1998, 2000, 2001, and 2002 sablefish longline surveys, a combined total of 596 sablefish were surgically implanted with an electronic archival tag. Two fish were tagged and released at each station from the eastern Aleutian Islands and eastern Bering Sea throughout the Gulf of Alaska to Dixon Entrance. The archival tag contains a computer chip that records depth and temperature for a period of 1-1/2 to 2 years. Data from these tags will provide information about sablefish behavior in the sea as well as the marine environmental conditions they experience. To date, 50 tags have been recovered. Rewards of $200 or $500 are being offered to fishermen for the recovery of these tags, depending on the year of release. Based on the recovered tags, three daily movement patterns have been observed: random movement (irregular depth movements not related to time of day), diel vertical movement (greater depths during day and movement to shallower water at night), and reverse diel vertical movement (shallower depths during day and movement to deeper water at night).

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

Juvenile Sablefish Studies

Juvenile sablefish studies in Alaska have been conducted by the Auke Bay Laboratory since 1984 and were continued in 2003. A total of 736 juvenile sablefish (age 1+) were tagged and released during a cruise of the NOAA vessel *John N. Cobb* at St. John Baptist Bay near Sitka in September-October 2003. This relatively small bay is the only known location in Alaska where juvenile sablefish have been consistently found. During the same cruise, 74 additional juveniles were implanted with electronic archival tags and released. The archival tags are programmed to record temperature and depth and are designed for recovery in the commercial fishery at age 2+ or greater.

Also during the cruise, a total of 13 electronic, acoustically-transmitting sonic tags was surgically implanted into juvenile, age 1+, sablefish captured in St. John Baptist Bay. The tags were programmed to acoustically transmit a record of temperature and depth experienced by the fish. Mobile acoustic receivers located onboard the *John N. Cobb* were used to monitor short-term juvenile sablefish behavior and habitat utilization in the bay. In addition, fixed acoustic receivers were set in St. John Baptist Bay to determine long-term behavior patterns and the timing and duration of emigration from the bay to the more open waters of the Gulf of Alaska. Analysis of the data from the sonic tags has not yet been completed.

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

b. Stock Assessment

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

The 2003 sablefish assessment showed that sablefish abundance increased during the mid-1960's due to strong year classes from the late 1950's and 1960's. Abundance subsequently dropped during the 1970's due to heavy fishing; catches peaked at 56,988 mt in 1972. The population recovered due to exceptional year classes from the late 1970's; spawning abundance peaked again in 1987. The population then decreased as these exceptional year classes died off.

The longline survey abundance index decreased 7% from 2002 to 2003. This decrease follows recent increases, so that relative abundance in 2003 is 10% higher than in 2000. The fishery abundance index also generally increased and is 6% higher in 2002 than in 2000 (2003 fishery data are not yet available). Spawning biomass is projected to decrease slightly (<1%) from 2003 to 2004. Sablefish abundance is moderate; projected 2004 spawning biomass is 40% of unfished biomass. Abundance has increased from a low during 1998 to 2000. The 1997 year class is an important part of the total biomass and is projected to account for 31% of 2004 spawning biomass. Another year class likely is above average, the 1998 year class, although not as strong as the 1997 year class.

We have recommended recent ABC's less than the maximum permissible because sablefish abundance has been low. Abundance now has increased to a moderate level due to conservative quotas in previous years and the strong 1997 year class. The maximum permissible yield from an adjusted $F_{40\%}$ strategy is 25,400 mt for 2004 and 20,700 mt for 2005. This 2004 ABC, however, represents a substantial increase (22%) while abundance is projected to decrease slightly (1%). Furthermore, the probability that the maximum permissible yield will reduce spawning biomass below the benchmark $B_{30\%}$ in five years is 0.27. Thus, we recommend a 2004 ABC less than the maximum permissible, either 23,000 mt or 20,700 mt for the combined Bering Sea, Aleutian Islands, and Gulf of Alaska stock. The 23,000 mt ABC is a moderate increase (10%) compared with the maximum permissible ABC. This ABC increase represents a balance between a stock now at the target abundance but also projected to decline. This ABC increase appears to be sufficiently risk-averse given that next year's assessment will re-evaluate the stock status. The 20,700 mt ABC is similar to the 2003 ABC of 20,900 mt. This ABC is more risk-averse because it is consistent with the abundance trend. Abundance is projected to decline slightly in 2004 and continue decreasing thereafter. A 2004 ABC of 23,000 mt was recommended by the NPFMC Groundfish Plan Teams and Science and Statistical Committee, and this was the 2004 ABC value accepted by the NPFMC at its December 2003 meeting.

For more information, contact Michael Sigler at (907) 789-6037 or Sandra Lowe at (206) 526-4230.

6. Flatfish

a. Research

BERING SEA

Distribution of flathead sole by habitat in the Bering Sea

Biotic and abiotic variables were analyzed to identify preferred habitat for flathead sole in the Bering Sea. A model was constructed based on data from three Bering Sea bottom trawl surveys and then tested on data from two different years. Habitat variables were chosen based on their presumed importance for growth and survival, and included sediment type, temperature, depth, prey biomass, and invertebrate cover. Statistical models were used to describe the relationships between flathead sole catch and each of the five habitat variables.

For further information, contact Chris Rooper at (206)526-4689.

b. Stock Assessment

BERING SEA

Yellowfin sole

The 2003 assessment incorporates the 2003 catch and trawl survey information. This year's EBS bottom trawl survey resulted in a biomass estimate of 2,280,000 t, an increase of 14% from last year's survey. As in last year's assessment, the authors investigated the relationship between survey catchability (q) and mean annual bottom water temperature using a linear model. Results indicated that q, averaged over 22 survey years, = 1.35.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying yellowfin sole for management under tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 390,000 t, 0.12, and 0.14, respectively. Given that the projected 2004 spawning biomass of 446,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2004 were calculated under sub-tier "a" of Tier 3. For the 2004 fishing season the F_{ABC} was set at the $_{40\%}$(=0.12) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2004 ABC of 114,000 t. The OFL was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.14 gives a 2004 OFL of 135,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The yellowfin sole stock had been slowing declining over the past twenty years due to average recruitment levels which are less than those which built the stock to high levels in the late 1960s and early 19770s. However, the female spawning stock remains well above the target level (B_{40}). In response to SSC recommendations, the authors analyzed stock-recruitment data to consider an

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

Rock sole

Changes to the input data in 2003 assessment include addition of the 2002 fishery age composition, 2002 survey age composition, and 2003 trawl survey biomass point estimate and standard error. This year's bottom trawl survey resulted in a biomass estimate of 2,140,000 t, a 12% increase over last year's estimate of 1,900,000 t. The assessment continued the investigation of catchability (q) began in 2002. Prior to 2002, modeling assumed a catchability (q) of 1.0. Last year's assessment used a catchability (q) of 1.82 based on the fit to all of the population information in the model. Increasing q by this magnitude resulted in estimates of abundance which were approximately half of the previously estimated values. In this year's assessment, a value of 1.4 obtained from a trawl "herding" experiment was used as the mean of a prior distribution on q. The new assessment gives a q estimate of 1.45. This results in estimates of total and female spawning biomass that are higher than last year's estimates but still lower than previous estimates. Biomass of rock sole is expected to decline over the next few years due to below average recruitment observed in the 1990s.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock; therefore this stock qualifies for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 203,000 t, 0.17, and 0.21, respectively. Given that the projected 2004 spawning biomass of 425,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2004 were calculated under sub-tier "a" of Tier 3. The recommended F_{ABC} is at the $F_{40\%}$ (=0.17) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2004 ABC of 139,000 t.

The OFL was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.21 gives a 2004 OFL of 166,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The authors responded to a request by the SSC to examine rock sole for possible management under Tier 1. In the case of rock sole, the time series of recruitment estimates from this assessment is 28 years. In the stock assessment model, a Ricker form of the stock-recruit relationship was fit to these data. Very different estimates of F_{MSY} and B_{MSY} were obtained depending on which years of data were included. Recent research indicates a decadal scale shift in atmospheric forcing, which may affect the recruitment of rock sole. Given these concerns, the authors plan to perform a simulation study to determine the appropriateness of applying a Changes to the input data in 2003 assessment include addition of the 2002 fishery age composition, 2002 survey age composition, and 2003 trawl survey biomass point estimate and

standard error. This year's bottom trawl survey resulted in a biomass estimate of 2,140,000 t, a 12% increase over last year's estimate of 1,900,000 t. The assessment continued the investigation of catchability (q) began in 2002. Prior to 2002, modeling assumed a catchability (q) of 1.0. Last year's assessment used a catchability (q) of 1.82 based on the fit to all of the population information in the model. Increasing q by this magnitude resulted in estimates of abundance which were approximately half of the previously estimated values. In this year's assessment, a value of 1.4 obtained from a trawl "herding" experiment was used as the mean of a prior distribution on q. The new assessment gives a q estimate of 1.45. This results in estimates of total and female spawning biomass that are higher than last year's estimates but still lower than previous estimates. Biomass of rock sole is expected to decline over the next few years due to below average recruitment observed in the 1990s.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock; therefore this stock qualifies for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 203,000 t, 0.17, and 0.21, respectively. Given that the projected 2004 spawning biomass of 425,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2004 were calculated under sub-tier "a" of Tier 3. The recommended F_{ABC} is at the $F_{40\%}$ (=0.17) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2004 ABC of 139,000 t.

The OFL was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.21 gives a 2004 OFL of 166,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The authors responded to a request by the SSC to examine rock sole for possible management under Tier 1. In the case of rock sole, the time series of recruitment estimates from this assessment is 28 years. In the stock assessment model, a Ricker form of the stock-recruit relationship was fit to these data. Very different estimates of F_{MSY} and B_{MSY} were obtained depending on which years of data were included. Recent research indicates a decadal scale shift in atmospheric forcing, which may affect the recruitment of rock sole. Given these concerns, the authors plan to perform a simulation study to determine the appropriateness of applying a harvest strategy resulting from fitting the full time series for a fish stock experiencing temporal less productive reproductive potential due to changing oceanic conditions. Therefore, management under Tier 1 is not recommended at the present time.

Changes to the input data in 2003 assessment include addition of the 2002 fishery age composition, 2002 survey age composition, and 2003 trawl survey biomass point estimate and standard error. This year's bottom trawl survey resulted in a biomass estimate of 2,140,000 t, a 12% increase over last year's estimate of 1,900,000 t. The assessment continued the investigation of catchability (q) began in 2002. Prior to 2002, modeling assumed a catchability (q) of 1.0. Last year's assessment used a catchability (q) of 1.82 based on the fit to all of the population information in the model. Increasing q by this magnitude resulted in estimates of abundance which were approximately half of the previously estimated values. In

this year's assessment, a value of 1.4 obtained from a trawl "herding" experiment was used as the mean of a prior distribution on q. The new assessment gives a q estimate of 1.45. This results in estimates of total and female spawning biomass that are higher than last year's estimates but still lower than previous estimates. Biomass of rock sole is expected to decline over the next few years due to below average recruitment observed in the 1990s.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock; therefore this stock qualifies for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 203,000 t, 0.17, and 0.21, respectively. Given that the projected 2004 spawning biomass of 425,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2004 were calculated under sub-tier "a" of Tier 3. The recommended F_{ABC} is at the $F_{40\%}$ (=0.17) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2004 ABC of 139,000 t.

The OFL was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.21 gives a 2004 OFL of 166,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The authors responded to a request by the SSC to examine rock sole for possible management under Tier 1. In the case of rock sole, the time series of recruitment estimates from this assessment is 28 years. In the stock assessment model, a Ricker form of the stock-recruit relationship was fit to these data. Very different estimates of F_{MSY} and B_{MSY} were obtained depending on which years of data were included. Recent research indicates a decadal scale shift in atmospheric forcing, which may affect the recruitment of rock sole. Given these concerns, the authors plan to perform a simulation study to determine the appropriateness of applying a harvest strategy resulting from fitting the full time series for a fish stock experiencing temporal less productive reproductive potential due to changing oceanic conditions. Therefore, management under Tier 1 is not recommended at the present time.

Flathead sole

The 2003 assessment updates last year's by incorporating new catch, discard, survey biomass, length composition, and age composition data. The 2003 trawl survey biomass estimate of 530,000 t was about 8% lower than last year's estimate of 575,000 t. Survey biomass has been relatively stable over the past three years compared to the decrease observed from 1998-2000. A change in methodology for this year's assessment investigated the relationship between temperature anomalies and survey biomass anomalies whereby the survey catchability coefficient was modeled as a function of temperature anomalies. This addition had an effect on survey biomass estimates since 1998, during which time temperature fluctuations were greater.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying it for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 119,000, 0.30, and 0.37, respectively. Given that the projected 2004

spawning biomass of 205,000 t exceeds $B_{40\%}$, ABC and OFL recommendations for 2004 were calculated under sub-tier "a" of Tier 3 where F_{ABC} is set at the $F_{40\%}$(=0.30) level, the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2004 ABC of 61,900 t. The OFL was also determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.37 gives a 2004 OFL of 75,200 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Alaska plaice

This is the second year in which Alaska plaice has been evaluated as a separate species instead of the principal component of the "other flatfish" species group. Minor changes in this year's assessment include adjusting the initial year of the model from 1971 to 1975, changing the age of recruitment in the model from age 1 to age 3 because of limited ages-1 and -2 data, inclusion of the 2003 trawl survey biomass estimate and standard error, updating of the 2002 catch data, and inclusion of fishery catch through September 2003.

There was one major change in the assessment methodology and input data that affected this analysis. In the past, the model used age/length keys based on survey data and applied them to the fishery. The most significant change in the model was the construction of a matrix to convert modeled numbers at age to numbers at length, thus enabling the authors to use length-frequency data as input. This permitted inclusion of 12 years of survey length composition data and 19 years of length data from the fishery. The authors tested the stability of the age/length curve over time and validated the use of a single age/length key. The inclusion of the new length data primarily affected the fishery selectivity curve. There was little change in the survey selectivity, with an age at 50% selection of 9.7 years. However, there was a large change in the age at 50% selection in the fishery selectivity curve from 8.5 years to 10.3 years. The size of the fish (33 cm) at 50% selection is similar to the size at 50% selection for flathead sole (35 cm), implying that the gear is acting similarly on the two species. The change in fishery selectivity doubles the value of F_{40} from 0.28 in last year's assessment to 0.57 in this year's assessment. Additionally, the authors investigated the effect of bottom water temperature on the catchability of Alaska plaice. No correlation was found and survey catchability remained fixed at a value of 1.0.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, therefore qualifying it for management under Tier 3. The updated point estimates are $B_{40\%}$ = 132,000 t, $F_{40\%}$ = 0.57, and $_{35\%}$ = 0.78. Given that the projected 2004 spawning biomass of 261,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2004 were calculated under sub-tier "a" of Tier 3. Projected harvesting at the $F_{40\%}$ level gives a 2004 ABC of 203,000 t. The OFL was determined from the Tier 3a formula, where projected harvesting at $F_{35\%}$ gives a 2004 OFL of 258,000 t. Though the newly calculated selectivity indices resulted in a 48% increase in ABC over 2003, the sensitivity of the spawning-per-recruit fishing reference points to the change in fishing selectivity is not unexpected, given that the age at 50% maturity is approximately 8.5 and the natural mortality rate (0.25) is relatively large compared to other flatfish. Because the age at 50% selection in the fishery is 10.3, Alaska plaice has the potential to spawn twice before it is recruited to the fishery.

Additionally, the high natural mortality of 0.25 indicates that the lifetime spawner per recruit potential is rapidly reducing at the ages of highest fishing selectivity. Recruitment has been stable from the late 1970s through present. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Other flatfish

With the removal of Alaska plaice from this category last year, 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 85% of the "other flatfish" catch in 2003.

Because of insufficient information about these species, no model analyses are possible. The assessment incorporates 2002 total catch and discard, catch through 20 September 2003, and 2003 trawl survey information. The 2003 EBS bottom trawl survey resulted in biomass estimates of 90,300 t, an 8% decrease from the estimate of 97,900 t in the 2002 survey.

Prior to last year, "other flatfish" had been classified as Tier 4, using the $F_{35\%}$ and $F_{40\%}$ rates for flathead sole as proxies. In 2002, the Plan Team concluded that these fishing mortality reference points may not apply to the species in the "other flatfish" complex due to the variability in natural mortality and other life-history characteristics among flatfish species, and recommended reclassification of "other flatfish" as a Tier 5 species complex with an assumed natural mortality rate of 0.2.$_{ABC}$ was set at the 0.75 *M* level (=0.15), which is the maximum permissible level under Tier 5. Projected harvesting at the 0.75 *M* level gives a 2004 ABC of 13,500 t. The overfishing level was set with an F_{OFL} value of 0.20, giving a 2004 OFL of 18,100 t. It is not possible to determine whether the "other flatfish" complex is overfished or approaching an overfished condition because it is managed under Tier 5.

Greenland turbot

This year's model incorporated new catch and length frequency data from the fishery. It also included an aggregated longline survey index and updated trawl survey information on biomass and length frequency data. Biomass and size composition data were also included from the EBS slope survey. The stock assessment model indicates that this stock has continued to decline due to the reduced recruitment levels observed in the last 20 years relative to the strong recruitment observed in the 1970s. The stock is still above the $B_{40\%}$ reference level and is lightly harvested. Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock. Updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 58,800 t, 0.26, and 0.32, respectively. Projected spawning biomass for 2003 is 69,300 t.

Greenland turbot therefore qualify for management under Tier 3a. The maximum permissible value of F_{ABC} under this tier translates into a 2004 catch of 15,700 t. The assessment authors'

recommend setting the 2004 ABC at a value less than the maximum permissible. Using $_{ABC}$ = 5-year average results in a 2004 ABC of 4,740 t corresponding to a full selection fishing mortality rate of 0.07. The proposed harvest is apportioned by area on the basis of relative survey biomass, giving an EBS ABC of 3,162 t and an AI ABC of 1,578 t. The OFL fishing mortality rate is computed under Tier 3a, $F_{OFL} = F_{35\%} = 0.32$, and translates into an overfishing level of 19,300 t.

Arrowtooth flounder

The present assessment introduced catchability as a function of annual average bottom temperature during the EBS shelf trawl survey and also uses the EBS shelf trawl survey sex ratios as prior information to estimate sex-specific population numbers at age. This year's EBS shelf bottom trawl survey resulted in a biomass estimate of 554,000 t, a 56% increase relative to last year's estimate, but only 26% larger than the 2001 EBS shelf bottom trawl survey. The stock remains very lightly harvested with fish caught primarily as bycatch in other fisheries. Discarding occurs at a rate exceeding 50%.

Since more female arrowtooth flounder are caught in trawl surveys throughout Alaska compared to males, and because the oldest female fish have been determined to be older than the oldest males, it is assumed that there are different natural mortality values for each sex. With the female natural mortality rate fixed at 0.2, male natural mortality was profiled over a range of values to determine which value provided the best fit to all the observable population characteristics. The male natural mortality rate that provided the best fit was 0.32. With the stock assessment model configured in this way, the population biomass was estimated at 696,000 t. This is about 16% less than the peak value estimated for 1995. Thus the stock is in a high and stable condition, but declining slowly from the peak observed in 1995.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying arrowtooth flounder for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 249,000 t, 0.28, and 0.36, respectively. Given that the projected 2004 spawning biomass of 503,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2004 were calculated under sub-tier "a" of Tier 3 by *se*tting $_{ABC}$(=0.28) which is the maximum permissible level under Tier 3a. Projected harvesting at the $_{40\%}$ level gives a 2004 ABC of 115,000 t. The OFL fishing mortality rate under Tier 3a is $F_{35\%}$(=0.36), or a 2004 OFL of 142,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

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

GULF OF ALASKA

New data for this year's flatfish assessment includes the 2003 NMFS bottom trawl survey biomass estimates and the 2003 catch. The 2003 survey only sampled to a depth of 700 m. The 2003 survey biomass estimates were used to calculate ABCs for 2004 for all species except

Greenland turbot and deepsea sole, where the mean catch from 1978 to 1995 was used. New data on the maximum age of Dover sole decreased the estimate of natural mortality from 0.10 to 0.085 which is reflected in the 2004 ABC calculations.

The flatfish group is subdivided into arrowtooth flounder, deep water flatfish, flathead sole, rex sole, and shallow water flatfish. Flathead sole and arrowtooth flounder are presented in separate assessments using age-structured models. The 2004 exploitable biomass for each group (except for flathead sole and arrowtooth flounder) is based on results from the 2003 NMFS trawl survey. ABC and OFL were calculated by species, with individual species identified as Tier 4, 5, or 6 depending upon the available data. The ABCs for northern and southern rock sole were estimated based on Tier 4 with $F_{ABC} = F_{40\%}$ (Southern rock sole $F_{40\%}$=0.162; Northern rock sole $_{40\%}$=0.204) and $F_{OFL}=F_{35\%}$ (southern rock sole $F_{35\%}$=0.192; northern rock sole $F_{35\%}$=0.245) while other flatfish ABC's were estimated with F_{ABC}=0.75 M and F_{OFL}=M (Tier 5).

Greenland turbot and deep-sea sole ABC's were estimated at Tier 6 with ABC=0.75 OFL and OFL=average catch from 1978 to 1995. Total flatfish ABC for 2004 was 7,100 mt greater than the 2003 estimate. ABCs were apportioned among the regulatory areas by applying the average fraction of the catch in each area from 1991 to 1995. As in 2003, the ABC was split between the eastern GOA and the WY and EYAK/SEO sub areas.

A new age-structured assessment of Dover sole was developed and reviewed by the Plan Team. It is expected that the Dover sole will be a separate SAFE chapter next year and the new model will be used.

2004 ABC area apportionment

Flatfish group	Western	Central	WYAK	EYAK/SEO	Total
Deep water	310	2970	1880	910	6,070
Rex sole	1680	7340	1340	2290	12,650
Shallow water	21,580	27,250	2,030	1,210	52,070

Flathead sole

New data for the 2004 flathead sole assessment includes the 2003 survey biomass estimate and length data, and 2003 catch and fishery length data. Analysis of maturity by age and length for the 2003 assessment was used in this assessment to estimate fishing mortality values. Prior to 2002, flathead sole was included in the flatfish complex. The 2004 biomass estimate is based on abundance estimates derived from an age-structured model developed with AD Model Builder software. Model estimates of age 3+ biomass increased from about 256,600 mt in 1984 to about 298,900 mt in 1996, decreased to about 287,000 mt in 2000, then increased to 291,400 mt in 2003, indicating a stable population.

The SSC concludes that reliable estimates of $B_{40\%}$ exist. The projected 2004 female spawning biomass is estimated at 109,980 mt, well above the $B_{40\%}$ level estimated at 47,700 mt. Therefore, flathead sole are in Tier 3a of the ABC and overfishing definitions. Under this definition, $F_{OFL}=F_{35\%}$, and F_{ABC} is less than or equal to $F_{40\%}$. The ABC for 2004 using $F_{40\%} = 0.47$ was estimated at 51,721 mt. The overfishing level using $F_{35\%} = 0.63$, results in 64,750 mt. Area apportionments of flathead sole ABC's for 2004 (using $F_{40\%}$) are based on the fraction of the 2003 survey biomass in each area:

Western	Central	West Yakutat	East Yakutat/SE	Total
13,410	34,430	3,430	450	51,720

For further information, contact Jack Turnock (206) 526-6549.

Arrowtooth flounder

The 2004 arrowtooth flounder assessment features new biomass and length composition data from the 2003 NMFS bottom trawl survey and updated catch and fishery length data for 2002. The 2004 estimated exploitable biomass of 2,391,550 mt is based on abundance estimates derived from an age structured model and indicates that the population is at a historical (past 40 years) high level. Data from halibut trawl surveys in the 1960s, groundfish trawls in the 1970s, and NMFS triennial trawl surveys from 1984 to 2003 were included in the model. Similar to the previous assessment, the model matched the observed higher proportion of females in the larger size intervals of both survey and fishery data by allowing males a higher mortality rate than females.

The ABC estimate was based on Tier 3a calculations due to the fact that the estimated 2004 female spawning biomass (1,306,460 mt) is greater than the $B_{40\%}$ estimate (620,340 mt). Therefore, $F_{OFL}=F_{35\%}=0.165$ and $F_{ABC}=F_{40\%}=0.142$ resulting in an ABC recommendation that is 39,800 mt larger than last year's estimate (194,930 mt). The overfishing level for arrowtooth flounder is estimated to be 228,130 mt. The Plan Team recommended that ABC be apportioned among regulatory areas in proportion to biomass distributions in the 2003 trawl survey as follows:

Western	Central	West Yakutat	East Yakutat/SE	Total
23,590	151,840	10,590	8,910	194,930

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

7. Walleye pollock

a. Research

GULF OF ALASKA

Echo Integration-Trawl Surveys

Winter surveys in the Shumagin Islands and Sanak Trough
The MACE Program conducted Echo Integration-Trawl (EIT) surveys of midwater walleye pollock in the Shumagin Islands area and Sanak Trough between 5 - 12 February, 2003. The Shumagin survey began in Shumagin Trough, then progressed into Stepovak Bay, through the gully off of Renshaw Point and Unga Strait, and ended off the southwest end of West Nagai Island. Parallel transect spacing was 5 nmi in Shumagin Trough, 3 nmi in Stepovak Bay and West Nagai Strait, 2.5 nmi in Unga Strait, and 1 nmi off of Renshaw Point. Sanak Trough was surveyed using 3 nmi parallel transect spacing.

In the Shumagin Islands, the densest aggregations were observed off Renshaw Point, where the majority of pollock exceeded 40 cm fork length (FL). Elsewhere, most of the fish were less than 40 cm FL. The maturity composition for males longer than 40 cm FL was 1% immature, 11% developing, 87% pre-spawning, 2% spawning, and 0% spent. The maturity composition for females longer than 40 cm FL was 3% immature, 13% developing, 73% pre-spawning, 2% spawning, and 9% spent. The high percentage of pre-spawning females suggests that the survey timing was appropriate. Female pollock were estimated to be 50% mature at 41 cm FL and the mean gonado-somatic index (GSI) for mature pre-spawning females was 0.15. Midwater pollock abundance estimates in the Shumagin Islands area are 115 million fish weighing 67 thousand t based on catch data from 10 trawl hauls and acoustic data from 300 nmi of survey transects.

The densest pollock aggregations in Sanak Trough were detected in the northern part of the

trough and over half of the echosign was observed on a single transect. Pollock were observed over bottom depths as shallow as 50 m and within 30 m of the surface. The maturity composition for males longer than 40 cm FL was 0% immature, 7% developing, 59% pre-spawning, 15% spawning, and 19% spent. The maturity composition for females longer than 40 cm FL was 2% immature, 15% developing, 52% pre-spawning, 3% spawning, and 27% spent. Female pollock were estimated to be 50% mature at 46 cm FL, and the mean GSI for mature pre-spawning females was 0.14. Midwater pollock abundance estimates are 84 million fish weighing 81 thousand t based on catch data from 4 trawl hauls and acoustic data from 64 nmi of survey transects.

Winter surveys in Shelikof Strait and near Chirikof and Middleton Islands

The MACE Program also conducted winter EIT surveys of walleye pollock in the Shelikof Strait area and the continental shelf break areas near Chirikof Island and Middleton Island during 16 - 31 March, 2003. The Shelikof Strait survey covered the area from near Chirikof Island to about Cape Chiniak on the Alaska Peninsula. Parallel transect spacing was 7.5 nmi in the Shelikof Strait area, 8.0 nmi along the shelf break from about 10 nmi east of Chirikof Island to the mouth of Barnabas Trough, and 5 nmi along the shelf break near Middleton Island.

The densest echosign attributed to near-bottom pollock in Shelikof Strait occurred from about 30 nmi northwest of Chirikof Island to Katmai Bay. Similar to the 2001 and 2002 surveys but unlike most other Shelikof Strait surveys, very little echosign was detected north of Katmai Bay along the west side of the Strait, where the bulk of the mature pre-spawning pollock are usually found. Mid-water layers as well as more discrete aggregations of sub-adult pollock, were detected at about 175-200 m depth along some transects. The discrete pollock aggregations were more common during the day than at night. The maturity composition of male pollock longer than 40 cm FL was 8% immature, 22% developing, 24% pre-spawning, 39% spawning, and 0% spent. The maturity composition for females longer than 40 cm FL was 10% immature, 42% developing, 46% pre-spawning, 0% spawning, and 2% spent. The percentage of females in the spawning and spent stage of maturity was similar in 2000-2002 but substantially lower than in 1998 (17%), 1997 (15%), and 1996 (23%). Female pollock were estimated to be 50% mature at 44 cm FL. The mean GSI for mature pre-spawning females of 0.11 was similar to the mean GSI from the 2001-2002 surveys but lower than the mean GSIs (0.14-0.19) reported for other recent (1992-2000) Shelikof surveys, which suggests that the fish may have spawned later in the Shelikof Strait area this year. Midwater pollock abundance estimates are 1.1 billion pollock weighing 270,000 mt based on catch data from 19 trawl hauls and acoustic data from 784 nmi of survey transects. The biomass estimate was 18% higher than the 2002 estimate, which was the lowest in survey history.

Along the Chirikof shelf break, most echosign attributed to midwater layers of pollock occurred between 300 and 500 m depth within the two shelf-break bights between Chirikof Island and Barnabas Trough over bottom depths of 300 to 800 m. No fish shorter than 35 cm FL were caught during the survey. The maturity composition for male pollock longer than 40 cm FL was

1% immature, 4% developing, 74% mature pre-spawning, 21% spawning, and 0% spent. The maturity composition for females longer than 40 cm FL was 0% immature, 8% developing, 92% pre-spawning, 1% spawning, and 0% spent. Female pollock were estimated to be 50% mature at 44 cm FL, and the mean GSI for mature pre-spawning females was 0.15. Midwater pollock abundance estimates are 29 million pollock weighing 30,900 t based on catch data from 8 trawl hauls and acoustic data from 224 nmi of survey transects.

The small amounts of pollock detected east and west of Middleton Island occurred at similar water column and bottom depths to those observed in the Chirikof Island survey area. Adult fish dominated the size composition. The maturity composition for male pollock longer than 40 cm FL was 0% immature, 3% developing, 44% mature pre-spawning, 52% spawning, and 0% spent. The maturity composition for females longer than 40 cm FL was 0% immature, 5% developing, 95% pre-spawning, 0% spawning, and 1% spent. Female pollock were estimated to be 50% mature at 44 cm FL, and the mean GSI for mature pre-spawning females was 0.14. Midwater pollock abundance estimates are 7 million pollock weighing 6,000 t based on catch data from 5 trawl hauls and acoustic data from 131 nmi of survey transects.

Summer survey of western-central Gulf of Alaska from the Shumagin Islands to Prince William Sound

The MACE Program conducted a summer echo integration-trawl feasibility survey in the Gulf of Alaska to determine whether it would be possible to estimate walleye pollock distribution and abundance during this time of year within the Gulf. The study was conducted from 4 June to 16 July 2003 and focused on the western-central portion of the Gulf between the Shumagin Islands and Prince William Sound. The area of operations extended over bottom depths of about 50 m over shallow inshore shelf regions to about 1,000 m beyond the shelf break. . Survey transects were generally oriented parallel to one another and spaced 20 nmi apart. Areas where the commercial pollock fishing fleet traditionally operates in recent years were surveyed using more closely spaced transects: 2 nmi off Renshaw Point, 3 nmi near Nakchamik Island, Alitak Bay, Barnabas Trough and Chiniak Trough, 3.5 nmi near Mitrofania Island, 4 nmi in West Nagai Strait and Marmot Bay, 8 nmi in Prince William Sound, and 10 nmi in Shelikof Strait. Transect spacing was reduced to 10 nmi along the shelf break area between the Trinity Islands and the mouth of Chiniak Trough and in Amatuli Trough.

The densest pollock aggregations were detected in the vicinity of Kodiak Island in Barnabas and Chiniak Troughs, the Shelikof Strait sea valley, and within Marmot and Alitak Bays. Near-shore pockets of deep water (>150 m bottom depth) also contained pollock echosign, such as off Renshaw Point and off Nakchamik Island. Low densities of diffuse mid-water pollock echo sign were occasionally observed along the shelf break between bottom depths of 300 - 500 m. Virtually no pollock echosign was detected over bottom depths less than 100 m with the exception of Alitak Bay, where substantial amounts of pollock were detected outside the bay over bottom depths of 50-70 m. Trawl hauls conducted in the densest pollock echosign contained mostly fish 30-45 cm FL. Midwater pollock abundance estimates for the area surveyed were 1.3 billion fish weighing about 320 thousand t based on 93 trawl hauls and

acoustic data from 3,470 nmi of survey transects.
Capelin appeared to have the most potential for assessment using EIT survey methodologies of all the other fishes encountered during the survey. This species often aggregated in distinct schools, which did not appear to avoid the trawl. However, capelin escapement through the larger trawl meshes was a problem. For example, dense capelin echosign was often observed with the headrope- and vessel-mounted sounders during trawling. Trawls targeting these dense aggregations would capture relatively few individuals in the codend although large numbers of these fish would be caught in the meshes of the intermediate section of the net. Although suitable target strength to length relationship for capelin has not yet been developed, target strength data for capelin were recently collected in the GOA. Analysis of these data is currently in progress.

For more information, please contact Michael Guttormsen, (206) 526-4163.

b. Stock Assessment

GULF OF ALASKA

The age-structured model developed using AD Model Builder and used for GOA pollock assessments in 1999-2002 is fundamentally unchanged. This year's pollock assessment features the following new data: (1) total catch and age composition from the 2002 fishery; (2) biomass and age composition from the 2003 Shelikof Strait echo integration trawl (EIT) survey; (3) biomass and length composition from the 2003 ADF&G coastal trawl survey and age composition from the 2002 ADF&G survey; (4) biomass and age composition for the 2003 NMFS bottom trawl survey; and (5) new ageing error transition matrix using percent agreement between age readers and testers for 1987-2002. The 2003 NMFS bottom trawl survey biomass estimate increased 86% over a comparable area surveyed in 2001. The 2003 Shelikof Strait EIT survey biomass estimate increased 18% over the 2002 estimate, although a continued decline in adult biomass was indicated. In addition, the 2003 ADF&G near shore survey biomass estimate declined 30% from 2002. Stock concerns include the continued decline in Shelikof Strait spawning activity and continued reduction in estimated size of the 1999 year class.

Two independent reviews of the Gulf of Alaska pollock assessment have been completed and the assessment author addressed the modeling aspects of the reviewer comments but recognized that reviewer suggestions that involve survey design may be financially or practically difficult to implement. Preliminary analysis based on peer reviews suggested: (1) there is no compelling evidence that $F_{35\%}$ is inappropriate as a proxy for F_{MSY}; and (2) fishing effects have not been overly detrimental to GOA pollock recruitment patterns relative to environmental effects.

The stock assessment authors evaluated six models: Model 1 estimated NMFS trawl survey catchability; Model 2 fixed trawl survey catchability at 1.0 (similar to previous assessments) and estimated other catchabilities; Model 3 was similar to Model 2 but excluded the 2002 Shelikof EIT data; Model 4 was similar to Model 2 but excluded the NMFS bottom trawl survey data; Model 5 was similar to Model 2 but excluded the ADF&G 2002 trawl survey data; and Model 6 was similar to Model 2 but excluded the historical NMFS 400-mesh Eastern trawl survey data.

The author's recommended selecting Model 2 for stock biomass projections. Successive annual assessments have continued to reduce the estimated strength of the 1999 year class, although it is not clear whether the downward trend in the estimated magnitude of the 1999 year class is attributable to increased predation of juvenile pollock. Several components of conservatism included in Model 2 are: (1) fixing trawl catchability at 1.0; (2) assuming an average 1999 year class instead of the model estimate; (3) not adjusting the 2003 Shelikof strait survey biomass estimate despite evidence suggesting an unexpectedly low fraction of the stock spawned in Shelikof Strait in 2003; and (4) applying a more conservative harvest rate than the maximum permissible F_{ABC}. Using Model 2, results in an ABC of 65,660 mt for GOA waters west of 140 degrees W. longitude. Model results, which assume an average abundance for the 1999 year class, produced an estimated 2004 spawning biomass of 165,580 mt, or 27% of unfished spawning biomass. The $B_{40\%}$ estimate of 248,130 mt for 2004 is similar to estimates in the 2000 to 2002 assessments. Because model estimated 2004 biomass is below $B_{40\%}$, Gulf of Alaska pollock are in Tier 3b. The projected 2004 age-3+ biomass estimate is 740,440 mt under an assumption of average abundance for the 1999 year class. Markov Chain Monte Carlo analysis indicated the probability of the stock being below $B_{20\%}$ to be less than 1% in 2004 and subsequent years. The OFL fishing mortality rate under Tier 3b is 91,060 mt.

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

EASTERN BERING SEA

The present assessment is a straightforward update of last year's assessment, incorporating new data from the 2003 fishery and bottom trawl survey. The 2003 bottom trawl survey estimated a biomass of 8,510,000 t, an increase of 77% relative to the 2002 estimate and the highest estimate in the entire time series. Other new inputs include age composition data from the 2002 fishery and the 2002 echo-integration trawl survey. The 1991-2002 time series of total catch was recompiled for this assessment.

Seven alternative models are presented in the assessment, all of which follow the statistical age-structured approach that has been used for the last several years. All of these models give point estimates of 2004 age 3+ biomass in the range 8,710,000 t to 15,800,000 t. Model 1, which is identical to last year's model, was chosen as the reference model for the 2004 fishing season.

The current assessment provides results very similar to last year's assessment, with the main difference being that the current assessment's estimates of biomass tend to be slightly higher than last year's assessment.

The SSC has determined that reliable estimates of B_{MSY} and the probability density function for F_{MSY} exist for this stock, and that EBS walleye pollock therefore qualify for management under Tier 1. The senior assessment author continues to feel that the Tier 1 reference points are reliably estimated given the structure of the model. The updated estimate of $_{MSY}$ from the present

assessment is 2,470,000 t, compared to 2,290,000 t from last year's assessment. The projected spawning biomass for 2004 is 4,080,000 t, placing EBS walleye pollock in sub-tier "a" of Tier 1. This year's assessment uses a new method to compute the maximum permissible ABC for Tier 1a. The new method is more consistent with the Tier 1a formula and is based on the ratio between MSY and the equilibrium age 3+ biomass corresponding to MSY. The harmonic mean of this ratio (0.233) is multiplied by the geometric mean of the projected age 3+ biomass for 2004 (11,000,000 t) to obtain the maximum permissible ABC for 2004, 11 which is 2,560,000 t. This ABC is about 1% higher than the 2004 yield corresponding to an $F_{40\%}$ strategy. In each of the last two years, the senior assessment author, Plan Team, and SSC all recommended setting ABC at the maximum permissible value. This year, the senior author again recommends setting ABC at the maximum permissible value.

Given that TAC will necessarily be set below the recommended ABC, the assessment also provides alternative harvest scenarios, including the seven standard scenarios analyzed in all age-structured assessments and two constant catch scenarios (1,300,000 t and 1,500,000 t). The OFL harvest ratio under Tier 1a is 0.250, the arithmetic mean of the ratio between MSY and the equilibrium age 3+ biomass corresponding to MSY. The product of this ratio and the geometric mean of the projected age 3+ biomass for 2004 (11,000,000 t) is the OFL for 2004, which is 2,740,000 t.

Aleutians

Last year, the SSC determined that Aleutian pollock qualified for management under Tier 5. Because the Aleutian Islands were not surveyed this year, the best available biomass estimate is the estimate of 175,000 t from the 2002 bottom trawl survey. The maximum permissible for 2004 ABC is identical to the 2003 ABC of 39,400 t, which is the recommended ABC. The 2004 OFL is identical to the 2003 OFL of 52,600 t. As a Tier 5 stock, it is not possible to determine whether Aleutian pollock is overfished or whether it is approaching an overfished condition.

Bogoslof

The 2003 hydroacoustic survey of the Bogoslof region resulted in a biomass estimate of 198,000 t. Last year, the SSC determined that Bogoslof pollock qualified for management under Tier 5. The maximum permissible ABC under Tier 5 is 75% of the product of the natural mortality rate (0.20) and biomass, giving a value of 29,700 t, which is the recommendation for 2004 ABC. For several years, the North Pacific Fisheries Management Council's Plan Team has recommended setting ABC for this stock at the maximum permissible level while the SSC has used a much more conservative approach. If the formula used by the SSC is applied, the resulting fishing mortality rate is 0.014, giving a 2004 ABC of 2,570 t. The overfishing level under Tier 5 is the product of the natural mortality rate and biomass, giving an OFL of 39,600 t for 2004. As a Tier 5 stock, it is not possible to determine whether Bogoslof pollock is overfished or whether it is approaching an overfished condition.

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

8. Other Species

a. Research

Pacific Sleeper Shark Relative Abundance in the Northeast Pacific

Pacific sleeper sharks (*Somniosus pacificus*) are a deepwater shark of the North Pacific Ocean. Some information suggests their abundance is increasing. Our purpose was to analyze existing sleeper shark data to determine the trend in abundance and whether any change was statistically significant. Last year, we analyzed a long-term time series, 1979-2000, of Pacific sleeper shark bycatch from fishery-independent sablefish longline surveys in Alaskan waters of the northeast Pacific. This year we updated the analysis, adding the years 2001-2003. Results indicated a significant increase in the relative abundance of Pacific sleeper sharks in the central Gulf of Alaska between the years 1989-2003. These results were presented to the Gulf of Alaska Groundfish Plan Team and included in the Ecosystem Considerations Chapter of the Groundfish Plan Team's Stock Assessment and Fisheries Evaluation Report for 2004.

For more information, contact Dean Courtney at (907) 789-6006 or Mike Sigler at (907) 789-6037.

Pacific Sleeper Shark Movement Study

Pacific sleeper sharks (*Somniosus pacificus*) are a deepwater shark of the North Pacific Ocean. We began a movement study of sleeper sharks in 2003. Sleeper sharks were tagged in Chatham Strait, Alaska with two types of tags. The first type is archival tags which record temperature, depth, and time. The recovery method is the sablefish fishery which occurs in Chatham Strait each fall. The second type is sonic tags which if followed by a vessel, indicate local movements. The pilot year was successful, and further work is planned for 2004.

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

D. Other Related Studies

Effects of Fishing on Sea Floor Habitat

Distribution of Deep-Water Corals and Associated Communities in the Aleutian Islands

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996, requires the regional Fishery Management Councils and NMFS to minimize, to the extent practicable, adverse effects from fishing on essential fish habitat including coral habitat. Major fisheries presently occur throughout the Aleutian Island Archipelago and down the continental slope to at least a depth of 1,500 m. Summaries of archived data and recently acquired fisheries bycatch specimens indicate that the Aleutian

Islands may harbor the highest abundance and diversity of temperate water corals in the world. However, these data reveal little about the distribution of corals in relation to the overall underwater landscape and the importance of corals to marine ecosystems.

In July 2002, Auke Bay Laboratory (ABL) scientists used the manned submersible *Delta* to study Aleutian Islands coral habitat in waters down to 350 m depth near the Andreanof Islands and on Petrel Bank in the Bering Sea. Coral and sponges were found at 30 of 31 dive sites investigated and percent coverage ranged from approximately 5% on pebble substrate to 100% coverage on bedrock outcrops. Unique coral habitat consisting of high density "gardens" of corals, sponges, and other sessile invertebrates was found at 5 sites between 150 and 350 m depth. These "gardens" were similar in structural complexity to tropical coral reefs. This habitat had not been previously documented in the North Pacific Ocean or Bering Sea. Disturbance to epifauna, likely anthropogenically induced, was observed at most dive sites and may have been more evident in heavily fished areas.

Scientists from ABL, the Alaska Department of Fish and Game, and the University of Alaska returned to the central Aleutian Islands in 2003. Multibeam bathymetry and backscatter sea floor maps were created for 17 sites systematically selected between Seguam Pass and Petrel Bank. These maps will be used to classify the habitat within the sites. The manned submersible *Delta* was used in 2003 to collect *in situ* observations and videographic data on strip transects at depths down to 350 m within ten of the mapped sites.

In 2004, *in situ* observations of Aleutian Islands corals will again be collected with the *Delta.* In addition, the ROV *Jason II* will be used to collect *in situ* observations in deeper water down to 3,000 m. Ultimately, the goal is to construct a model to predict the distribution and density of coral habitat throughout the Aleutian Islands based on depth, substrate type, habitat type, oceanographic parameters, and geological features. Fishing effort and predicted coral habitat distribution data will be entered into a geographical information system to create maps showing areas of coral habitat and fishery interaction. The scientific goals of this work are to study the zoogeography, ecology, and life history aspects of deep-water corals. This information will also directly assist managers in developing methods to minimize fishing interactions with coral habitat in the Aleutian Islands.

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

Growth and Recruitment of an Alaskan Shallow-Water Gorgonian

At least 20 species of gorgonian corals inhabit Alaskan waters. Specimens of all but one species have been found incidentally entangled in fishing gear (e.g., hook and line, longlines, trawls, crab pots, and fish traps) and detached from the seafloor. Several species attain large size and provide habitat in the form of structure and refuge for species of demersal fish and invertebrates. The effects of coral habitat alteration on benthic communities are unknown, but may be substantial due to the reported longevity and slow growth rates of cold-water corals. The North Pacific Fishery Management Council is currently considering measures to establish several

marine protected areas where gorgonian corals are abundant. A study to examine the growth and recruitment of *Calcigorgia spiculifera*, a shallow-water gorgonian, was established by the Auke Bay Laboratory in 1999 to provide insights into gorgonian growth rates, validate radiometric aging techniques, and elucidate the effects of fishing activities on coral habitat.

Computer image analysis tools were used to measure the linear length of colony branches from digitized video images collected by scuba diving on tagged specimens. Length of a branch was measured along the medial axis from the point opposite its origin. This method provides a permanent record of colony morphometry. Highly accurate measurements are possible with proper colony orientation with respect to the calibration grid and parallel alignment of the camera lens with the grid.

Thirty seven colonies were tagged at 2 sites in southeastern Alaska in July 1999 and thirty colonies were tagged at a third site in 2001. Growth rate was variable for branches from the same colony and also between colonies. Mean branch growth rate at both sites ranged from -1.82 to 14.83 mm yr^{-1} in 2000 and -0.80 to 9.7 mm yr^{-1} in 2001. Growth rates (2000 mean =5.81 mm yr^{-1}, sd =4.99, 2001 mean =2.95 mm yr^{-1}, sd =2.66) measured during both years were generally much lower than those reported for other gorgonians worldwide, including Alaskan *Primnoa*, a deep-water species. Recruitment of new colonies had not occurred at either study site for a minimum of several years indicating that recruitment in this species, at least at our study sites, is a rare sporadic event.

The slow growth rates measured so far in this study, although preliminary, are noteworthy because shallow-water corals are widely believed to have faster growth rates and shorter life spans than deep-water corals. Additionally, recruitment appears to be a rare, sporadic event. Shallow-water gorgonian communities may therefore exhibit slow recovery rates from sea floor perturbations. In 2002 and 2003, the study was expanded to collect samples for examining the reproductive characteristics of *Calcigorgia spiculifera.*

For more information, contact Robert Stone at (907) 789-6031.

Sea Whip (Order Pennatulacea) Resiliency to Simulated Trawl Disturbance

In 2001, scientists at the Auke Bay Laboratory (ABL) conducted a study to investigate the immediate effects of intensive bottom trawling on soft-bottom habitat, particularly in an area colonized by sea whips. Sea whip biological characteristics and their resistance to two levels of trawling were studied near Kodiak Island using both a chartered trawler and the manned submersible *Delta*. Sea whips are highly visible, and changes in their abundance can be readily quantified. Within the study site, at least two species of sea whips (*Halipteris* sp., and *Protoptilum* sp.) were present with densities up to 10 individuals per m^2. Sea whip beds provide vertical relief to otherwise homogeneous, low relief habitat. Sea whips may be particularly vulnerable because they can be removed, dislodged, or broken by bottom fishing gear. Furthermore, because sea whips are believed to be long-lived, recolonization rates may be very slow. Analysis of the 2001 data is ongoing and will identify immediate bottom trawling impacts to sea whips,

including the percentage of sea whips damaged and dislodged.

However, the long-term fate of damaged and dislodged sea whips remains unknown. To address this problem, Auke Bay Laboratory scientists in 2003 initiated new studies to investigate long-term impacts to sea whips. Large (1-2 m) sea whips of the genus *Halipteris* are being observed *in situ* at a study site in Auke Bay and small (<30 cm) sea whips of the genus *Protoptilum* are being observed in laboratory aquaria. The purpose of these studies is to simulate disturbances caused by fishing gear and document the ability of sea whips to 1) survive after having their internal skeleton broken or flesh torn and 2) re-bury themselves after being dislodged.
For the *Halipteris* sp. study, a large bed of these sea whips was found in Auke Bay at a depth of approximately 30 m. Scuba divers placed numbered stakes in the substrate to identify individual sea whips that were randomly assigned to 3 treatment groups and one control group. Treatments included dislodging, breaking of the internal skeleton, and flesh abrasion. Videographic documentation of tagged sea whips was performed approximately weekly for four months and will continue at longer intervals for up to a year or more.

For the *Protoptilum* sp. study, *Protoptilum* specimens were collected from an area of the seafloor heavily colonized by these sea whips in Chiniak Gully near Kodiak Island. A 6-m shrimp trawl was used to collect approximately 300 sea whips from a depth of 145 m. Live sea whips were retained in seawater and held overnight at the NMFS lab in Kodiak and transported by commercial airliner to ABL on the following day. The sea whips were allowed to acclimate before being randomly assigned to control and treatment groups and observed in live tanks lined with 10 cm of fine sediment similar in composition to that found in Chiniak Gully.

Preliminary results indicate that *Halipteris* sp.were more able to recover from dislodgement than *Protoptilum* sp. Fifty percent of dislodged *Halipteris* were able to recover to an upright position compared to just 5% of dislodged *Protoptilum*. Light tissue abrasion to *Halipteris* resulted in minor flesh injuries that did not affect survival. However, mortality among *Halipteris* with fractured axial rods was 100%. Dislodged and damaged *Halipteris* were much more vulnerable to predation by the nudibranch *Tritonia diomedea*, that appeared to illicit a strong scavenging/predatory response to sea whips in contact with the seafloor. In September 2003, a poster presentation of preliminary results from this study was presented at the Second International Symposium on Deep Sea Corals in Erlangen, Germany.

For more information, contact Patrick Malecha (907) 789-6053 or Robert Stone (907) 789-6031.

Habitat Evaluation of Major Fishing Grounds

The Sustainable Fisheries Act of 1996 was passed to attain long-term protection of essential fish habitat, and it specifically requires that NMFS minimize adverse impacts to essential fish habitat by fisheries that it manages. While considerable legal and administrative effort has been expended to meet the requirements of the Act, there has been little effort to observe the habitat where ongoing fisheries occur. NMFS has limited knowledge of bottom habitat where major fisheries occur. Any regulatory measures adopted to minimize impacts without the

knowledge of whether or where vulnerable habitat is at risk may be ineffective or unnecessarily restrictive. This study, initiated by the Auke Bay Laboratory in 2001, is an effort to attain such knowledge.

During summer 2001, high-resolution echosounder data (multibeam and backscatter) and video data were collected on the Portlock Bank area of the central Gulf of Alaska in the vicinity of extensive bottom trawl and longline fisheries for groundfish. The echosounder data were collected by chartered RV *Davidson*, and the video data were collected from the manned submersible *Delta*. The objective of the study was to characterize bottom habitat in or near heavily fished grounds to understand whether habitats in present fishing grounds are vulnerable to ongoing fishing activities. The area mapped by echosounder was about 1,000 km^2 of the outer continental shelf and upper continental slope. Preliminary interpretations of multibeam and backscatter data indicate the presence of at least a dozen different benthic macro- or mesohabitats. The megahabitats of this area are distinctly the result of past glaciations with the glacial deposits presently being reworked and shaped into moderate (cm-m) relief features. Many submarine canyons notch the upper slope and provide steep relief with alternating mud-covered and consolidated sediment exposures. The video data showed little evidence of trawling on the flatter grounds of the continental shelf, where perhaps the relatively level bottom does not induce door gouging and there is a lack of boulders to be turned over or dragged. The most common sessile epifauna were crinoids, small non-burrowing sea anemones, glass sponges, stylasterid corals, and two species of brittlestars. Occasional large boulders located in depressions were the only anomalies in the otherwise flat seafloor. These depressions may have afforded benthic fauna some protection from fishing gear, as the glass sponges and stylasterid corals attached to these boulders were larger than were typically observed. In the fished areas of the upper slope, there was evidence of boulders turned over or dragged by trawling. The uneven bottom of the slope may have induced gouging by the trawl doors. The substrate was mostly small boulders, cobble, and gravel. Presently there does not appear to be much habitat within the entire study area that can be damaged by trawl impacts. No large corals and very few large sponges were seen. Whether this is the result of past trawl activity is unclear.

During 2002 and 2003, the study was expanded to include additional areas. High-resolution echosounder data were collected by the RV *Davidson* on the Pamplona Spur and South Yakutat Valley areas of the eastern Gulf of Alaska and in the vicinity of Albatross Bank in the central Gulf. The areas mapped by echosounder were 162 km^2 of Pamplona Spur in water depths of 120 m to 940 m, 372 km^2 of the Yakutat Valley in water depths of 190 m to 1,045 m, and 340 km^2 of Albatross Bank in water depths of 20 to 810 m. These mapped areas were also in the vicinity of extensive bottom trawl and longline fisheries for groundfish. Video data of the bottom previously were collected in some of the mapped areas from the manned submersible *Delta*. The objective of the 2002 and 2003 study was similar to that of the 2001 study (i.e., characterize bottom habitat in or near heavily fished grounds) and also to compare these findings to those obtained from the 2001 survey of Portlock Bank. Analysis of the 2001- 2003 data is ongoing.

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

Short-term Trawling Effects and Recovery Monitoring (Eastern Bering Sea, 2001-present)

This ongoing multi-year study is a process-oriented investigation of short-term effects and recovery using a BACI experimental design. The study area is located within the CHPZ1 closed area, approximately 25-50 mi south and west of the chronic effects site (above, item #4). In 2001, 6 pairs of predesignated 10-mi long research corridors were sampled before and after a trawling disturbance with commercial gear. Biological sampling consisted of 15 min research trawls for epifauna (n=72 total) and 0.1 m2 van Veen grab samples for infauna (n=144 total at 2 per epifauna site). At each infauna sampling site, a second grab sample (n=144 total) was collected for characterizing carbon and nitrogen levels in surficial sediments, as well as grain size properties. The experimental and control corridors were also surveyed before and after trawling using a Klein 5410 side scan sonar system, to evaluate possible changes in sediment characteristics and bedforms. The 2001 study aimed to quantify short-term changes in the experimental corridors due to trawling. To investigate the recovery process, these same corridors were resampled in 2002. Data are being processed and further studies are being planned.

Effects of Long-term Bottom Trawling in the Eastern Bering Sea (1996-2003)

Chronic bottom trawling may decrease the numbers of individuals of the affected marine population or their mean body size, thereby influencing the structure and function of populations, communities and ecosystems. Using data from the original study in 1996, the mean sizes (kg) of 16 invertebrate taxa in heavily trawled (HT) and untrawled (UT) areas straddling the Crab and Halibut Protection Zone 1 (CHPZ1; area 512) closed area boundary in Bristol Bay were compared. For comparison with experimental results, natural size variability of benthic invertebrates was estimated by examining catches at standard NMFS trawl survey stations located within the CHPZ1 closed area.

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

Reconnaissance Mapping with Side Scan Sonar

A reconnaissance of Bristol Bay seafloor habitats was undertaken using a high-resolution 500 kHz side scan sonar (Klein 5410). The reconnaissance effort was centered on an 800 mi2 area of central Bristol Bay that has never been surveyed by NOAA hydrographers. A 150 m swath of bathymetric data and imagery were collected along survey lines totaling nearly 600 linear miles. The survey intentionally intersected six of the Bering Sea trawl study corridors currently being studied (above, item #5) in order to provide a spatial context for these results. In support of coordinated EFH characterization studies in the area, the reconnaissance survey also crossed 18 RACE Division trawl survey stations and followed 78 mi of seabed previously classified using a QTC View single beam acoustic system. Imagery was systematically groundtruthed using an underwater video camera and van Veen grab samples. The imagery is currently being processed and will be classified using supervised (geological) and unsupervised (statistical) methods in an effort to identify large homeogenous regions that would be the basis for more systematic study of

mobile gear effects. Suitability for EFH characterizations will also be considered. In early 2003, the Klein system was co-purchased with the NOAA Office of Coast Survey (OCS) using accrued lease credits.

EFH Characterization/Mapping

Evaluating Single Beam Echosounders for Synoptic Seabed Classification

Collaborative analyses with the Quester Tangent Corporation, Sidney, B.C. (QTC) are continuing in order to develop an optimum seabed classification scheme for the eastern Bering Sea shelf. The standard QTC method uses a set of proprietary algorithms based on Principal Components Analysis (PCA) to extract features from individual echoes. PCA reduces the full set of features to the three linear combinations that explain a large fraction of echo (seabed) variance. A three-factor cluster analysis then groups the echoes into distinct seabed types based on their acoustic diversity. New techniques being incorporated into this process include fully-automated, objective clustering using the Bayesian form of the Akaike Information Criterion (BIC, or "cost function"), and global minima search in multi-dimensional spaces using simulated annealing (SA). Data being analyzed are echo returns from the seafloor simultaneously collected at two frequencies (38 and 120 kHz) along a 9,000 nm trackline in the eastern Bering Sea during a 1999 hydroacoustic fishery survey by the Miller Freeman. Once this is accomplished, it will be possible to evaluate the system for benthic habitat studies using standardized measures of fish and invertebrate abundance from annual trawl surveys.

Studies on Sea Lion/Groundfish Interactions

Seasonality of Prey Availability in Regions of Contrasting Steller Sea Lion Abundance Trends

The Auke Bay Laboratory (ABL) began research in 2001 to test the hypothesis that sea lion prey diversity and seasonality are related to Steller sea lion population trends. The decline in the western population of Steller sea lions may be due to decreased prey availability; this decrease may be exacerbated by fishery removals of prey in sea lion habitat. Area-specific diet diversity and population change of Steller sea lions also appear to be related, with faster declines in areas of lower diet diversity (Merrick et al. 1997). Steller sea lions also may switch diet seasonally, as different prey become more available. The purpose of this set of studies is to test the hypothesis that sea lion prey diversity and seasonality are related to Steller sea lion population trends. The approach is to measure Steller sea lion prey, prey quality (energy density), and predator abundance and fishery removals near selected rookeries and haul-outs, emphasizing seasonal measurements conducted during critical life stages of Steller sea lions. Two regional trend areas, southeast (SE) Alaska and the Kodiak area, are being compared. Study haul-outs and rookeries were selected based on year-round accessibility; simultaneous sampling of sea lion abundance, distribution, and diet (scats) is occurring by other cooperating agencies. The University of Alaska currently is conducting a seasonal study on Kodiak Island, an area where Steller sea lion abundance is declining. The ABL is studying sites in SE Alaska, where Steller sea lion

abundance has been slowly increasing. In SE Alaska, ABL is cooperating with the Alaska Department of Fish and Game, the University of Alaska, and the University of British Columbia. This study also is being coordinated with the existing University of Alaska study on Kodiak Island.

For ABL's SE Alaska study, two study sites were selected where Steller sea lions are known to haul-out in relatively large numbers: 1) Benjamin Island, north of Juneau, and 2) the Brothers Islands in Frederick Sound. Field work began in March 2001, and each site has been visited on at least a quarterly basis since then. Prey abundance at each site is determined by echo-integration and midwater trawling, and sea lion scat is collected from the haul-outs to infer diet. Fish are also collected for proximate and free fatty acid analysis. These studies will be completed in May 2004.

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

Availability of Nearshore Prey to Steller Sea Lions at Two Haul-Outs in Southeastern Alaska

To better understand the declining abundance of Steller sea lions (SSL) in central and western Alaska, we examined the seasonal availability of SSL prey in southeast Alaska where SSL abundance is increasing. From 2001-2004, we identified prey in nearshore waters <100 m deep near two SSL haulouts in summer and winter. Study areas were Benjamin Island, a seasonal haulout used by up to 800 SSLs, and the Brothers Islands, a year-round haulout used by up to 1,500 SSLs. Available prey species were inventoried by beach seine, jig, and ROV within 7 km of each haulout.

Regardless of sampling method, total catch was always greater at the Brothers Islands than at Benjamin Island and was greater in summer than in winter. Mean total seine catch in summer (all years) was nearly 57,000 fish representing 37 species at the Brothers Islands, compared to about 4,000 fish representing 30 species at Benjamin Island. Mean total seine catch in winter (all years) was 328 fish representing 25 species at Brothers Islands and 125 fish representing 21 species at Benjamin Island. Seine catches were dominated by walleye pollock, Pacific sand lance, and Pacific herring in summer and armorhead sculpin, tubesnout, and rock sole in winter. Jig catches ranged from 9 to 1 fish per rod hour in summer and winter. Fish captured by jig were larger (mean FL >190 mm) than fish captured by seine (mean FL <100 mm). Jig catches were dominated by armorhead sculpin, Pacific cod, dusky rockfish, walleye pollock, and yellowfin sole. Few species were observed with the ROV that were not captured by seine or jig. Sixteen species that we captured have been identified in SSL scat at either haulout. More prey is available to SSLs in summer than in winter in nearshore areas.

For more information, contact John Thedinga at (907) 789-6025 or Scott Johnson at (907) 789-6063.

E. Other Items

Groundfish Bottom Trawl Survey Standardization - RACE

The AFSC experienced the first year of survey operations subject to standardization protocols developed during the National Trawl Survey Standardization Workshop in November 2002. Our experiences implementing the protocols in the field were generally positive. Most problems encountered dealt with the standards for measuring and marking trawl warps prior to beginning survey sampling. After implementing the measuring/marking protocol in the field, we concluded that the degree of precision called for by the specifications was unrealistic considering the measuring equipment we currently use. Better measuring equipment, whether installed as fixed metering blocks or temporary-use meters, is required. Until then, we need to establish our specifications more realistically. Operational protocols, those dealing with how each step of the sampling process is accomplished, had been well-written and implementing them worked out well.

Trawl gear studies conducted by the Groundfish Assessment Program over the last couple years have focused on issues closely related to obtaining reliable, consistent samples with our standard trawls. We have investigated the effects on trawl geometry and catching efficiency due to changes in speed through the water, tow duration, unequal warp length, whether autotrawl systems are used, and even the cumulative effect of the instruments hung on the trawl to monitor its performance. Investigators have used several tools to look at these problems, including trawl mounted video cameras, auxiliary "underbags" hung below the footrope, and multiple bottom contact sensors mounted at various points along the bridles and footrope. Footrope contact has been shown to decrease with increased towing speed, suggesting that trawl speed might best be standardized to speed through the water rather than speed over ground, as currently used. Using autotrawl systems, as opposed to locked winches, have been shown to improve the bottom-tending characteristics of the trawl's footrope. Relative bottom contact and fishing dimensions have been evaluated for varying degrees of difference between trawl warp lengths. A decrease in tow duration from 30 to 15 minutes was shown to increase the CPUE of some species (snow crab) while having no effect on the CPUE of others (red king crab). More studies are being planned.

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

GIS Resources

No notable new developments, though some projects are in the works.

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

APPENDIX I

Alaska Fisheries Science Center Groundfish Publications - 2003 and In Press (AFSC authors in bold text).

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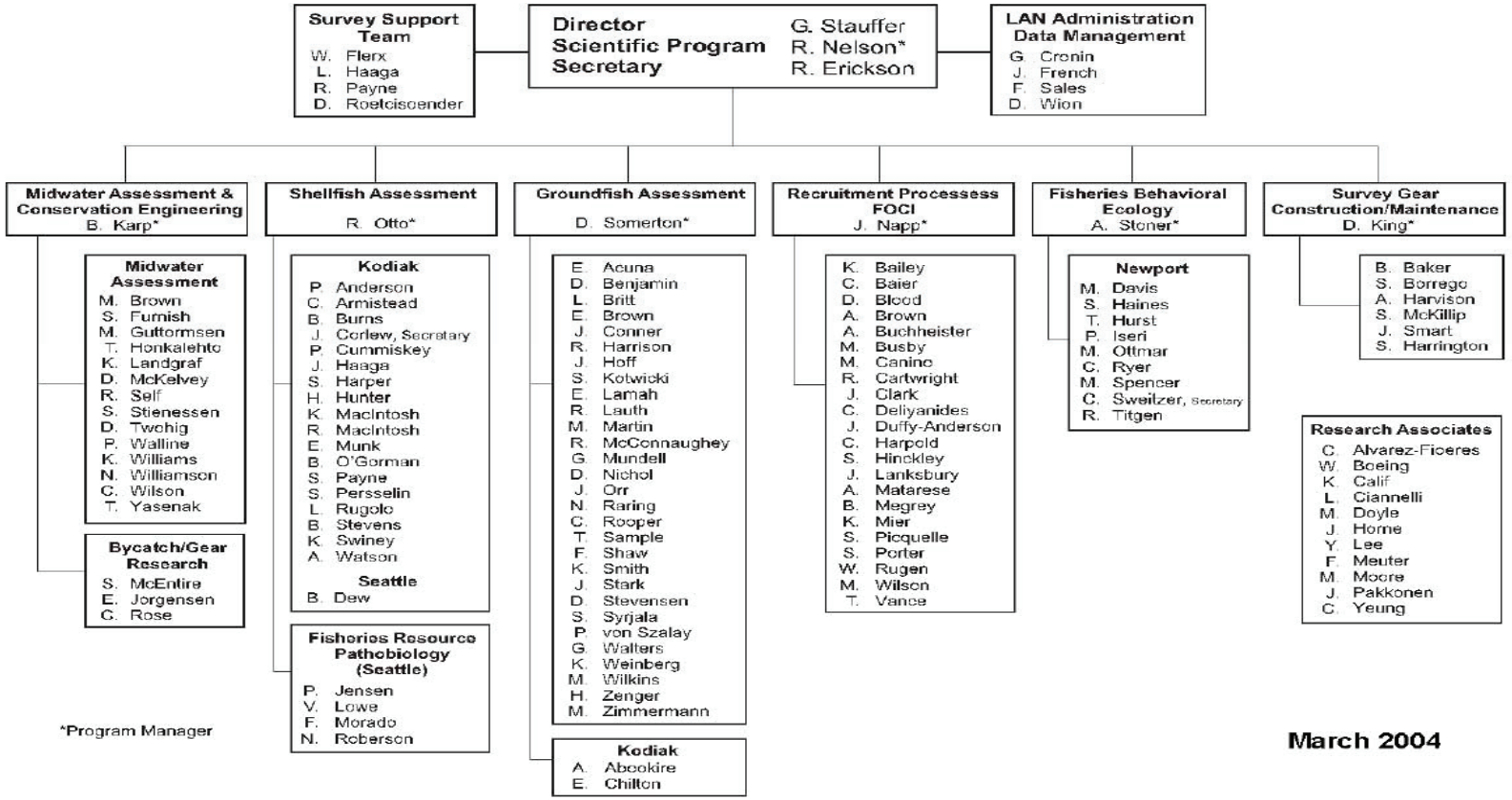
ZIMMERMANN, **M.**, **M. E. WILKINS**, **K. L. WEINBERG**, **R. R. LAUTH**, and **F. R. SHAW**. 2003. Influence of improved performance monitoring on the consistency of a bottom trawl survey. ICES J. Mar. Sci. 60:618-826.

APPENDIX II.--RESOURCE ASSESSMENT AND CONSERVATION ENGINEERING DIVISION ORGANIZATION CHART 2003



North Pacific Groundfish Observer Program - Ito, Daniel -- Supervisor Barbeaux, Steven Barns, Alison Berger, Jerry Campbell, Glenn Corcoran, Andrew Corey, Sheryl Dakan, John Davis, Sharon Decker, Daniel DeMorett, Kim Dixon, Brian Dunn, Ed Ferdinand, Jennifer Fitzgerald, Shannon Hewitt, Robert Kenney, Heather Kruse, Kenneth Limpinsel, Douglas Loefflad, Martin Loomis, Todd Maier, Robert Mandina, Stephanie Martin, Troy McCauley, Kathleen Middleton, Angela Moser, John Narita, Ren Neidetcher, Sandra Nordeen, Carrie Reeves, Brenda Ridley, Patricia

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Loh Lee Low -- Deputy Director

North Pacific Groundfish Observer Program

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Campbell, Glenn
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Corey, Sheryl
Dakan, John
Davis, Sharon
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DeMorett, Kim
Dixon, Brian
Dunn, Ed
Ferdinand, Jennifer
Fitzgerald, Shannon
Hewitt, Robert
Kenney, Heather
Kruse, Kenneth
Limpinsel, Douglas
Loefflad, Martin
Loomis, Todd
Maier, Robert
Mandina, Stephanie
Martin, Troy
McCauley, Kathleen
Middleton, Angela
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Goetz, Betty
Hutchinson, Charles
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Kastelle, Craig
Price, Tim
Roberson, Nancy
Shockley, Wes
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Observer Program (continued)

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Neidetcher, Sandra
Nordeen, Carrie
Reeves, Brenda
Ridley, Patricia
Risse, Peter
Seither, Russ
Swanson, Rob
Teig, Karen
Thompson, Lisa
Vijgen, Alison
Watson, Jennifer
Weikart, Heather

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Ianelli, James
Ingraham, James
Lowe, Sandra
Munro, Peter
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Spencer, Paul
Thompson, Grant
Turnock, Jack
Wennberg, Sherrie
Wilderbuer, Thomas

Resource Ecology and Ecosystems Modeling

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Buckley, Troy
Derrah, Christopher
Goiney, Bernard
Lang, Geoffrey
Yang, Mei-Sun

Socio-Economic Assessment

Terry, Joe -- Leader
Felthoven, Ron
Hiatt, Terry
Lee, Todd

APPENDIX IV - Auke Bay Laboratory Groundfish Assessment Program Staff

Name	Duties
Phil Rigby	Program Manager
Dave Clausen	Rockfish, Gulf of Alaska Groundfish
Dean Courtney	Rockfish, Sharks, Stock Assessment
Dave Csepp	Sea Lion Prey/Predation
Linc Freese	Effects of Fishing, Sponge Life History
Jeff Fujioka	Sablefish, Rockfish, Stock Assessment, Effects of Fishing
Dana Hanselman	Rockfish, Stock Assessment
Jon Heifetz	Effects of Fishing, Rockfish, Sablefish, Stock Assessment
Leland Hulbert	Sea Lion Prey/Predation, Sharks
John Karinen	Gulf of Alaska Groundfish
Mitch Lorenz	Essential Fish Habitat
Chris Lunsford	Rockfish, Sablefish, Stock Assessment, Longline Survey
Patrick Malecha	Effects of Fishing
Nancy Maloney	Sablefish Tag Database, Longline Survey, and Seamounts
Tom Rutecki	Sablefish, Webmaster
Mike Sigler	Sablefish, Stock Assessment, Sea Lion Prey/Predation
Robert Stone	Effects of Fishing, Coral Life History
	Other ABL Staff Working on Groundfish
Scott Johnson	Essential Fish Habitat, Sea Lion Prey
John Thedinga	Essential Fish Habitat, Sea Lion Prey
Bruce Wing	Groundfish Early Life History, Corals
Christine Kondzela	Rockfish Genetics

Northwest Fisheries Science Center

2003 Agency Report to the Technical Sub-committee of the Canada-U.S. Groundfish Committee

March, 2004

Review of Agency Groundfish Research, Assessments, and Management

A. Agency Overview

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

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

FRAM consists of a multi-disciplinary team with expertise in fishery biology and ecology, stock assessment, mathematical modeling, statistics, computer science, and field sampling techniques. Additional members of this program are stationed at the NWFSC in Seattle. Together, they work to develop and provide scientific information necessary for managing West Coast marine fisheries and strive to provide useful and reliable stock assessment data with which fishery managers can set ecologically safe and economically valuable harvest levels. FRAM researchers develop models for managing multispecies fisheries; design programs to provide information on the extent and characteristics of bycatch in commercial fisheries, as they look at methods to reduce fisheries bycatch; characterize essential habitats for key groundfish species; and investigate the design, feasibility, function, and value of marine protected areas.
Research facilities in Newport on the Oregon coast are particularly important for groundfish research. The Newport location provides opportunities for staff to work with and share information and ideas with researchers from Oregon State University, the Oregon Department of Fish and Wildlife, Alaska Fisheries Science Center, U.S. Environmental Protection Agency, and the fishing industry.

During 2003, the FRAMD continued to: implement a West Coast observer program; build a survey program that will conduct West Coast groundfish hydroacoustic and trawl surveys previously conducted by the AFSC; and further augment its stock assessment, economics, and ecosystem research. Significant progress continues in all programs. For more information on FRAMD and groundfish investigations, contact the Division Director, Dr. M. Elizabeth Clarke, at Elizabeth.Clarke@noaa.gov, (206) 860-3381.

The Conservation Biology Division is responsible for characterizing the major components of biodiversity in living marine resources, using the latest genetic and quantitative methods. It also has responsibility for identifying factors that pose risks to these components and the mechanisms that limit natural productivity. The Division's multi-disciplinary approach draws on expertise in the fields of population genetics, population dynamics, and ecology.

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

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

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

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

B. Multispecies Studies

1) Research

Historical foreign catch of rockfish (Sebastes and Sebastolobus sp.) off California, Oregon, and
Washington was allocated to individual species by year and INPFC area. Allocation involved selecting 1965-1976 foreign catch estimates, separating that catch by fishing strategy, and finally applying species compositions specific to each strategy. Total foreign rockfish catch for 1965-1976 was estimated at 115,799 mt. Top ten species in the catch (in order of decreasing importance) were Pacific Ocean perch, shortbelly rockfish, widow rockfish, bocaccio, splitnose rockfish, darkblotched rockfish, yellowtail rockfish,

shortspine thornyhead, chilipepper rockfish, and canary rockfish. Details of the allocation are available in the following 2003 NOAA Technical Memorandum:

Rogers, Jean Beyer. 2003. Species Allocation of Sebastes and Sebastolobus sp. caught by foreign countries from 1965 through 1976 off Washington, Oregon, and California, USA. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-57, 117 p.

This allocation provides a consistent approach for all rockfish and will be utilized in 2004 stock assessments. In the past, stock assessment authors for Pacific Ocean perch, darkblotched rockfish, yellowtail rockfish, and canary rockfish have used varying approaches, resulting in overlapping catch allocations. Stock assessment authors for the other rockfish species have assumed no foreign catch.

For more information, contact Dr. Jean Rogers at Jean.Rogers@noaa.gov, (541) 867-0535.

2) Stock Assessment

Unassessed Species

Quantitative assessments of many West Coast rockfish stocks of both major and minor importance to commercial fisheries have shown varying declines in abundances. The population sizes of less-abundant, co-occurring unassessed species may also be declining. However, determining stock status of the many non-targeted, minor species with high levels of certainty and quantifiable predictability may be prohibitively expensive and/or impractical because of the dearth of available data. Using a system of qualitative indicators may provide a cost-effective method to create preliminary assessments of the relative status of minor rockfish stocks and subsequently prioritize future studies. Therefore, this project used an array of indicators including catch-per-unit-effort, the proportion of positive hauls, and length composition data to detect population trends of minor West Coast rockfish species including *Sebastes aurora*, *S. babcocki*, *S. aleutianus*, *S. zacentrus*, *S. borealis*, *S. diploproa*, and *S. reedi*. Data were taken from three West Coast bottom trawl surveys conducted by the National Marine Fisheries Service. A ranking system of relative concern was created based on the generated trends in the indices using a modified categorical point-scoring approach. The interpretation of the health of the population projected by the indicators was compared to the population status based upon formal stock assessments for four species, *S. alutus, S. crameri, S. melanostomus,* and *S. rufus*.

For more information, contact Stacy Miller at (206) 860-3480, Stacey.Miller@noaa.gov.

C. By Species, by Agency

1) Shelf Rockfish

West Coast

a) Research

Statistical methodology for bomb radiocarbon ageing validation. The use of the radiocarbon signal from atmospheric testing of nuclear weapons in the middle of the twentieth century has emerged, over the past decade, as a reliable method for ageing validation. The bomb radiocarbon method uses measured radiocarbon levels in otolith cores to validate the annulus counts determined by break and burn or other ageing methodologies. We have developed a statistical method to rigorously compare reference radiocarbon data sets to each other and to compare test data sets to reference data sets. The statistical method evaluates assumptions inherent to radiocarbon validation and the degree of ageing bias. With this method, we combined time series from two studies that used known-age fish, haddock from the North Atlantic and Pacific halibut from the Northeast Pacific, to create a single robust reference for North American species. We tested six published data sets for various species from the published radiocarbon validation literature, showing fairly widespread evidence of under-ageing. Under-ageing is of particular concern for stock assessments in that, through biased age compositions, stock assessments can be overly optimistic about the productivity of a species.

We applied this method to canary rockfish by selecting and coring otoliths for radiocarbon analysis. To test two assumptions of the method, two sampling designs were used. A sampling design that controls for age-dependent ageing error allowed for testing the assumption of parallelism of the standardized rates of bomb radiocarbon increase for the validation and reference time series. A second sampling design that produces a linear relationship between the estimated age and birth year allowed for testing the assumption of ageing error consistency. Neither assumption was shown to be statistically invalid. Using the combined data sets, the similarity of the timing of increase in 14C levels in the canary otolith cores and the reference time series indicated that the canary rockfish ages determined using the break and burn method are reasonably precise, though with an average underaging bias of 2-3 years. We are currently working on validating the ageing of other species using this methodology.

Manuscripts describing this work have been submitted to the Canadian Journal of Fisheries and Aquatic Sciences.

For more information, contact Owen Hamel at (206) 860-3481, Owen.Hamel@noaa.gov, or John Wallace at (206) 860-3456, John.Wallace@noaa.gov.

b) Stock Assessment

Pacific Ocean perch. In 2003, Pacific ocean perch (*Sebastes alutus*) (POP) were assessed for the combined US Vancouver and Columbia INPFC areas. The assessment uses a forward projection age-structured model. New data and changes to the data from that used in the 2000 assessment include updated (and reduced) estimates of historical foreign catch of Pacific ocean perch; biomass indices and age- or size-composition data (for some years) from the Alaska Fisheries Science Center (1992, 1996, 1997, 1999-2001), and Northwest Fisheries Science Center (1999-2002) slope surveys, and the most recent year of data from the triennial shelf survey (2001). Four years (1999-2002) of break-and-burn fishery age data were newly available and included when fitting the model. The inclusion of non-independent fishery age- and size-composition data for 13 years (1968-80) was removed, by omitting the size-composition data from the model fit. Two additional years of fishery catch data (2001-2), along with updated PacFin catch records for the years 1981-2000, were available and were included in the assessment. The reduction of the historical catch estimates had the greatest effect of the changes and additions to the data, resulting in lower estimates of both equilibrium unfished biomass and maximum sustainable yield.

A number of sources of uncertainty are explicitly included in this assessment. For example, allowance is made for uncertainty in natural mortality, the parameters of the stock-recruitment relationship, and the survey catchability coefficients. However, sensitivity analyses based on alternative model structures / data set choices suggested that the overall uncertainty may be greater than that predicted by a single model specification. There are also other sources of uncertainty that are not included in the current model. These include the degree of connection between the stocks of Pacific Ocean perch off British Columbia and those in PFMC waters and the effect of the PDO, ENSO and other climatic variables on recruitment, growth and survival of Pacific Ocean perch.

For full documentation go to
http://www.pcouncil.org/groundfish/gfsafe0803/gfsafe0803.html
For more information, contact Owen Hamel at (206) 860-3481, Owen.Hamel@noaa.gov.

Yellowtail Rockfish. The Pacific Fishery Management Council (PFMC) manages the U.S. fishery as two stocks separated at Cape Mendocino, California (40°30'N). This report presents the "coastwide" stock extending from Cape Mendocino to approximately 49°N. Traditionally, this coastwide stock is divided into three unit stocks: Southern Vancouver stock from Cape Elizabeth (47° 20'N) to approximately 49°N, Northern Columbia stock from Cape Falcon (45° 46'N) to Cape Elizabeth (47° 20'N), and Eureka/South Columbia stock from Cape Mendocino (40° 30'N) to Cape Falcon.

Due to redistribution of rockfish species composition and the new estimation algorithm, the catch data in the three stock areas were different from that reported in the last assessment. Based on the revised catch data, U.S. coastwide total catch reached a plateau at around 9,000 mt in 1978-1983 and then declined due to trip limits imposed in 1985. Annual U.S. landings decreased to 1,454 mt in 2002.

The following new information were included in the analysis: (i) 2001 NMFS survey abundance index and catch at age (sex-combined), (ii) the revised catch series by using new estimation methods, and (iii) catch at age and weight-at-age data by sex for 1999-2002. However, the domestic trawl CPUE index from 1988 to 1999 and the whiting fishery bycatch index from 1978 to 1999 were kept as they were assessed in 2000 because the changing fishery regulations make have altered the statistical properties of these abundance indices. Also, the area specific matureogive and age transition matrix were kept as they were assessed in 2000 due to insufficient new data. The stock assessment model is an age-structured model written with AD Model Builder software in 2000. The reference model is to fit the newly revised catch series of the coastwide stock.

There were concerns on usefulness of auxiliary abundance indices and their time-variant catchabilities as the stock was assessed in 2000. These concerns remain even if the whiting bycatch index and CPUE index were not updated and were treated to be non-informative. The survey indices fluctuated over the surveys, which may be the cause of flat trend in estimates of biomass. The effects of low age-4 recruitment in 1995-2002 on future management have yet to be evaluated. Concerns are also on low precision and potential bias for parameter estimation in 2002, especially the recruitment.

Assuming constant recruitment, equal to the average of 1967-2000 (13.0 million fish), the estimates of unfished biomass (B_0) is 115,493 mt, unfished spawning biomass (SPB_0) is 33,329 mt, target level spawning biomass ($SPB_{40\%}$) is 13,332 mt, overfishing threshold spawning biomass ($SPB_{25\%}$) is 8,332 mt and the recommended fishing mortality rate ($F_{50\%}$) is 0.091. The estimated coastwide biomass in year 2002 was 63,388 mt with a 26% CV. The estimated 2000 biomass was 66,933 mt in this assessment, compared with 69,400 mt estimated in the last assessment. In general, the trends of total biomass and population size in number of fish are declining. Total biomass in 2002 is 46% of the 1967. The spawning biomass is estimated to be 155% of the target spawning biomass ($SPB_{40\%}$).

Annual fishing mortality peaked in 1982 (F = 0.17). From 1983 to 1996, F fluctuated in the range of 0.06 to 0.17. However, F was in range of 0.04 to 0.09 after 1996, due to more restricted regulations on other overfished rockfishes.

Under the Council's $F_{50\%}$ policy and assuming the constant recruitment (equal to the geometric mean of 1967-1997) the profile of 3-yr mean yield is 3,133 mt at 25-percentile, 3,971 mt at 50-percentile, and 5,034 mt at 75-percentile. The projected coastwide 3-yr average yield for 2004-2006 is 3,966 mt. The Council adopted ABC/OY for 2001-2003 was 3,146 mt. Council ABC and OY determinations need to account for the expected harvest by Canadian fishers.

Recommendations: (1) Increase sampling effort for age, length, weight, and maturity data; (2) Estimate new discard rate with the new observer data; (3) Investigate the effects of current low recruitment events on the future perspective of fisheries; (4) Include all landings in stock assessment; and (5) Assess the status of stock in area south of Cape Mendocino.

For more information, contact Han Lin-Lai at (206) 860-3361, Han-Lin.Lai@noaa.gov.

2) Slope Rockfish

West Coast

b) Stock Assessment

Darkblotched Rockfish. Stock assessment and rebuilding analyses were updated for the population of darkblotched rockfish (*Sebastes crameri*) off the Pacific west coast United States between Mexico and Canada. This was the second update of the 2000 assessment, which used the length-based stock synthesis model. The first update was the basis of the 2001 rebuilding plan. The first update added data through the year 2000 and refit recruitments. This year's update added 2001 AFSC survey data and fishery data through 2002 and refit all parameters.
Since the late 1990's, estimated biomass has increased and catch and exploitation rates decreased. Biomass (mt) of age 1+ fish at the start of the year declined until 1999 and then increased. Recent increase in biomass is partly due to high estimates for 2000 age 1 recruitments. Estimated catch has declined in recent years with increasing management restrictions. The estimated exploitation rate (catch/biomass available to fishermen) has progressively dropped since 1998.

Although the model was extended through 2002**,** management was based on recruitments estimated only through 2000. This was viewed as a moderate choice, balancing a desire to use new information while recognizing risks from estimating recent recruitments using limited data.

Allowable Biological Catch (ABC) and Optimum Yield (OY) for 2004 were higher than in 2003. ABC (Fmsy proxy at F50%) was lower than OY (80% probability of rebuilding to Bmsy by 2047) due to different time scales. The high 2000 age 1 recruitment would not greatly affect biomass available to the fishery in 2004, but would increase ability to rebuild the stock by 2047.

Three sources of uncertainty affected fixed values or model structure and were therefore beyond the scope of an update. Age data produced for this update had different aging error and possibly aging bias than did earlier age data. Also, newly published indirect estimates suggest darkblotched rockfish natural mortality is higher than the value assumed in the model (Gunderson et al. 2003). Finally, NWFSC slope survey data from 1999-2002 were not included in this update. Those data were not combined with AFSC slope survey data because the two sources had different length compositions and trends for years with data from both sources. Exploratory models with either higher natural mortality or the NWFSC survey as a separate index increased spawning biomass relative to unfished levels. In both cases, however, the models fit extremely high 2000 recruitments and very low early recruitments.

For more information, contact Dr. Jean Rogers at (541) 867- 0535, Jean.Rogers@noaa.gov.

3) Sablefish

West Coast

a) Research

Depth Distribution of Sablefish. This year's main objective was to determine if the sablefish existed outside the usual range of the trawl survey. Specifically, we sought to investigate the areas of pinnacles and slopes that exist outside the first 700 fathom contour but would still be shallow enough to sample with standard trawl gear (700 fathom). If sablefish did exist on these pinnacles our goal would be to determine the relative densities of those fish and to further determine if those fish where different than those sampled by the trawl survey with respect to length, age, and sex ratio.

During Leg 1 (July 7-14, 2003) pot gear was set at 12 stations sampled by the trawl survey. Pot sets were made within 48 hours and between one quarter and one half miles from the trawl site. These stations are collectively referred to as "inside" stations. During Leg 2 (July 18-25, 2003) pot gear was set at 12 stations outside the usual range of the trawl survey (west of the first 700 fathom contour) at station located on the tops and slopes of topographic features that are referred to as pinnacles. These stations are collectively referred to as "outside" stations.
Station depths sampled by both gear types (inside) were similar to those sampled by only the pot gear (outside). As all stations were 700 fathom, in theory all should be trawlable gear. However, factors such as bottom hardness could render some outside stations untrawlable. Mean individual weight of sablefish was lower at the inside stations (1.83 kilograms) than at the outside stations (2.92 kilograms). Mean density of sablefish by numbers (mean number of fish-per-pot) was slightly higher at the inside station (14.4 fish-per-pot) than at the outside stations (10.0 fish-per-pot). Mean density of sablefish by weight (mean weight of fish-per-pot) was slightly higher at the inside station (25.4 kilograms-per-pot) than at the outside stations (23.1 kilograms-per-pot). Sex ratios by station departed from 50:50 much more so at the outside stations than at the inside stations. Sex ratio was not dependent on depth at the inside stations but highly dependent on depth at the outside stations. Caches tended to be biased towards males at the tops of the pinnacles while catches made on the adjoining slopes tended to biased towards females. Catches dominated by females were of lower density than those dominated by males.

Sablefish densities at the inside stations were very similar to those at the outside stations. Sablefish caught at the outside stations were larger in size and more distributed by sex than those caught at the inside stations. While it is apparent that the trawl survey is missing this segment of the population, it has yet to be seen whether or not these fish remain unaccounted for in "virtual population" that is created in the assessment model. In Leg 3 we will again sample stations that the trawl gear samples (different stations than Leg 1). In Leg 4 we will sample the same stations as in Leg 2 in an effort to determine if the density of sablefish changes and whether or not the sex-based segregation remains in tact.

For more information, contact Dr. Michael Schirripa at (541) 867-0536, Michael.Schirripa@noaa.gov.

Changes in sablefish *(Anoplopoma fimbria*) Recruitment in Relation to Oceanographic Conditions. Sablefish (*Anoplopoma fimbria*) range from the southern west coast of the United States, north to Alaska, the Bering Sea, and west to Japan. The species supports substantial fisheries in both the east and west Pacific Ocean. Juvenile recruitment along the west coast of the continental United States has been highly variable over the past three decades. Examining the estimates of spawning stock biomass from extensive surveys made over this same period point to the fact that factors external to the sablefish population dynamics have significant effects on population level recruitment. Using a General Additive Model (GAM), we demonstrate that there are physical oceanographic variables that significantly interact with sablefish recruitment. Significant relations were found between juvenile recruitment and northward Ekman transport, eastward Ekman transport, and sea level during key times and at key locations within the habitat of this species. The overall model explains nearly 70 percent of the variability in sablefish recruitment between the years 1974 and 2000. Bootstrapping techniques were applied to the parameter estimates and the resulting distributions were found to support the modeling assumptions of normality. Given the above model, it is possible to draw preliminary conclusions concerning year class strength of cohorts not yet available to the survey gear as well as historic year class strengths.

For more information, contact Dr. Michael Schirripa at (541) 867-0536, Michael.Schirripa@noaa.gov.

4) Pacific Hake

West Coast

a) Research

US-Canada Hake/Whiting Working Group
In 2003, a joint U.S.-Canada acoustic survey of coastal Pacific hake was completed. Scientist teams from both the U.S. and Canada participated on all legs of the cruise that was conducted aboard the vessel CCGS W.E. Ricker from 29 June to 1 September 2003, covering the length of the west coast from south of Monterey California to the Dixon Entrance area. A total of 119 line transects were completed. During the acoustic survey, aggregations of hake were found along the continental shelf break from just north of San Francisco Bay to Queen Charlotte Sound. Peak concentrations of hake were observed north of Cape Mendocino, California, in the area spanning the US-Canadian border off Cape Flattery and La Perouse Bank, and in Queen Charlotte Sound. As revealed by the associated midwater and bottom trawl samples, the majority of the coastal stock is currently dominated by the 1999 year-class (age 4). Our understanding of the level of abundance of Pacific hake was changed by the 2003 biomass estimate and subsequent assessment. The previous hake assessment in 2002, estimated spawning stock size to be at 20% of unfished in 2001. Because the stock was estimated to be below B25%, Pacific

hake were declared overfished in 2001. New information in the 2003 assessment includes fishery age composition in 2002 and 2003, but more importantly, the results of the 2003 acoustic survey. The increase in biomass in the 2003 acoustic survey and the dominance of the 1999 year class in both fishery and survey data suggest that the 1999 year class is even higher than previously estimated.

Also, on November 21, 2003, U.S. and Canada signed an agreement that allocates a set percentage of the Pacific whiting catch to American and Canadian fishermen over the next decade. In this agreement, a Joint Technical Committee (JTC) will be established, as well as a Scientific Review Group (SRG) to provide independent peer review of the work of the JTC. These technical working groups would replace the historical working and STAR/PSARC groups -- the agreement is now in review by each government for ratification.

For more information, contact Guy Fleischer at (206) 860-3289, Guy.Fleischer@noaa.gov.

Analysis of Variable Annual Growth in Pacific Hake, *Merluccius productus*. Past El Niño Southern Oscillation (ENSO) events have affected populations across tropic levels in the northeastern Pacific Ocean (Barber and Chavez 1983). Understanding these past environmental variations and their effect on the growth of Pacific hake is necessary for management to make informed decisions. Fish otoliths contain chronological records of environmental histories experienced at the individual level, and we assume that otolith growth increments can be used as a proxy for somatic growth. Therefore, otoliths can be used to correlate past environmental variations to fish growth. The 1983 ENSO event was very strong and was associated with reduced otolith growth increments in Pacific hake (MacLellan and Saunders 1995). The objective of this study was to determine if a similar reduction in growth occurred during the 1997 ENSO event, which was comparable in strength and duration to the one of 1983.

b) Stock Assessment

The coastal population of Pacific hake (*Merluccius productus*, also called Pacific whiting) was assessed in February 2004 using an age-structured assessment model. The U.S. and Canadian fisheries were treated as distinct fisheries. The primary indicator of stock abundance is the acoustic survey, and a midwater trawl juvenile survey provides an indicator of recruitment. New data in this assessment included updated catch at age through 2003, recruitment indices from the juvenile survey in 2003, and results from the U.S./Canadian acoustic survey conducted in summer of 2003. Based on the new acoustic survey and updated data, the strength of the 1999 year class and consequently mature female spawning biomass was greater than previously estimated in the 2002 assessment. The current assessment results reflect uncertainty that is represented by a range of biomass. The lower biomass end of the range is based upon the conventional assumption that the acoustic survey catchability coefficient, Q=1.0, while the higher end of the range represents the Q=0.6 assumption.

The coastal stock of Pacific hake in 2003 was estimated to range from 2.6 to 4.0 million mt (age 3+ biomass) for the Q=1.0 and Q=0.6 model scenarios, respectively. Stock biomass increased to a historical high in 1987 due to exceptionally large 1980 and 1984 year classes, and then it declined as these year classes passed through the population and were replaced by more moderate year classes. Stock size stabilized briefly from 1995-1997, but then it declined continuously to its lowest point in 2001. Since 2001, stock biomass has increased substantially as the strong 1999 year class has entered the population. The mature female biomass in 2003 was estimated to range from 47% to 49% (Q=1.0 and Q=0.6) of an unfished stock. Thus the stock can be considered to be rebuilt to the target level of abundance only 3 years after reaching a low level that resulted in the depleted (overfished) determination. The hindcast estimation of biomass in 2001 remains near, but slightly above, the depleted level (25% of the unfished level). The coastwide ABC and OY for 2004 are estimated to be 501,000 mt and 740,000 mt (Q=1.0 and Q=0.6) based upon a F40% harvest rate and 416,000 mt and 630,000 mt (Q=1.0 and Q=0.6) based upon the F45% harvest rate. With biomass above 40% unfished biomass level, the 40:10 OY adjustment would not be applied. Projections beyond 2004 are for a decline in stock biomass and ABC-OY as the 1999 year class passes through its age of peak abundance. At this time there is no evidence of sufficiently large recruitments after 1999 to maintain the stock at a high abundance level. By 2006, the spawning stock biomass is projected to again decline to near the depleted threshold (25% unfished). Such a rapid increase and subsequent decrease in stock abundance and potential yield is to be expected for a stock with such extreme fluctuations in recruitment. A new examination of the harvest policy that takes into account this variability is recommended for this highly fluctuating stock.

The hake assessment is highly dependent on acoustic survey estimates of abundance. Since 1993, the assessment has relied primarily on an absolute biomass estimate from the joint US-Canadian acoustic survey. The acoustic target strength of Pacific hake, used to scale acoustic data to biomass, is based on a small number of *in situ* observations. While the fit to the acoustic survey time series has improved with revision of the survey biomass estimates (1977-1992) these are still uncertain with poor fits in some years. Large fluctuations in the most recent estimates of recruitment and biomass (2001) are not entirely unexpected given the high uncertainty in terminal year estimates. This is because the information content regarding the 1999 year class, in particular, was only present as age 2 fish in the 2001 fishery and acoustic survey age compositions, and coupled with the relatively low acoustic survey biomass in 2001 produced lower estimates. The addition of new information regarding fishery and survey age compositions, along with the 2003 survey biomass estimate, decreases the level of uncertainty about this year class.

Uncertainty in the assessment result is characterized in terms of variability in model parameters and in terms of the assumption regarding the acoustic survey catchability coefficient, Q. All past assessment results and recommendations have been based upon fixing the acoustic survey Q=1.0; thus asserting that the acoustic survey estimate of biomass is an absolute measure of biomass and not just a relative measure. The past several assessments have explored relaxation of this assumption, but final results have been based upon the Q=1.0 scenario. The ability to relax the Q=1.0 assumption in this

year's assessment is based upon: 1) continued lengthening of the acoustic survey time series, thus allowing the survey to be treated as an index of relative abundance in the model; 2) relatively better model fits to the data when Q is less than 1.0; and 3) high quality of expertise in the STAR Panel to allow critical examination of the Q=1.0 assertion. Uncertainty in the final model result is therefore represented by a range of biomass. The lower biomass end of the range is based upon the conventional assumption that the acoustic survey catchability coefficient, Q=1.0, while the higher end of the range represents the Q=0.6 assumption. Even lower Q values are indicated by some model runs, but these are considered by the STAT team and STAR panel to be implausibly low. Future assessments may be able to explore alternative model configurations that could provide more insight on which aspect of the data lead to the low Q estimates.
The relative probability of the range of plausible Q levels was discussed extensively at the STAR. The two endpoints are considered as less likely than intermediate points and an equal blending of results from the two endpoints is not unreasonable.

Acoustic Survey Recommendations:

1. a) Determine whether there are differences in survey performance between the WE Ricker & Miller Freeman. These include differences in mid-water and bottom trawl efficiency as well as differences in acoustic capabilities between the vessels. Analyze the available data to determine if we can continue to accept the null hypothesis that there is no difference in survey performance between these vessels;

   b) Perform a detailed meta-analysis across all survey years: compare spatial distributions of hake across all years and between bottom trawl and acoustic surveys to estimate changes in catchability/availability across years;

   c) Generate appropriate estimates of variability for every survey year; and

   d) Review the methods used to estimate proportions at age for the acoustic survey with

2. Estimation of Target Strength
   a) Evaluate the current target strength for possible biases, particularly the use of nighttime experiments which are applied to daytime survey transects. Explore alternative methods for estimating target strength;

   b) Assess the value of the recent Canadian hake target strength observations and, if these are assessed to be useable, add these into the target strength model; and

   c) Commission the acquisition of additional in-situ observations to increase the model sample size.

For more information, contact Thomas Helser at (206) 302-2435, Thomas.Helser@noaa.gov.

5) Estimates of Pacific Halibut Bycatch and Mortality in IPHC Area 2A in 2002

West Coast

a) Research

The estimate of Pacific halibut bycatch and mortality in the bottom trawl fishery was updated through the calendar year 2002. The estimate of halibut bycatch and mortality in the bottom trawl fishery is based upon the method developed in the report for 1999 (Wallace, 2000). The 2002 analysis uses halibut bycatch rates observed from 31 August 2001 thru 28 August 2002 in the West Coast Groundfish Observer Program. These rates are stratified by season, depth, latitude, and level of arrowtooth flounder catch, and then multiplied by the amount of trawl effort in each stratum determined from Oregon and Washington trawl logbooks in 2002. Estimated halibut bycatch and mortality in other gear types was not updated for 2002.

For more information, contact John Wallace at (206) 860-3456, John.Wallace@noaa.gov.

6) Pacific Mackerel and Sardines

West Coast

a) Research

Pacific mackerel, jack mackerel, and Pacific sardine are seasonally abundant off Oregon and Washington. Sardines presently support a purse-seine fishery off N Oregon/SW Washington and spawn off the Northwest in summer. Presently, fish catches from the NOAA Fisheries/BPA Columbia River Plume surface trawling surveys and Predator/Baitfish surveys off the Columbia River are being used as annual relative indices of abundance. Ocean temperatures and currents appear to play an important role in sardine and mackerel distribution and abundance. The Fish Ecology (FE) division is working with the SWFSC to develop a coast-wide estimate of Pacific sardine abundance.

Pelagic trawl surveys off Oregon/Washington indicate that northern anchovy are now relatively abundant and there have been commercial landings. The increased abundance appears to be linked to cooler ocean conditions that started in 1999. The abundance of northern anchovy and other forage fishes may be partly responsible for the recent increases in the salmonid marine survival and subsequent improved adult runs.

For more information, contact Robert Emmett at Robert.Emmett@noaa.gov, (541) 867-0109.

D. Other Related Studies

1) Age, Growth and Maturity of Longnose Skate, *Raja rhina*, from the U.S.

West Coast

The two greatest accomplishments made since September include the optimization of an ageing technique and finding a reliable source for monthly samples of longnose skates. In order to arrive at a satisfactory procedure, several different methodologies were tested on centra which had been collected during the summer of 2002, on the West Coast slope survey. All of these methods were used to age vertebral centra of other elasmobranch species in the past. The preparation tests varied in several of the following respects: 1) the chemical(s) used to stain the age structure (which helps clarify the bands), 2) the part of the centrum which is stained (half-section, thin-section, or exterior of a whole centrum), 3) soak time in the stain, and 4) concentration of stain solution. Also tested were the difference between thin-sections, which were soaked in ethanol before being stained, and thin-sections which were not. Soaking in ethanol has been shown to help clarify the growth bands in otolith age structures, and is a common practice.

The results of these tests were presented in a poster at the Western Groundfish Conference, attended during the week of February 9-13, 2004 in Victoria, B.C. At the conference, I was able to meet with a few more of the skate species experts from Moss Landing Marine Lab (MLML), as well as a few people studying skate species found off the coast of Canada and in the Bering Sea.

Living in Newport has also facilitated the collection of monthly samples (25 individuals per month) from the docks, which are needed for the age validation portion of my research. The employees at Pacific Shrimp seafood plant trust me, and have been willing to give me full access to their skates. Since I do not do any damage to the pectoral fins in my sampling, which is the only meat from the animal that is used, I simply put the skates back on ice when I am done with them. I have now collected samples for the months of November, January, February and March. Therefore, it looks as though I will be collecting these samples through October 2003.

For further information, contact Josie Thompson at (541) 867-0520, Josie.Thompson@noaa.gov.

2) At-sea Hake Observer Program

The at-sea hake observer program continued to deploy observers to collect total catch and species composition data on the at-sea hake motherships and catcher-processors. The vessels fish in waters from the Canadian border to Northern California. A class of 22 observers was briefed from May 7th to 9th. All participating vessels in the 2003 fishery carried two observers and fished from May 15th to October. Over 98% of all the hauls were sampled by observers.

The observer program is run entirely by NWFSC FRAM D staff. However, as all of these vessels also participate in the Alaskan fisheries, they already have an observer data transmission system (ATLAS) on board. Also, the data collection protocols followed by the observers are those utilized by the North Pacific Groundfish Observer Program. Therefore, because of the assistance provided by the North Pacific Groundfish Observer Program, the collected data is stored on AFSC's computer system (NORPac) and observers use the gear similar to that issued to observers deployed in the North Pacific.

The goals of the program are to collect:
1) Total catch data,
2) Species composition of the catch,
3) Biological samples of hake, rockfish bycatch, prohibited species and protected species.

The Northwest Regional Office uses the observer catch data for in-season management of the at-sea hake fishery. In addition, stock assessment scientists use the collected hake biological samples for use in hake assessments.
For more information, contact Vanessa Tuttle at (206) 860-3479, Vanessa.Tuttle@noaa.gov.

3) Bycatch Modeling

In 2001, a model was developed within FRAM for purposes of projecting groundfish trawl catch of target species, and associated bycatch of several groundfish species that have been listed as overfished and are subject to rebuilding plans. During 2003, data collected from the trawl fleet during the first year of observation by the WCGOP were incorporated into the model. Bycatch rates were calculated for species under rebuilding plans, relative to the retention of target species. These rates were then applied to projected target species landings within the model in order to calculate bycatch mortality. Additionally, for pre-season modeling management options for the 2004 fishery, discard rates for major target species were also derived from the observer data and integrated into the model. The availability of WCGOP data represents a major step forward in the ability to accurately estimate total mortalities for both bycatch and target species, under the current management regime.

For more information, contact Dr. Jim Hastie at (206) 860-3412, Jim.Hastie@noaa.gov.

4) Comparison of Submersible Surveys on Heceta Bank, Oregon: Changes in Groundfish Populations after a Decade

This project is part of a larger ongoing study of groundfish habitat on Heceta Bank. This has been an interdisciplinary project involving Waldo Wakefield (NWFSC FRAM Division), Brian Tissot (Washington State University Vancouver), Mark Hixon (Oregon State University), David Stein (NOAA OAR), William Barss (ODFW Newport), Mary Yoklavich (SWFSC Santa Cruz), and Julia Clemons (NWFSC FRAM Division).

During Fall 2002, a major submersible dive series was completed on Heceta Bank, Oregon with the Delta submersible. The purpose of this project was to conduct a comparison of habitat-specific densities for groundfish inhabiting the Bank between surveys completed in the late 1980's and the present (2002). Considerable effort was employed to duplicate the original survey to reduce bias. The survey followed the historical methodologies, utilized the same submersible, took place during the same season (September), shared some of the original pilots, and was restricted to the original observers (Hixon, Stein, and Barss). These data were worked up in 2003 and are being incorporated into posters and talks that will be presented at conferences in 2004. Following is a brief overview of some results from that work.

The density of numerically dominant and commercially important fishes within different habitat types was examined for statistically significant changes between periods to determine long-term trends. The abundance of many species in 2002 fell within the range of interannual variation displayed in 1988-1990. However, a few species declined and other species increased in abundance in 2002 relative to earlier surveys. These abundance patterns will be examined in relation to the spatially explicit intensity of fishing on and near our survey sites derived from trawling records and with the AFSC and NWFSC trawl surveys.

For more information, contact Waldo Wakefield at (541) 867-0542, Waldo.Wakefield@noaa.gov, or Brian Tissot at tissot@vancouver.wsu.edu.

5) Cooperative Ageing Unit

The NWFSC continues its collaborative effort with Oregon Department of Fish and Wildlife and the Pacific States Marine Fisheries Commission to maintain a laboratory dedicated to the ageing of west coast groundfish. In 2003, Oregon Department of Fish and Wildlife withdrew from the role of officially supervising the lab and the vacancy was filled by Mr. Patrick McDonald of Pacific States Marine Fisheries Commission. From August 2003 to January 2004 12,561 otoliths were aged by the Cooperate Ageing Project. The species and number of associated otoliths aged for this reporting period include; Pacific hake Merluccius productus (5759), darkblotched rockfish Sebastes crameri (1996), sablefish Anoplopoma fimbria (1933), Dover sole Microstomus pacificus (1841), Pacific Ocean perch S. alutus (723), Canary rockfish S. pinniger (291) and blackgill rockfish S. melanostomus (18). The total number of otoliths aged includes production (7795), training (1400), double read (2842) and research related ageing (724).

The only stock assessment for which production ageing directly supported for this reporting period was for Pacific hake (whiting). The otoliths aged for this assessment account for 45.8% of the total (12,561) otoliths aged. An otolith exchange with the ageing lab in Naniamo Canada was completed and analyzed. An interlab workshop is planned to take place in the upcoming 2004 Committee of Age Reading Experts conference to further increase precision and reduce bias between the two labs.

Darkblotched rockfish otoliths from the 1995, 1998 and 2001 federal shelf surveys were re-examined and re-aged. It was determined that the 1995 and 1998 surveys were aged using an inconsistent criteria compared to the 2001 survey.
Production age reading has been lower than normal due to several factors: 1) Non-assessment year has allowed for individuals to perform age related research in collaboration with NMFS personnel. Research performed will contribute to future stock assessments; 2) Re-ageing of darkblotched rockfish from three federal surveys was very time consuming for our darkblotched rockfish lead ager; 3) Our four newest age readers are continuing to learn and gain experience in age reading. This means that more time than normal has been allowed for training purposes; and 4) The Pacific hake (whiting) ageing manual that is to be incorporated into the Committee of Age Reading Experts groundfish-ageing manual was not completed. The completion date has been pushed back. There are two reasons for this: 1) The individual responsible for completing the Pacific hake (whiting) ageing manual was promoted to supervisor and has had less time to commit to the project, and 2) The collaborating author in Canada has had additional priorities that have precluded her from committing the time necessary to finish as well.

Titles of presented work not mentioned previously in this document include:

1. The Percentage of Misidentified Blackgill Rockfish Otoliths in Darkblotched Rockfish Otolith Collections for Years 2000, 2001 and 2002.
2. Difficulty of Age Determination of Pacific hake (Merluccius productus), Pacific Ocean perch (Sebastes alutus) and Sablefish (Anoplopoma fimbria).
3. Using Marginal Increment Analysis to Validate the Periodicity of Annulus Formation in Dover sole, Microstomus pacificus. Poster presentation (2004 Western Groundfish Conference).

For further information, contact Michael Schirripa at (541) 867-0536, Michael.Schirripa@noaa.gov, or Patrick McDonald at (541) 867-0513, Patrick.J.McDonald@noaa.gov.

6) Cooperative Resource Surveys

The NWFSC conducted its sixth annual bottom trawl resource survey for groundfish off the coasts of Washington, Oregon, and California. The objective of the 2003 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, Blue Horizon*, and *Captain Jack* were contracted to survey the area from Cape Flattery, WA to the Mexican border in Southern California, beginning in the later part of June and continuing through the third week of October.

Each vessel was chartered for eight weeks with vessels operating in pairs, along the coast. The survey followed a stratified random sampling scheme with 15-minute tows at randomly selected depths. The depth strata were: shallow (30-100 fms), middle (100-300 fms), and deep (300-700 fms). The sample design consisted of 620 sampling locations, with 170 on the shelf (30-100 fms) and 450 on the slope (100-700 fms). Each of the four vessels occupied a different subset of 155 cell sites.

In 2003, we also converted to a new data collection system, using new software applications, new hardware, and wireless networking. Newly established NOAA national bottom trawl protocols were used throughout the survey. As in prior years, a series of special research projects were undertaken in cooperation with other NOAA groups and various Universities.

For more information, contact Aimee Keller at (206) 860-3460, Aimee.Keller@noaa.gov.

7) Economics Research Program

During 2003, the NWFSC economics program focused on providing economic analyses related to developing and implementing of fisheries management regimes that comply with the Sustainable Fisheries Act (SFA). The program also provided technical support for the National Marine Fisheries Service's Northwest Region office and the Pacific Fishery Management Council. The program also addresses requirements of the Regulatory Flexibility Act, including community impact analyses of proposed and alternative management options. During 2003, the NWFSC began an effort to collect data that will be used to estimate the economic value of recreational, groundfish fishing off the Pacific Coast. The data will be collected in 2004-2005 and the results of the study are expected to be completed in 2005. Additionally plans were initiated during 2003 for the development of a new survey to collect cost and earnings information from several components of the commercial fishing fleet operating off the Pacific Coast. A major focus of this effort will be the groundfish trawl fleet. Collection of data and development of models during 2004-2005 are expected to improve the ability to quantify the status of, and changes to, the economic health of the trawl fleet. These data will provide an important benchmark, revealing conditions existing prior to the implementation of a permit buyback in late 2003.

For more information, contact Dr. Jim Hastie at Jim.Hastie@noaa.gov, (206) 860-3412.

8) Fish/Habitat Associations

Over the past decade a number of regional interdisciplinary groups have come together to apply innovative approaches to the study of fish habitats. The formation of these interdisciplinary groups was a bottom-up phenomenon encouraged by technological advances, and funded and facilitated by NOAA's National Undersea Research Program and parallel support in Canada. In general, these groups have linked the fields of marine geology and fisheries science to study the habitat ecology of commercially-important species of fish.

The NWFSC FRAM Division has formed an interdisciplinary team with the Southwest Fisheries Science Center Santa Cruz Lab, Pacific Marine Environmental Laboratory, Oregon State University, Washington State University Vancouver, and a host of other government, academic, and private institutions. Heceta Bank, Oregon has been the focus for this group's research, although recently the team has expanded the geographic boundaries to include a larger portion of the shelf break off central Oregon.

Heceta Bank is the largest of the heavily fished rocky banks on the outer continental shelf off Oregon. Since the late 1980's this bank has been a primary focus of groundfish habitat investigations. The first phase (1987-90) used submersible transects to establish relationships between seafloor habitats and the distribution of rockfish (genus *Sebastes*) and other populations of demersal fishes and epibenthic invertebrates. A second phase began after a comprehensive multibeam survey was completed in 1998. The data from the 1980's submersible dives were retrofitted onto the multibeam grid using GIS techniques and extrapolated to broader areas of the bank using the new imagery. This work was completed in the spring of 2000 (OSU Masters Thesis completed by Nicole Nasby, and manuscript published in 2002 in Fishery Bulletin, Nasby et al., Fish. Bull., 100:739-751). The third phase of the study represents an on-going NOAA NURP program with additional support from NOAA's Office of Ocean Exploration to conduct an interdisciplinary and comprehensive study of the Bank's habitats using state-of-the-art survey strategies, instrumentation, and data analysis.

The project focuses on the following questions:

1) At what scales are there quantifiable relationships between groundfish populations and morphology/texture?
2) What are the factors that control these relationships?
3) What changes have occurred in the fish populations and habitat after a decade? And
4) What is the likelihood of the existence of natural refugia on the Bank?

During the summer of 2000 and 2001 a diverse team of marine geologists, fisheries scientists, invertebrate biologists and ecologists, conservation biologists, commercial fisherman and educators participated in two cruises at Heceta Bank aboard the R/V Ronald Brown with the ROPOS remotely operated vehicle (ROV) and two-person submersible Delta (in 2000 only). The ROV and submersible were used to explore and intensively sample five of the original six transect stations in addition to extensive transects over new areas identified on the seafloor imagery.

ROPOS completed twenty-one line transects, covering ~150 km of distance, to assess fish, invertebrate and habitat relationships and to ground-truth the multibeam topography and backscatter imagery data collected in 1998. The NWFSC FRAM Division and the Heceta Bank Project's research team completed the extraction of all of the fish and invertebrate counts from the extensive ROPOS ROV video in 2003. Habitat associations, the distribution of habitat types, and habitat-specific densities were determined for non-schooling species of demersal fishes for all primary habitat types observed. Preliminary

results from this study show: (1) Juvenile rockfish dominated the observed fish assemblages in rock ridge and boulder habitats with densities of ~1350 fish/ha. Cobble habitats were dominated by sharpchin rockfish (~2000 fish/ha) and fish densities in mud habitats were the lowest of all habitats with observed counts of flatfish (~400 fish/ha) and greenstriped rockfish (45 fish/ha) comprising the largest portion of those assemblages. In a related effort, four demersal fish habitats were mapped across the entire extent of the multibeam imagery collected in 1998 (OSU Masters Thesis completed by Curt E. Whitmire, and manuscript being developed). The next step is to extrapolate fish densities observed via submersibles to the larger geographic extent of these new habitat predictions.

These analyses are in preparation for a series of presentations to be given at conferences in 2004:

"Using Remote Sensing, In situ Observations, and Geographic Information Systems to Map Benthic Habitats at Heceta Bank, Oregon." Curt E. Whitmire, Robert Embley, W. Waldo Wakefield, Susan Merle, Brian Tissot, and Noelani Puniwai
"Fish habitat studies at Heceta Bank on the Oregon outer continental shelf." Julia E.R. Clemons, W. Waldo Wakefield, Robert W. Embley, Brian N. Tissot, Mary M. Yoklavich, Ted D. Hart, Susan G. Merle, Curt E. Whitmire, and William H. Barss

Some of the goals of the Heceta Bank Project and related projects, currently under development or funded, are:

1) Design of better stock assessment surveys;
2) Development of a more quantitative approach to mapping essential fish habitat for the U.S. EEZ;
3) Improvement in West Coast rockfish assessments; and
4) Incorporation of baseline data from this and related projects into the process of identifying habitat areas of particular concern and siting marine protected areas/reserves.

For more information, contact Waldo Wakefield at (541) 867-0542, Waldo.Wakefield @noaa.gov, or Julia Clemons at (541) 867-0539, Julia.Clemons@noaa.gov.

9) Habitat Requirements of Pacific Coast Groundfish Species - Update

The 1996 Sustainable Fisheries Act significantly amended the Magnuson-Stevens Act by requiring the Fishery Management Councils and the Secretary of Commerce, through the National Marine Fisheries Service (NMFS), to include provisions in fisheries management plans that describe, identify, conserve, and enhance essential fish habitat (EFH). In 1998 the NMFS recommended to the Pacific Fishery Management Council (PFMC) that the Pacific Coast Groundfish Management Plan be amended to include a limited number of composite EFHs for all Pacific Coast groundfish species and attach an appendix document to the amendment that describes the life histories and EFH designations for each of the 82 individual species included in the Fishery Management

Plan (FMP). This publication, titled "Essential Fish Habitat West Coast Groundfish Appendix" was prepared by Casillas et al. (1998).

The EFH regulations also indicate that the Councils and NMFS should periodically review and revise the EFH components of FMPs at least once every 5 years. Such review should include information regarding the description and identification of EFH, threats to EFH from fishing and non-fishing activities, and measures that could be taken to minimize those threats. In 2003 habitat requirements of the 82 groundfish species on the West Coast as previously described by Casillas et al. (1998) were updated. This most recent update of the "Appendix" was performed by conducting literature searches, and resulted in the identification of additional habitat associations for various life history stages of 70 of the species.

For more information, contact Bruce McCain at (541) 867-0523, Bruce.McCain@noaa.gov.

10) Samples and Data from Spiny Dogfish to Aid Stock Assessment and Demographic Analysis

The most recently published study of spiny dogfish (Squalus acanthias) from the West Coast of the U.S. is from 1954. Since then, Canadian scientists have validated an ageing method using second dorsal spines, but it has primarily been applied to dogfish in British Columbia. In order to understand the population dynamics and stock structure of spiny dogfish in U.S. waters and their links to the B.C. population (as well as those farther afield), age distributions, length and maturity at age data, and genetic information will be crucial. This species covers a remarkable range of habitat from Mexico to Alaska and nothing is known about genetic or demographic variation over this range.

In 2002, spines were collected from the NWFSC slope survey, but samples from the full range of depths will be necessary to have a complete and unbiased study of this species which has in previous surveys been more abundant in shallower waters on the shelf. At least three graduate students, Ian Taylor (stock assessment), Cindy Tribuzio (reproduction & development), and Nicole Vega (genetic & demographic variation) would benefit greatly from the data that would be result from this project.

For further information, contact Ian Taylor at (206) 221-6776, itaylor@u.washington.edu.

11) Science for Ecosystem-based Management Initiative

Current projects:

1. Using Leslie matrices to identify essential fish habitat. NMFS is required by statute to identify and protect habitat areas of particular concern (HAPCs)—subsets of EFH that are especially ecologically important, sensitive to human-induced environmental degradation, stressed by development activities, and/or rare. We seek to

develop of methodology that could be used nation-wide to designate and delineate HAPC.

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

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

2. Risk Analysis of West Coast Groundfishes. Many populations of marine fish have declined steeply over the last several decades. On the other hand, many populations have increased or remained stable. By applying the methodology of SEMI team member, Eli Holmes, we will conduct a standardized assessment of risks faced by groundfish on the continental shelf of the US Pacific coast. Using the same techniques of population viability analysis that have been used on Pacific salmon (as well as numerous other at-risk terrestrial and marine species), we will estimate population growth rates and the probability of reaching various conservation or management benchmarks (e.g. probability of 90% decline in 100 years, probability of rebuilding in 100 years, etc.). Additional analyses will illuminate what life history attributes are associated with high risk species. Our hope is that this work will serve as a "partial" assessment for a number of currently unassessed species.

For more information, contact Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov, or Kevin Piner at (858)546-5613, Kevin.Piner@noaa.gov, or Elizabeth Holmes at (206) 860-3369, Eli.Holmes@noaa.gov.

3. Impacts of fishing on marine community structure. Using food web models, we are examining a range of marine communities, varying in species richness, productivity, and fishing intensity, to determine how fishing has affected community structure and some basic ecosystem parameters. Our initial work suggests that incompatibilities exist between managing for sustainable fisheries versus managing for the health of coast ecosystems—2 of the missions of the NMFS. We are developing indices of "ecologically sustainable yield" based not on single-species fish population dynamics, but on systemic dynamics and NMFS ecosystem goals.

For more information, contact Chris Harvey at (206) 860-3228, Chris.Harvey@noaa.gov, or Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov, or Rich Zabel at (206) 860-3290 x166, Rich.Zabel@noaa.gov.

4. Role of *Spartina alterniflora* in estuarine food webs. We are studying the importance of *Spartina alterniflora*-derived organic matter in the food web of Willapa Bay on the coast of Washington. *S. alterniflora*, an exotic cordgrass native to eastern North America, has taken over substantial areas of Willapa Bay that were formerly mudflats or eelgrass beds. It dies back each fall, producing large amounts of detritus that may be an important component of the diets of filter feeders and scavengers. We are using stable isotope analysis to trace flows from various primary producers to oysters in both bays, in order to determine the importance of *S. alterniflora* in oyster diets and its affects on oyster growth. We will expand our analysis to other key consumers, such as juvenile groundfish and salmon

For more information, contact Chris Harvey at (206) 860-3228, Chris.Harvey@noaa.gov or Blake Feist at (206)860-3408, Blake.Feist@noaa.gov.

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

For more information, contact Nick Tolimieri at (206) 302-2444, Nick.Tolimieri@noaa.gov, or Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov, or Teresa Turk at (301)713-2328 x164, Teresa.Turk@noaa.gov.

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

interested in multi-species or community-level fisheries management plans, as opposed to single-species plans.

For more information, contact Chris Harvey at (206) 860-3228, Chris.Harvey@noaa.gov, or Nick Tolimieri at (206) 302-2444, Nick.Tolimieri@noaa.gov, or Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov, or Kevin Piner at (858)546-5613, Kevin.Piner@noaa.gov.

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

For more information, contact Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov, or Chris Harvey at (206) 860-3228, Chris.Harvey@noaa.gov.

Projects in the planning stage:

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

For more information, contact Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov, or Steve Katz at (206)860-3396, Steve.Katz@noaa.gov, or Guy Fleischer at (206) 860-3289, Guy.Fleischer@noaa.gov.

2. Influence of fisheries on coastal food web structure. Restricting or closing fisheries in MPAs has been shown to change the abundances of many species, including both

target and non-target organisms. The goal of MPA establishment is often to increase one or more ecologically desirable variables, such as total system biodiversity or standing stock biomass of one or more imperiled species. Less attention has been paid to how community or food web structure is affected by fisheries closures. This is a research topic that deserves more focus, especially given recent studies that cite massive, non-linear changes in communities that have been overfished, and the likely difficulty in reversing those changes. We plan to use stable isotope analysis to examine food web structure within and outside of regions with fisheries restrictions to determine if there are differences in basic food web parameters (e.g., food chain length, indexes of omnivory, importance of benthic vs. planktonic primary production). Scales of interest will be spatial (i.e., sites within MPAs vs. sites on a distance gradient away from the MPA, taking circulation patterns into account) and temporal (i.e., sites that recently were closed to fishing vs. sites that have been closed to fishing for longer periods of time).

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

Future collaborative projects we are developing:

1. Marine mammals. Dr. Alejandro Acevedo (Western Washington University), a marine mammal ecologist, has expressed interest in working with us. Possible projects would include how pinnipeds affect marine communities. This effort would be based on both empirical study and modeling efforts, including seal bioenergetics modeling and models of density-dependent predation on fish and other prey.

2. Groundfish otolith stable isotopes and microchemistry. Dr. Bill Peterson (University of Saskatoon) has expressed interest in working with us on analyzing the stable isotopes of annual growth rings in groundfish otoliths. The oxygen isotopic signatures in an annual ring should provide information about the temperature experienced by the fish, and the carbon signatures should provide information about the fish's diet. By examining these signatures, estimating growth based on the widths of the otolith annuli, and correlating these values with long-term oceanographic data, we may be able to determine how different groundfish species responded behaviorally, energetically, and ecologically to changes in climate. That is, the isotopes and growth patterns should reveal if different species moved to maintain preferred temperatures, if their growth patterns changed, and if their diet changed during times of climate anomalies.

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

12) Sea-truthing Modern Geophysical and Historic Geologic Data, Working Towards Establishing a Natural Disturbance Mosaic on the Pacific Northwest Margin

A damped gravity corer and seafloor imaging system has been developed as part of a cooperative research project between Oregon State University oceanographers (Rob Wheatcroft, Clare Reimers and Tony D'Andrea) and a NWFSC FRAM Division scientist (Waldo Wakefield). This coring device has been designed to be deployed from

commercial fishing vessels as part of a collaborative research program. OSUSSS is a new system that combines a hydraulically damped gravity corer and a video/digital still camera system. The corer collects high quality (i.e., sediment and pore-water intact) cores in coarse sand to mud, thereby permitting quantitative enumeration of benthic macroinvertebrates and high-resolution sediment properties, whereas the digital still camera yields data on epibenthic megafauna and seafloor structure (e.g., ripples, mounds, etc.). The OSUSSS will be used in projects to groundtruth the evolving database and GIS for Oregon and Washington habitats. It will also be used in new projects to examine the environmental effects of fishing. Following is a summary of accomplishments in 2003.

During a 2-week period in August of 2003, researchers from OSU/COAS and NMFS/NWFSC conducted a successful test cruise of the OSU/NOAA corer off central Oregon on board the F/V Watchman. The test cruise demonstrated clearly that: (1) high-quality images and sediment samples could be collected from a range of bottom types on the continental shelf and upper slope; (2) it is feasible to safely deploy and recover an advanced sampling package off a mid-sized commercial fishing vessel; and (3) collaborations between the fishing community and academic scientists can be quite fruitful.

Cara Fritz, OSU COAS Ph.D. student, working with Rob Wheatcroft and Waldo Wakefield, is working on her dissertation project to develop a natural vs. anthropogenic disturbance mosaic for the Pacific Northwest as part of her effort to provide insight into the impacts of trawling on benthic habitats. She will be presenting this work in a poster at the Western Groundfish Conference in 2004.

For more information, contact Rob Wheatcroft at (541) 737-3891, raw@coas.oregonstate.edu, or Waldo Wakefield at (541) 867-0542, Waldo.Wakefield@noaa.gov.

13) Stable Isotope and Dietary Studies of Demersal Fishes Off of Oregon and Washington

The combination of stable isotope studies with the analysis of feeding habits presents an effective tool for characterizing some of the dynamics of exploited marine ecosystems on both a species and a trophodynamic basis. This area of research began in earnest during the Ocean Exploration cruise to Astoria Canyon in 2001, when tissue samples from several species of rockfish were collected along with a suite of potential prey items to look at tropic relationships in and around the Canyon (Bosley et al. *In press*). This study specifically looked at several commercially-important rockfish species, and the findings indicated a significant amount of direct predation on other rockfish species was occurring. With this information, we expanded the research to include much of Washington and Oregon. During the summer of 2003, NOAA Fisheries conducted a trawl survey of demersal species inhabiting the continental shelf waters along the U.S. west coast. Tissue samples for isotopic analysis, and stomachs for characterizing feeding habits, were collected from several rockfish species to try to assess the degree of competition between species and trophic relationships. With yearly changes in harvest

limits, for instance, it is possible that we may be able to track changes in trophodynamics through continued, long-term studies such as these.

The new information from 2003 is currently being analyzed and will be presented in at least one international forum in 2004, the Quantitative Ecosystems Indicators in Fisheries Management meeting in Paris, France.

In addition to scientists from the NWFSC (Bosley, Brodeur and Wakefield), this research has included collaborations with two graduate students, Keri York (Washington State University, Vancouver) and Todd Miller (Oregon State University). For more information, contact Keith Bosley at (541) 867-0506, Keith.Bosley@noaa.gov, or Richard D. Brodeur at Rick.Brodeur@noaa.gov, or Waldo Wakefield at (541) 867-0542, Waldo.Wakefield@noaa.gov.

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

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

The goal of this program, begun in 2001, was to create and use a comprehensive, helpful and easily accessible, multi-layered GIS database and associated CD-ROM-based products for groundfish habitat assessment in the Pacific Northwest. The database for Oregon and Washington has been linked to an integrated habitat database for California (Gary Greene at Moss Landing Marine Laboratories and Mary Yoklavich at SWFSC Santa Cruz). For the first time, marine researchers working along the U.S. West Coast have an integrated map of structural habitat for the entire region (San Diego, CA to Cape Flattery, WA). In addition, the combined GIS database for California, Oregon and Washington is being used in the current Essential Fish Habitat Environmental Impact Statement for West Coast groundfish.

Version 1.0 of the maps for Oregon and Washington were completed in 2003. This release is entitled "Active Tectonics and Seafloor Mapping Laboratory Publication 02-01: Interim Seafloor Lithology Maps for Oregon and Washington Version 1.0". The interim habitat maps are now in use at the Northwest Fisheries Science Center. Investigators there are beginning to integrate fisheries data and benthic habitat data to look for associations, and to assess the state of existing benthic habitat data in terms of future needs. One such preliminary analysis will be presented at the Western Groundfish Conference in Victoria, BC in early February 2004:

"Relating high-resolution submersible observational data to regional trawl survey data – a work in progress." Curt E. Whitmire, W. Waldo Wakefield, Richard D. Methot, Brian N. Tissot, Allison Bailey, Levon Yengoyan, Chris Hansen.

The following section describes the basic elements incorporated in the initial version of the habitat maps:

The interim map captures the essential habitat classifications to be found offshore Oregon and Washington, but due to time constraints, lacks ground-truthing, cross checking, and some of the components of rock prediction. Since delivery of the interim maps, work has continued in 2003 on a second iteration of the habitat maps (Version 2) that will include detailed grain size mapping, fully cross-checked and ground-truthed rock prediction mapping, similar cross-checking, ground-truthing of lithologic data to resolve conflicts between datasets, and removal of artifacts. Version 2 will also include additional oil industry core samples from archives of the Minerals Management Service, as well as much more comprehensive interpretation of the sidescan datasets, quantitative classifications of bathymetry data, and will include significant new multibeam/backscatter datasets collected in 2002. In particular, under separate funding, 10 days of high-resolution multibeam mapping aboard the R/V Thomas Thompson was conducted. These data comprise 2 blocks on the Oregon slope, both adjacent to existing high-resolution surveys. These data increase the coverage of the Oregon upper slope between ~200-800 m by ~ 50%. Interpretation of these data will be included in the Version 2 release. Additional multibeam and backscatter data collected by NOAA on the Washington margin will also be interpreted and incorporated into bathymetry grids, and into the interpreted habitat layers in Version 2. Another significant task underway at present is the use of extensive submersible and ROV video data for ground-truthing the maps. These data are being used to verify and or modify the existing layers, and are particularly useful for calibrating the interpretation of sidescan datasets. Virtually all observational data are co-located with sidescan surveys, which were conducted for use during the dives.

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

15) West Coast Groundfish Observer Program

The West Coast Groundfish Observer Program began deploying observers in the summer of 2001. During 2003, the program continued to successfully deploy observers on commercial west coast groundfish vessels. The program is a cooperative agreement between NOAA Fisheries and Pacific States Marine Fisheries Commission (PSMFC). PSFMC has contracted the Seattle-based observer company, Alaskan Observers Inc., to provide qualified, bachelor degreed biologists to be trained as observers. Currently, there are 42 active observers stationed in ports along the coast from San Diego, California to Bellingham, Washington.

The goals of the program continue to be:

1. Estimation of total catch
2. Estimation of total discarded catch
3. Species composition of discarded catch
4. Collection of biological information

5. Provide a timely and efficient system for collection, storage, analysis and communication of collected data.

The program deploys observers on the bottom trawl fleet, the limited entry fixed gear fleet, open access fixed gear fleets that target groundfish, and ancillary fleets such as prawn and shrimp vessels. In addition to collecting the above information, observers also collect fishing effort data including position, depth and gear used. The data is recorded on weatherproof forms and entered into into a NMFS-designed database. The observer is debriefed and the data goes through a number of quality controls before it is released for summarization and analysis.

During 2003, the program summarized and performed final data quality checks to prepare the data collected from the second observation year of the groundfish bottom trawl fleet (Sept 2002-Aug 2003) and three observation years of the sablefish endorsed fixed gear fleet (Aug. 2002- Oct. 2003) for analysis. The results were presented in two reports and made available on-line early this year at: http://www.nwfsc.noaa.gov/research/divisions/fram/Observer/ . The data results were incorporated into a bycatch model for management use presented in the March 2004 Pacific Fishery Management Council meeting (see below).

In addition, the program collected all the at-sea data for the ODF&W-sponsored flatfish trawl EFP. It also aided CDF&G and WDF&W with data collection for the Scottish seine and arrowtooth EFPs, respectively. The program also expanded coverage in the California fixed gear fleets that target groundfish as well as some fleets that take groundfish as bycatch. The program also conducted a Small Boats Workshop in March 2003 to explore the limitations and restrictions of observing small boat fleets.

Coverage of the groundfish bottom trawl and fixed gear fleets will continue into 2004. Also, the program expects to expand coverage in the Oregon fleets permitted for nearshore species, rockfish and pink shrimp and continue coverage of similar small boat fleets in California.

For more information, contact Jonathan Cusick at (206) 302-2413, Jonathan.Cusick@noaa.gov.

Appendix 1. Reports and Publications

Able, K.W., Wakefield, W.W., Grassle, J.F., Petrecca, R.F., Vivian, D., Taghon, G., Glenn, S. 2003. Characterization of Substrates/Fish Habitats in the Vicinity of Beach Haven Ridge off Suthern New Jersey. *Inst. of Marine and Coastal Sciences Rutgers Univ. Tech. Report*. 100-19. 30 pp.

Bosley, K.L., D.A. Witting, R.C. Chambers and S.C. Wainright. 2002. Estimating turnover rates of carbon and nitrogen in recently metamorphosed winter flounder, *Pseudopleuronectes americanus*, with stable isotopes. Marine Ecology Progress Series. 236: 233-240.

Bosley, K.L., W. Lavelle, R.D. Brodeur, W.W. Wakefield, R.L. Emmett, E.T. Baker, K.M. Rehmke. *In press.* Feeding relationships among pelagic and benthic communities in relation to the hydrodynamics of Astoria Submarine Canyon, Oregon, USA. Journal of Marine Systems.

McCain, B.B., S.D. Miller, and W.W. Wakefield. 2004. A Pacific Coast Groundfish Habitat Use Relational Database. A CD produced by NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA, in cooperation with MRAG Americas, Inc., London, UK.

Orensanz, J.M., A.M. Parma, T.A.Turk, and J. Valero. Dynamics, Assessment and Management of Exploited Natural Populations. In: Scallops: Biology, Ecology and Aquaculture. Sandra Shumway, editor. Elsevier, Amsterdam. *In review*.

Rogers, J.B. 2003. Darkblotched rockfish (*Sebastes crameri*) 2003 stock status and rebuilding update. Status of the Pacific Coast Groundfish Fishery through 2003 and Recommended Acceptable Biological Catches for 2004, Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201

Rogers, Jean Beyer. 2003. Species Allocation of Sebastes and Sebastolobus sp. caught by foreign countries from 1965 through 1976 off Washington, Oregon, and California, USA. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-57, 117 p.

Stout, H.A., R.G. Gustafson, W. H. Lenarz, B.B. McCain, Donald M. VanDoornik, T.L. Builder, and R.D. Methot. Status review of Pacific herring (*Clupea pallasi*) in Puget Sound, Washington. NOAA Tech. Memo. NMFS-NWFSC-45. 175 pp.

Stout, H.A., B.B. McCain, R.D. Vetter, T.L. Builder, W. H. Lenarz, L.L. Johnson, R.D. Methot. Status review of the Copper rockfish (*Sebastes caurinus*), Quillback rockfish (*S. malinger*), and Brown rockfish (*S. auriculatus)* in Puget Sound, Washington. NOAA Tech. Memo. NMFS-NWFSC-46. 158 pp.

Turk, T.A. Spatial Distribution and Selected Habitat Preferences of Weathervane Scallops (*Patinopecten caurinus*) in Alaska. Spatial Processes and Management of Marine Populations. University of Alaska Sea Grant.

Turk, T.A, T. Builder, C.W. West, D.J. Kamikawa, J.R. Wallace, R.D. Methot, A.R. Bailey, K.L Bosley, A. J. Cook, E.L. Fruh, B.H. Horness, K. Piner, H.R. Sanborn and W.W. Wakefield. The 1998 Northwest Fisheries Science Center Pacific West Coast Upper Continental Slope Trawl Survey of Groundfish Resources. NOAA Technical Memorandum NMFS-NWFSC-50.

Whitmire, C.E. 2003. Using Remote Sensing, In situ Observations, and Geographic Information Systems to Map Benthic Habitats at Heceta Bank, Oregon. M.S. Thesis, Oregon State University, Corvallis, OR, USA, 61pp.

Yoklavich, M.M., C.B. Grimes, and W.W. Wakefield. 2003. Using laser line scan imaging technology to assess deepwater habitats in the Monterey Bay National Marine Sanctuary. Marine Technology Society Journal 37:18-25.

STATE OF ALASKA
GROUNDFISH FISHERIES

ASSOCIATED INVESTIGATIONS IN 2003

Prepared for the Forty-fifth Annual Meeting of the Technical Sub-committee of the Canada-United States Groundfish Committee

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With contributions from:
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April 2004

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION of COMMERCIAL FISHERIES & DIVISION of SPORT FISHERIES
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TABLE OF CONTENTS

State of Alaska Review of Agency Groundfish Research, Assessments, 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. North Pacific Fisheries Management Council (NPFMC) action in 1997 removed black and blue rockfish from the Gulf of Alaska FMP thus the state manages these species in both state and federal waters (of the GOA). The state also manages the lingcod resource in both state and federal waters of Alaska. Other groundfish fisheries in Alaskan waters are managed by the federal government, or in conjunction with federal management of the adjacent Exclusive Economic Zone (EEZ). The information related in this report is from the state-managed groundfish fisheries only.

The State of Alaska is divided into three maritime regions for marine commercial fisheries management. The Southeast Region extends from the Exclusive Economic Zone (Equi-distant line) boundary in Dixon Entrance north and westward to 144^{o} W. longitude and includes all of Yakutat Bay (Appendix II). This is a change from recent years when the Central Region began at 140^{o} W. longitude. The Central Region includes the internal waters of Prince William Sound (PWS), Cook Inlet, and Bristol Bay and the Outer District off the Kenai Peninsula. The Westward Region includes all territorial waters of the Gulf of Alaska 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, assistant project leader and 2 port biologists located there. Seasonal port samplers and data entry staff were employed in Petersburg, Ketchikan, Sitka, Craig and Douglas. The project also received biometrics assistance from the regional office in Douglas.

The Southeast Region's groundfish project has responsibility for research and management of all commercial groundfish resources in the territorial waters of the Eastern Gulf of Alaska as well as black and blue rockfishes and lingcod in the EEZ. The project cooperates with the federal government for management of the waters of the

adjacent EEZ. The project leader participates as a member of the North Pacific Fisheries Management Council's Gulf of Alaska Groundfish Plan Team and produces the annual stock assessment for demersal shelf rockfish for consideration by the North Pacific Fishery Management Council.

Project activities center on fisheries monitoring, resource assessment, and in-season management of the groundfish resources. In-season management decisions are based on data collected from the fisheries and resource assessment surveys. Primary tasks include fish ticket collection, editing, and data entry for both state and federal-managed fisheries; dockside sampling of sablefish, lingcod, Pacific cod, and rockfish landings; and skipper interview and logbook collection and data entry. Five resource assessment surveys were conducted during 2003. Funding for the Southeast Groundfish project comes from NOAA Grants NA16FN1273 and NA06F10074 and NA97FN0121, CFDA 11-407.

b. Central Region

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

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

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 seasonal age-determination unit biologist, two seasonal fish ticket processing technicians, and a seasonal dockside sampler. A full-time assistant area groundfish management biologist, a seasonal fish ticket processing technician, and a seasonal dockside sampler are located in the Dutch Harbor office. Seasonal dockside sampling also occurs in Chignik, Sand

Point, King Cove, and Adak. The R/V Resolution, R/V K-Hi-C, and R/V Instar are home ported in Kodiak and conduct a variety of groundfish related activities in the waters around Kodiak, the south side of the Alaska Peninsula, and in the eastern Aleutian Islands.

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

d. Headquarters

ADF&G personnel continued to collect, review, edit and amend, data capture, and archive all ADF&G fish tickets submitted to local offices. These tickets include those required as well as tickets voluntarily submitted by EEZ operators.

In 1997 ADF&G entered into a contract with the Pacific States Marine Fisheries Commission to expand previous data collection and management duties previously carried out under PACFIN. This new contract, which funds most of the ground fish fisheries data collection and analysis by ADF&G, is part of the Alaska Fisheries Information Network (AKFIN). It supports the enhancement of the fish ticket information collection effort including; GIS database development and fishery data analysis, catch and production database development and access, the age reading laboratory, database management and administration, Bering sea crab data collection and reporting, various fishery economic projects, fisheries information systems and regional fishery monitoring and data management.

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

e. Gene Conservation Laboratory

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

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 2003. Age structures from approximately 15,500 groundfish, 22 species, were received through statewide commercial and survey harvest sampling efforts and 13,309 age data were released back to managers. Additional structures were aged with release of data pending their review. The majority of funding for this project is through the Alaska Fisheries Information Network (federal), with a small degree (<5%) of general funding (state) and outside contract. Eleven people were employed for a total of 39 work months to age groundfish age structures or conduct associated work (sample preparation, data entry, archiving). Only one employee is funded year round. Other individuals are seasonal (employed for 1-8 months duration. In the present job-rich environment of ADFG, turnover of Fishery Biologist I/Age reader positions continues to seriously impact operations.

All Fishery Biologist I/Age Readers received additional training (basic or species-specific following initial training) during 2003. "Basic" training involves aging previously aged Southeast Alaska yelloweye rockfish samples. Readers are cleared for production status once their aging error has diminished to an acceptable level, generally achieved in 2-4mos. Species-specific training times can vary greatly: accomplishment of black rockfish pattern interpretation may be achieved in 2-4 weeks, while it may take 6 months of work on pollock or lingcod before sufficient age-range calibration and consistency therein is observed. Samples aged by readers-in-training are often 100% reaged by more experienced readers to ensure consistency in data.

Quality of age data is routinely assessed through second-reading 20% of the sample, either by the initial-reader or by a reader with equal or greater experience. Species-specific control limits are imposed and guide release of age data; transgression of control limits direct reviewing some or the entire sample.

The ADU completed review of age reading criteria for walleye pollock and reinstated production aging for this species effective June 2003. In year 2000 we had realized substantial differences in age determination of pollock between ADFG and an out of state federal aging lab, and suspended production aging while criteria were reviewed. Over 2000 pollock age data have since been released to managers. Additional work continues to document objective information to lend credibility to the reinterpretation of pollock growth patterns. Our data seem to reasonably suggest, with support of objective otolith measurements, that pollock are consistently and substantially older than what was previously aged. Other notable species with ongoing need for significant criteria

evaluation and documentation work are: pacific cod, sablefish, shortraker, rougheye, thornyhead, and lingcod (SEA). The goal for these is to better assess the correct species age range (for example, in pacific cod) or improve accuracy and precision (for the remaining species).

The ADU Oracle database AegIS, Age Information System, was deployed in 2003. It is presently utilized in importing and exporting data. It still requires substantial programming support to ensure integrity of data and to increase user facility.

Limited refinements to the ADU website (http://tagotoweb.adfg.state.ak.us/ADU/) were made.

2. Description of the State of Alaska recreational groundfish fishery program (Sport Fish Division)

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

Most management and research efforts are directed at halibut, rockfish, and lingcod, the primary species targeted by the recreational fishery. Statewide data collection programs include an annual mail survey to estimate overall harvest (in number) of halibut, rockfish, lingcod, and sharks, and a mandatory logbook to assess harvest of the same species in the charterboat fishery. The Deputy Director of the Division of Sport Fish (Rob Bentz), located in Juneau, takes the statewide lead in federal-state jurisdictional management issues.

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

a. Southeast Region Sport Fish

Regional staff in Douglas coordinates a data collection program for halibut and groundfish in conjunction with a region wide Chinook salmon harvest studies project. The project leader is Mike Jaenicke while assistant project biologists were also located in Ketchikan (Dennis Hubartt [retired as of October 2003 and replaced by Kathleen Wendt]) and in Juneau (Bruce White). The project biometrician (Steve Fleischman) is located in

Anchorage. About 20 technicians at major ports in the Southeast region interview both anglers and charter operators and then collect data from sport harvests of halibut and groundfish while also collecting data on sport harvests of salmon. Data collected on groundfish are limited to species composition, length of halibut and lingcod, and sex of lingcod; no otoliths or other age structures are collected. Data are provided to the Alaska Board of Fisheries, other ADF&G staff, the public, and a variety of other agencies such as the NPFMC.

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

b. Southcentral Region Sport Fish

The **Southcentral Region** groundfish staff consisted of the area management biologists and assistants for PWS and the North Gulf areas, Lower Cook Inlet, and Kodiak, Alaska Peninsula, and the Aleutian Islands. In addition, a region-wide harvest assessment project was based in the Homer office, consisting of a project leader, field supervisor, and six port samplers. The research project biometrician was located in Anchorage. Ongoing assessment of sport harvest and fishery characteristics at major ports throughout the region is the primary activity. Data are collected from harvested halibut, rockfishes, lingcod, and sharks, and anglers and charter boat operators are interviewed for fishery performance information. All age reading is done in Homer, and the staff are active participants in the Committee of Age Reading Experts (CARE). Seasonal technicians collected data from the sport harvest at seven major ports in the region, and two of them read all rockfish and lingcod age structures. Halibut otoliths collected in 2003 will be forwarded to the International Pacific Halibut Commission for age reading.

Southcentral region staff is responsible for management of groundfish fisheries in state and federal waters. For all species, the lack of stock assessment information has precluded development of abundance-based fishery objectives. As a result, management is based on building a long-term, sustainable regulatory framework specifying bag and possession limits, seasons, and methods and means. Inseason management action has generally been unnecessary.

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

B. By Species

1. Pacific Cod

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

a. Research

The **Westward Region** has continued the cod-tagging program that was initiated in 1997 in the Central and Western Gulf of Alaska. Approximately 1,500 fish were tagged in 2003, bringing the total number of tags released to11,300. By year's end, 664 tags had been recovered, 450 of them with useable recovery location information. Results to date show that while the vast majority of Pacific cod are recovered within 15 km of their tagging location, much longer recapture distances are possible. Several fish were recaptured more than 500 km from their tagging location. The relatively small number of long distance recaptures show movement of cod is occurring from the Shumagin Islands into the Bering Sea and from the Alaska Peninsula to Kodiak waters.

b. Stock Assessment

No stock assessment programs were active for Pacific cod during 2003.

c. Management

Regulations adopted by the Alaska Board of Fisheries during November 1993 established a guideline harvest range (GHR) of 340 to 567 mt for Pacific cod in the internal waters of **Southeast Alaska**. The GHR was based on average historic harvest levels rather than on a biomass-based ABC estimate.

Pacific cod 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 state water Pacific cod Management Plans for fisheries in 5 groundfish areas, Prince William Sound, Cook Inlet, Kodiak, Chignik and South Alaska Peninsula. Under these plans, participation is not restricted 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 Chignik, which has a regulatory opening date of March 1. The BOF restricted state fisheries to pot or jig gear in an effort to reduce crab bycatch. The guideline harvest levels (GHL) are allocated by gear type. The annual GHL's are based on the estimate of allowable biological catch (ABC) of Pacific cod as established by the NPFMC. The initial GHL's were set at 15% of the Western Gulf ABC to be reserved for the South Alaska Peninsula Area, 15% 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.

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

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

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

d. Fisheries

Most of the Pacific cod harvested in Southeast Alaska, and the North Gulf District of the Cook Inlet Area is taken by longline gear during the parallel season. Pots have been the dominant gear in the Cook Inlet District and in the Prince William Sound area. Overall Pacific cod harvest from the Cook Inlet and PWS areas during the parallel season has declined in recent years. In the Westward Region, trawl gear takes over 60% of the harvest, with the remainder split between longline, jig, and pot gear. Prior to 1993 much of the cod taken in Southeast was utilized as bait in fisheries for other species. Pacific cod harvested since that time is roughly evenly divided between bait use and human consumption. In other areas of the state, Pacific cod are harvested in both state and federal waters and utilized primarily as food fish. Harvests of Pacific cod totaled 175 mt in the Southeast state-managed fishery during 2003, up 35% from the 2002 catch. The 2003 GHL's for the Cook Inlet and Prince William Sound state-managed Pacific cod harvest were originally set at 653 mt and 798 mt, respectively. Action by the Alaska Board of Fisheries during 2002 reduced the initial Pacific cod allocation for Prince William Sound from 25% to 10% of the Eastern Gulf ABC, effective May 14, 2003, thereby reducing the GHL to 320 mt. The Cook Inlet state-managed Pacific cod fishery achieved its GHL in 2003 and step up provisions will result in an increase to 3% of the Central Gulf ABC in subsequent years. Due to the low number of vessels making landings in the PWS Area in 2003, harvest figures remain confidential. Harvest from the Central Region state-managed Pacific cod fishery totaled 603 mt from Cook Inlet. There was no effort or harvest by pot or jig vessels in the PWS Area in 2002. Harvest from the 2003 state managed fishery in the Kodiak Area totaled 3,694 mt, while 2,028 mt of cod were harvested in the Chignik Area, and the South Alaska Peninsula Area harvest totaled 5,224 mt. The Kodiak and South Alaska Peninsula Areas obtained their maximum GHL 'step up' provisions for 2000 and all subsequent years. The Kodiak Area will receive 12.5% of the Central Gulf ABC and the South Alaska Peninsula will receive 25% of the Western Gulf ABC in

all future years. The Chignik Area achieved its maximum GHL 'step up in 2003. The Chignik Area will receive 8.75% of the Central Gulf ABC in 2004 and all future years. Cook Inlet will remain at its current percentages of the Federal TAC for 2004. The Alaska Board of Fisheries reduced the Prince William Sound Area Pacific cod allocation from 25% to 10% of the Eastern Gulf TAC beginning in 2003.

2. Rockfishes

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

a. Research

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

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

In the **Southeast Region** port sampling and the mandatory logbook program for rockfish fisheries continued in 2003. The logbook and interview programs are designed to furnish detailed catch and effort information, to estimate at-sea discards, and to obtain more detailed information regarding specific harvest location. The port-sampling program provides species composition from the landed catch and an opportunity to collect biological samples. Otoliths were obtained from principal demersal shelf rockfish species and black rockfish and sent to the age-reading laboratory in Juneau for age determination. Data from these programs is entered into a regional database. In 2003, 1,197 yelloweye, 542 quillback, and 409 black rockfish were sampled for age, weight, length, sex, and maturity (Contact Mike Vaughn).
Rockfish habitat mapping projects continue in the Southeast Region. The objective of this project is to continue a bottom-mapping project of the Eastern Gulf of Alaska to provide

detail on habitat characterization in this important fishing ground. To date ADF&G has mapped approximately 2100 km^2 of seafloor. This represents over 7% of the total habitat inside the 100-fm contour along the outer coast of Southeast. More importantly, over 980 km^2 of rocky habitat has been mapped, approximately 32% of what is estimated to occur. The 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.

In 2003 ADF&G obtained processed multibeam data collected by NOAA (R/V Rainier) in 2002 of the area surrounding Salisbury Sound. NOAA also provided bathymetry data from the Edgecumbe Pinnacles Marine Reserve Area, collected by the R/V Rainier in 2003. Habitat classification of the multibeam and backscatter data collected by ADF&G in 2002 of 219 km^2 of seafloor on Fairweather Ground and 41 km^2 of seafloor inside Yakutat Bay was finalized and used in the 2003 stock assessment for DSR. The submersible "Delta" was used in 2003 to ground-truth multibeam habitat mapping data collected on the East Bank of the Fairweather grounds in 2002.

Skipper interviews and port sampling of commercial rockfish deliveries in **Central Region** during 2003 occurred in Homer, Seward, Whittier, Anchorage and Cordova. Efforts during the first half of the year primarily sampled slope and species delivered as bycatch in other groundfish fisheries. During the last half of the year, sampling focused primarily on the directed jig fishery that targets pelagic rockfish. Additional sampling occurred during the Cook Inlet and PWS trawl and sablefish longline surveys. Sample data collected included date and location of harvest, species, length, weight, sex, and gonad condition. Otoliths were collected from most sampled fish. Homer office staff determined ages of pelagic and demersal rockfish otoliths. Otoliths from all other rockfish species were sent to the Age Determination Unit (contact Willy Dunne).

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

The **Westward Region** continued its port sampling of the commercial rockfish and Pacific cod harvests in 2002. Rockfish sampling consisted mainly of black rockfish

with opportunistic sampling of light duskies, dark duskies, and other miscellaneous *Sebastes* species. Skippers were interviewed for information on effort, location, and bycatch. Length, weight, gonadal maturity, and otolith samples were collected (contact Kally Spalinger or Carrie Worton). Staff from the Kodiak office is currently aging otoliths collected during the 2002 and 2003 seasons.

The **Westward Region** began several studies on Western Gulf of Alaska black rockfish. Monthly collections were made of female fish in an effort to determine reproductive seasonality and size of maturity. Hydroacoustic equipment was purchased and a training class was attended by several staff members in preparation for assessment work in the summer of 2004 (Contact Dan Urban).

The **Division of Sport Fish—Southeast Region** continued to collect catch and harvest data from rockfish as part of a marine harvest onsite survey program with rockfish harvests tabulated back to 1978 in some selected ports. Data collected in the program include statistics on effort, catch, and harvest of the primary rockfish species commonly taken by Southeast Alaska anglers. Ports sampled in 2003 included Juneau, Sitka, Craig/Klawock, Wrangell, Petersburg, Gustavus, Elfin Cove and Ketchikan. Primary species harvested in Southeast Alaska included yelloweye, black, and quillback rockfish (Contact: Mike Jaenicke).

The **Division of Sport Fish—Southcentral Region** continued collection of harvest and fishery information on rockfish as part of the harvest assessment program. Rockfish objectives included estimation of 1) species composition, 2) age, sex, and length composition, and 3) the geographic distribution of harvest by the fleets by port. Approximately 2,900 rockfish were sampled at Seward, Valdez, Whittier, Kodiak, and Homer in 2003. (Contact: Scott Meyer)

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.

New density surveys were conducted during 2003 in CSEO and EYKT. There were no new surveys of NSEO and SSEO. The SSEO area was last surveyed in 1999, and NSEO was surveyed in 2001. Density estimates by area range from 1,420 to 3,557 adult yelloweye per km^2.

The density estimate for CSEO in 2003 was 1,864 adult yelloweye/km^2 (CV=11.22%). This is significantly lower than the previous estimate obtained in 1997 of 2,534 adult yelloweye/km^2 (CV=16.6%). The 2003 stock assessment was based on 102 transects compared to 32 transects run in 1997. The PDF has a better fit to the data in 2003 compared to 1997.
The density estimate for EYKT in 2003 was 3,557 adult yelloweye/km^2 (CV=17.2%). This is higher than the 1999 estimate of 2,322 adult yelloweye/km^2 (CV=30.8%). The

sample sizes were equal in both survey years (20 transects run) however the PDF has a better fit to the 2003 data compared to the 1999 data set.

In the **Southeast Region** no black rockfish surveys were conducted in 2003 however, one dive was made with the submersible "Delta" off Cape Georgiana, where more than 3,000 fish were tagged and released in 1999 and 2000. Black rockfish were observed but no tags were noted.

Beginning in 2000, **Central Region** groundfish staff initiated a three-year project designed to develop and implement a sampling approach for estimating black rockfish abundance in specific nearshore habitats of Southcentral Alaska along the Northern Gulf of Alaska. Harvest guidelines are currently based on long-term harvest patterns of all rockfish species in aggregate and have not been established to reflect changes either in the abundance of individual species or in fishing patterns. Black rockfish comprises the largest component of rockfish harvests along the northern Gulf of Alaska. This project used tagging and SCUBA to explore habitat-based assessment of black rockfish. The 2003 field season involved a 12-day cruise. An additional project with funding for two seasons beginning in 2004 will compare scuba and acoustic-based rockfish indices to catch indices from a commercial jig vessel. Rockfish will also be tagged during these cruises (contact Bill Bechtol).

c. Management

Management of DSR is based upon a combination of guideline harvest ranges, seasons, gear restrictions, and trip limits. The state has management authority for demersal shelf rockfish in both state and federal waters of **Southeast Alaska**. Directed harvest of demersal shelf rockfish is restricted to hook-and-line gear. Directed fishing quotas are set for the 4 outside water management areas individually and are based on the poundage remaining after assigning a 2% harvest rate to the adult yelloweye biomass estimate and estimating bycatch (reported and nonreported) mortality. Directed fishery quotas for the two internal water management areas are set at 25 mt annually. Regulations adopted in 1994 include trip limits (within any 5 day period) of 6,000 pounds per vessel (12,000 pounds in EYKT), and added a requirement that logbook pages must be submitted with fish tickets for each fishing trip. The 2003 TAC for DSR was 389 mt in Southeast Outside. The directed DSR fishery quota is now allocated with 2/3 of the quota apportioned to the January 1- March 15 season and 1/3 of the quota apportioned to the November 16- December 31 season. A significant portion of the total harvest is taken as bycatch mortality during the halibut fishery and 211 mt of the TAC was reserved for bycatch in other fisheries. In 2003 the directed DSR fishery was again pre-empted by the halibut fishery in the EYKT area (Contact Tory O'Connell).

The Alaska Board of Fisheries adopted several new regulations regarding rockfish during its 2003 meeting cycle. The Board established guideline harvest limits for the directed black rockfish fishery in Southeast Alaska. Directed fishery quotas are by management area, ranging from 11.3 mt in IBS to 57 mt in SSEOC, and totaling 136 mt. The Board also created a series of open and closed areas so managers could better understand the

effect a directed fishery has on the black rockfish stocks. Halibut and groundfish fishermen are required to retain and report all black rockfish caught.

The BOF specifically made thornyhead, shortraker, rougheye and redbanded rockfish bycatch only and removed language allowing directed fishing on other species of rockfish. This action closes the directed fisheries for slope rockfish and non-black pelagic species in state waters of Southeast Alaska.

Rockfish in **Central Region's** Cook Inlet and PWS Areas are managed under their respective Rockfish Management Plans. Plan elements include a fishery GHL of 68 mt and 5-day trip limits of 0.5 mt in the Cook Inlet District, 1.8 mt in the North Gulf District, and 1.4 mt in PWS. Rockfish regulations underwent significant change beginning in 1996 when the Alaska Board of Fisheries formalized the 68 mt GHL into a 68 mt harvest cap for all rockfish species in Cook Inlet and PWS and a 5% rockfish bycatch limit for jig gear during the state waters Pacific cod season. In 1998 the board adopted a directed rockfish season opening date of July 1 for the Cook Inlet Area and restricted legal gear to jigs, primarily because this 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. Rockfish bycatch levels were also set at 20% during sablefish and 10% during other directed fisheries. Proceeds from rockfish landed in excess of allowable bycatch levels are surrendered to the State of Alaska. (Contact Charlie Trowbridge)

The **Westward Region** has attempted to conservatively manage black rockfish since 1997, when management control was relinquished to the State of Alaska. Area guideline harvest levels were set at 75% of the average production from 1978-1995 and sections were created to further distribute effort and thereby lessen the potential for localized depletion. Since 1997, section GHL's have been reduced in some areas that have received large amounts of effort.

In the Kodiak Area, vessels may not possess or land more than 5,000 pounds of black rockfish in a 5-day period. Additionally, vessel operators are required to register for a single groundfish fishery at a time. . A registration requirement also exists for the Chingik Area; that area was also designated as super-exclusive for the black rockfish fishery beginning in 2003.

In 2003, 37 mt of black rockfish were harvested from six sections in the Kodiak Area. Directed effort and harvest were both lower in 2003; the section guideline harvest levels were attained in only one section. Unlike previous years, much of the harvest occurred as bycatch in other directed fisheries. The 2003 black rockfish harvest in the Chignik Area totaled 19 mt and totaled 4 mt in the South Alaska Peninsula Area. Harvest and effort also declined in these two management areas. Few processors within a reasonable distance from these fishing areas were willing to purchase black rockfish in 2003. 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. (Contact: Mike Ruccio). In **Southeast Alaska, sport** bag limits consist of 5 pelagic rockfish and 5 non-pelagic rockfish per day of which only 2 may be yelloweye rockfish. In addition, bag limits in areas near Ketchikan and Sitka are limited to 3 non-pelagic rockfish, only 1 of which may be a yelloweye rockfish (Contact Mike Jaenicke).

In most of the fisheries in **Southcentral Alaska**, the majority of rockfish is taken incidental to the recreational halibut fishery or while trolling for salmon. Bag limits in most areas have been designed to discourage targeting of rockfish yet allow for retention of incidental harvest. Bag limits in most areas are five fish daily and the harvest of non-pelagic (DSR and slope) rockfish is further restricted to one or two fish per day in most areas. The Alaska Board of Fisheries has allowed more liberal bag limits in the Kodiak and Alaska Peninsula areas because of lower levels of effort and predominance of pelagic species in the catch (Contact Len Schwarz).

Given the lack of quantitative stock assessment information for much of Alaska, sport fishery managers have established conservative harvest strategies for recreational rockfish fisheries. Recreational seasons and bag and possession limits for rockfish in Alaska are among the most restrictive on the West Coast.

d. Fisheries

Reported harvest of rockfishes from state-managed commercial fisheries in **Southeast** totaled 804 mt in 2003, 188 mt of which was directed DSR and 40 mt black rockfish. The majority of the remaining rockfish taken in the Southeast district were DSR rockfish bycatch made in conjunction with the IFQ halibut fishery. All rockfish harvested in state-managed fisheries in Southeast is taken by hook-and-line gear either in directed fisheries or incidental to fisheries for other species.

The 2003 **Cook Inlet Area** directed rockfish fishery opened July 1 and closed October 23 with a total harvest of 64 mt, primarily pelagic rockfish. This was the fourth year that the jig-only gear restriction was in place. Total rockfish harvest for the PWS Area rockfish bycatch-only fishery was 22 mt. This included a 2 mt incidental catch of slope rockfish from the walleye pollock trawl fishery and a 20 mt incidental harvest of demersal and slope rockfish from the sablefish and halibut longline fisheries.

Recreational rockfish harvest is typically estimated in numbers of fish. Estimates of the 2003 harvest are not yet available from the statewide mail survey, but the average estimated annual harvest for the most recent five-year period (1998-2002) was 58,400 rockfish (all species) in Southeast Alaska and 56,900 fish in Southcentral Alaska.

3. Sablefish

a. Research

In 2003, sablefish longline surveys were conducted for the two **Southeast Alaska** state-managed sablefish fisheries, Southern Southeast Inside (SSEI) and Northern Southeast Inside (NSEI). These surveys are designed to measure trends in relative abundance and biological characteristics of the sablefish population. Biological data collected in these surveys include length, weight, sex and maturity stage. Otoliths are collected and sent to the ADF&G age determination unit in Juneau for age reading. The cost of these surveys is offset by the sale of the fish landed. The fish are dressed and iced according to industry standards and the state receives all the revenues from the sale of the fish.

In the SSEI survey, the overall CPUE (kg/hook) was 0.49 in 2003, 0.41 in 2002, 0.38 in 2001 and 0.43 in 2000. Spiny dogfish (*Squalus acanthias*) dominated the bycatch in all areas surveyed. In the NSEI survey, the 2003 overall CPUE (kg/hook) of 1.09 was up slightly from 2002 (1.05) and similar to 2001 (1.1). Thornyhead rockfish dominated the bycatch in all areas except the northern-most statistical area.

The on-going mandatory logbook program in the sablefish fisheries provides catch and effort data by date, location, and set. In the SSEI sablefish fishery, overall CPUE (adjusted for hook spacing) in round pounds/hook for vessels using conventional gear increased 9% in 2003 (0.453 rd. lbs./hook) compared to 0.413 rd. lbs./hook in 2002 and 32% increase from 2001 (0.31 rd. lbs./hook). In the NSEI fishery, overall adjusted CPUE in round lbs./hook for vessels using conventional gear, was 0.75 in 2003, 16% higher than in 2002(0.63).

In 2003, ADF&G continued the mark/recapture study in NSEI, marking and releasing 7,781 sablefish using pot gear to capture the fish 1.5 months prior to the fishery opening date August 15, 2003. The external tags are also a part of the on-going study to describe movement patterns between the Gulf of Alaska and the inside waters of Southeast Alaska. Fish were caught with pot gear to minimize the apparent "hook shyness" pattern of tag returns observed in 1997, 1998 and 1999. Tag returns from the fishery in 2000 (the first year pot gear was used to capture sablefish for the mark/recapture study) were significantly higher than in previous years. This suggests that using different gear to capture the fish and extending the time period between capture and recapture may have minimized the "hook shyness" phenomenon. The higher returns could also be a result of a higher exploitation of fish in 2000 compared to 1998 and 1997.

In September of 2003 ADF&G initiated a tag shedding study, using PIT tags, at the Seward Marine Center (University of Alaska Fairbanks). Preliminary results will be available late in 2004. The department is investigating the use of PIT tags on sablefish to determine population size and exploitation rate. Our intent in exploring the use of PIT tags is to minimize or alleviate potential problems associated with misidentification of

clipped fins and intentional discards of fish with external marks by individuals, perhaps intending to influence management decisions based on returns of marked fish.

During the fall and winter of 2003-2004 the Alaska Department of Fish and Game (ADF&G) captured, tagged and held 152 adult sablefish (*Anoplopoma fimbria)*. Sablefish were tagged using passive integrated transponder (PIT) tags in order to: 1) test for differences in tag shedding rates between two candidate tagging sites on the fish 2) estimate a tag-shedding rate for each site and 3) estimate tagging-related mortality. Seventy-six of the 152 fish were implanted with a tag in the head (muscle mass just behind and below the left eye). The other half was implanted with a tag in the peritoneal cavity. The sablefish were then placed in 1 of 4 saltwater tanks (1/4 in each tank), with half of each treatment type per tank. Sablefish tagged in the cheek musculature showed a significantly higher tag retention rate than fish tagged in the peritoneal cavity 96% and 75% respectively. A complete report of these activities will be available latter this year.

Within **Central Region** ADF&G initiated a limited mark-recapture study in 1999 within PWS using the biennial bottom trawl survey as the capture vehicle. Tagging was continued in the 2003 PWS bottom trawl survey. Fewer than ten tagged fish have been recovered to date (contact Bill Bechtol).

Skipper interviews and port sampling occurred in Whittier, Cordova and Seward for the PWS Area fishery and in Seward and Homer for the Cook Inlet Area fishery. Data obtained included date and location of harvest, length, weight, sex, and gonad condition. Otoliths were removed and sent to the Age Determination Unit (contact Willy Dunne).

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 mid-summer, tagged with either an external tag and/or a fin clip and released. Tags are recovered from the fishery and fin-clipped fish are counted at the processing plants. In 2003, with tag recovery data collected from the 2003 fishery, we estimated abundance and used the lower 90 percent confidence limit for abundance to forecast the 2004 biomass. An $F_{40\%}$ harvest rate was used to set total allowable catch (TAC). The directed annual harvest objective was set after deducting estimated sablefish mortality in other fisheries and unreported mortality in the directed fishery from the TAC. The department intends to use PIT tags during the 2004 field season. In addition to the mark-recapture work, annual longline surveys are conducted in both NSEI and SSEI and provide biological data as well as relative abundance information. (Contact David Carlile).

A longline survey has been conducted in **Prince William Sound** annually since 1996 using ADF&G vessels. Mean CPUE has ranged from 0.07 fish/hook in 1997 to 0.13 fish/hook in 2000. Longline survey effort was recently extended into the North Gulf District in 1999, 2000 and 2002. The 2001 PWS survey focused on the northwest and southwest PWS, and was limited to the northwest area in 2002 and 2003. Relative to recent surveys, sablefish catch rates (not weighted for available depth strata) increased

from 2002 to 2003, but remained below rates in 2001. Survey costs are partially offset by the sale of the fish (contact Bill Bechtol).

c. Management

There are three separate internal water areas in Alaska, which are managed exclusively by the state. The Northern Southeast Inside Subdistrict (NSEI), the Southern Southeast Inside Subdistrict (SSEI), and the Prince William Sound District each have separate seasons and guideline harvest ranges. Sablefish fisheries in outer coastal state waters (0-3 miles) have been managed in conjunction with the federal-managed fishery in the EEZ. In some areas of the Gulf, the state opens the fishery concurrent with the EEZ opening. These fisheries, which occur in the North Gulf District of Cook Inlet and the Aleutian Island District, are open access in state waters, as the state cannot legally implement IFQ management at this time. The quotas are based on historic catch averages and closed once these have been reached. 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.

The GHL for the North Gulf District is set using an historic baseline harvest level adjusted annually by the same relative reduction to the TAC in the Central Gulf Area. The 2003 fishery GHL was 34 mt. The sablefish fishery in PWS has occurred under limited entry since 1996. Permit holders are restricted to gear and vessel size classes. Additionally a commissioner's permit, which stipulates a logbook and catch reporting requirements, must be obtained prior to participation in the fishery. The fishery GHL is set at 110 mt, which is the midpoint of the harvest range set by a habitat-based estimate. Fishery management continued to develop through access limitation and then into a quota share system wherein permit holders are allocated shares of the harvest guideline. Shares are equal within each of four vessel size classes, but differ between size classes. Central Region staff annually conducts post fishery dockside interviews and samples landings in the ports of Cordova, Whittier, and Seward.

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 3,120,000 pounds. The quota in NSEI decreased from 911 mt in 2002 to 909 mt in 2003, however due to the elimination of one permit holder the individual quota increased The SSEI quota was 0.696 million round lbs. in 2002, and remained the same in 2003.

During the January 2003 Alaska Board of Fisheries (BOF) meeting, the BOF made several major changes in regulations affecting the NSEI and SSEI sablefish fisheries: The

opening date for the NSEI fishery was changed from September 1 to August 15. Randomly selected permit holders will be allowed to fish outside of the regular season at the department's request to gather biological and catch data. Permit holders are allowed to release healthy sablefish and are required to document the number of fish released in their logbook. All injured or dead sablefish must be retained. The retention of sablefish for use as bait is prohibited in state waters. Permit holders are allowed to carry over up to 5% of their annual equal quota share as an overage or underage or transfer up to 5% of their legal harvest to another permit holder.

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

d. Fisheries

In the **Southeast Region** the NSEI sablefish fishery landed a total of 909 mt by 108 permits, averaging 8.4 mt per permit between August 15 and November 15, 2002. A total of 298 mt was landed by 28 permits in the SSEI Subdistrict, averaging 10.6 mt per permit between June 1 and August 15, 2002 (contact Tory O'Connell).

In the **Central Region** the 2003 open access sablefish fishery in the North Gulf District was open from July 15 – 17 and harvested 55 mt. Although effort declined from 23 to 14 vessels, catch per landing in the fishery almost doubled in 2003. In the Prince William Sound area, a "shared quota" system was adopted by the Board of Fish and instituted during the 2003 season. Season dates were April 7 - May 15 and August 1 – 21. The new system allocated half of the GHL equally among all registered participants with the balance of the GHL allocated using the number of registered permit holders within each vessel size class based on historic harvest within each class resulting in the following percentages: Classes A and B (90 and 60 feet maximum length = 18.53%; Class C (50 feet maximum length) vessels = 70.33% and Class D (35 feet maximum length) vessels = 11.14%. All sablefish landed in excess of an individual's quota must be sold with the proceeds going to the State of Alaska. Skipper interviews and biological sampling were conducted in-season which gathered effort and location information as well as age, length, weight, sex and gonad condition data (contact Charlie Trowbridge).

Within the **Westward region**, only the Aleutian Islands have sufficient habitat to support mature sablefish populations of sufficient magnitude to permit commercial fishing. All other sections within the region are closed by regulation to avoid the potential for localized depletion from the small amounts of habitat within the jurisdiction of the state. Bycatch from the areas closed to directed fishing is limited to 1%. The 2003 Aleutian Island fishery opened on May 15, 2003. Additional requirements for the fishery include registration and logbook requirements. The GHL was set at 286 mt for the state managed fishery. The preliminary harvest from the 2003 Aleutian Islands sablefish fishery was 124 mt. The season remained open until the November 15 closure date. This was the first time since the state-waters

season began in 1995 that the total quota was not obtained (Contact Barbi Failor-Rounds).

4. Flatfish

a. Research

No research activities were planned for flatfish during 2003.

b. Stock Assessment

No stock assessment programs were active for flatfish during 2003.

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 may restrict the type of gear used. Mandatory logbooks are required and some areas cannot be fished unless there is an ADF&G observer on board. This restrictive management is necessary because of reduced flatfish stocks and because of a history of very high, prohibited species bycatch rates, particularly crab and halibut. New regulations adopted in November 1993 implemented a 20,000-pound maximum weekly trip limit in the trawl fishery. This was an industry proposal, the intent of which was to keep large catcher-processor vessels out of this fishery. In 1997 a different industry proposal to the BOF requesting an increase in weekly trip limit was rejected.

d. Fisheries

The **Southeast Alaska** inside waters flatfish trawl fishery was restricted to three small areas during the 2002-03 season with a harvest objective set for each area. There has been almost no effort in the Southeast fishery for the past five years, with no harvest reported for the 2002-2003 season. The BOF restricted the Southeast flatfish trawl fishery to the use of beam trawl only. The Southeast flatfish trawl areas are also the sites of a shrimp beam trawl fishery. Most of the Southeast harvest is starry flounder and is used for bait in other groundfish fisheries while the **Prince William Sound** harvest is a mixture of shallow-water species.

5. Pollock

a. Research

Pollock continue to be a dominant species in the **Central Region** ecosystems. Due to uncertainty about the appropriate harvest level for the PWS pollock fishery, assessment in 2003 included commercial fishery catch sampling and bottom trawl surveys of the summer (post-spawning) population. In 1996, interactions between pollock, herring, and

juvenile salmon were also examined as part of Sound Ecosystem Assessment (SEA) funded by the *EXXON Valdez* Oil Spill Restoration.

In pollock we are testing for spatial patterns of genetic variation in six population samples from three regions: North America – Gulf of Alaska; North America – Bering Sea; Asia – East Kamchatka. We tested for annual stability of the genetic signal in replicate samples from three of the North American populations. These studies, begun in 1998 and 1999, continued into 2000. A manuscript documenting the findings is under internal review. Allozyme and mtDNA markers provide concordant estimates of spatial and temporal genetic variation. These data show significant genetic variation between North American and Asian pollock as well as evidence that spawning aggregations in the Gulf of Alaska, such as Prince William Sound, are genetically distinct and may merit management as distinct stocks. These data also provide evidence of inter-annual genetic variation in two of three North American populations. Gene diversity values show this inter-annual variation is of similar magnitude to the spatial variation among North American populations, suggesting the rate and direction of gene flow among some spawning aggregations is highly variable.

b. Stock Assessment

Hydroacoustic surveys, with sample collection by mid-water trawl, were conducted in PWS in the winters of 1995, 1997, 1998, 2000, 2001, and 2002 by the Prince William Sound Science Center in cooperation with ADF&G. Biomass estimates of prespawning pollock aggregations have been relatively stable, except for 1998, with a slight decline indicated in more recent years. The department also conducts a biennial bottom trawl survey during the summer in PWS, using pollock biomass estimates to establish the harvest guideline for the winter commercial fishery. This is because a significant portion of the spawning population targeted by the winter fishery is thought to have immigrated from federal waters, whereas the summer population is not assessed by the NMFS summer survey. Survey biomass estimates from the biennial bottom trawl survey have declined in recent years, with the subsequent fishery harvest level reduced accordingly (Contact Bill Bechtol).

c. Management

Prince William Sound pollock fishery regulations include a commissioner's permit and a registration deadline of January 13. The permit stipulates logbooks, catch reporting, and accommodation of a department observer upon request. Vessels are required to check in and check out of the area and fishery as well as contact the department daily to report catch, effort, and fishing location. In 2001 new regulations were adopted dividing the PWS Inside District into three sections (Port Bainbridge, Knight Island, and Hinchinbrook) and limiting harvest to a maximum of 40% of the GHL from any section (Contact Bob Berceli).

d. Fisheries

The 2003 fishery opened on January 20 with a GHL of 1724 mt. Catch and effort remained low until late February when aggregations of pollock in the Hinchinbrook section increased resulting in achievement of the 40% harvest level for that section. The section closed by emergency order on March 2. Subsequently, fishing improved in the Knight Island and Bainbridge sections, which closed on March 31 due to concerns over increased bycatch. Total pollock harvest for all sections combined was 1099 mt. As in past years, fishery bycatch was dominated by squid (9 mt), sharks (4 mt), and rockfish (2 mt). Salmon bycatch totaled 0.09mt in 2002.

6. Sharks

a. Research

In the **Central Region** Spiny dogfish and Pacific sleeper sharks have been tagged annually since 1997 as part of the PWS longline survey for sablefish, and since 2000 during bottom trawl surveys in Cook Inlet and PWS. Through 2003, over 400 each of spiny dogfish and Pacific sleeper sharks have been tagged. To date, ten tagged sleeper sharks have been recovered from PWS; maximum time-at-large was 1,259 days and most sharks moved less than 20 km between tagging and recapture locations. No spiny dogfish have been recovered. In 2003, 340 spiny dogfish were sacrificed and the posterior dorsal spine removed for age determination. In addition, 10-15 sleeper sharks have been sacrificed annually during 2000 to 2003 for parasite and contaminant analysis (contact Bill Bechtol).

In recent years, a small **recreational** fishery targeting salmon sharks has developed in the Gulf of Alaska and Prince William Sound. Little information is available to assess the status or structures of targeted stocks. The Division of Sport Fish initiated a modest cooperative tagging program with a few charterboat operators in 1998 and continues to collect biological data on all sharks harvested in the sport fishery through the port-sampling program.

b. Stock Assessment

Among **Central** Region assessment projects sharks are caught in the trawl surveys and the PWS longline survey. Among **Central** Region assessment projects sharks are caught in the trawl surveys and the PWS longline survey. Catch per unit effort for Pacific sleeper shark ranged from 1.1 fish/set in 1996 to 4.3 fish/set in 1999. Spiny dogfish CPUE has ranged from 0.9 to 9.2 fish/set except for a dramatic increase to 51.3 fish per set in 1998. The high catch rates of spiny dogfish in 1998 appear to have been an anomaly (contact Bill Bechtol).

The **Division of Sport Fish—Southcentral Region** collected harvest and fishery information on sharks through the groundfish harvest assessment program although no specific research objectives were identified. Shark harvest is still at a relatively low level, but it is hoped that size and age composition of the harvest can be estimated using multiple years of data. Forty salmon sharks and two spiny dogfish were sampled from the sport harvest throughout Southcentral Alaska for length, sex, and age structures. Interviewed anglers caught 36 salmon sharks in 41 angler-days of effort and kept 22 of them. An additional 21 salmon sharks were released by interviewed anglers fishing for other species. (Contact Scott Meyer).

The statewide charter logbook program also requires reporting of the number of salmon sharks kept and released in the charter fishery. Charter anglers' account for the vast majority of the recreational salmon shark harvest. In 2003 charter operators reported harvesting 30 salmon sharks in Southeast Alaska and 143 salmon sharks in Southcentral Alaska.

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.

Recreational fishing for sharks is allowed under the statewide Sport Shark Fishery Management Plan adopted by the BOF in 1998. The plan recognizes the lack of stock assessment information, the potential for rapid growth of the fishery, and the potential for overharvest, and sets a statewide daily bag limit of one shark and a season limit of two sharks of any species. Recreational demand for spiny dogfish remains low and they are widely considered a nuisance species. There is, however, a small directed charter boat fishery for salmon sharks in Southcentral Alaska, primarily at Seward and in Prince William Sound. Pacific sleeper sharks are occasionally caught but rarely retained.
In 2000 the BOF prohibited the practice of "fining", 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.

d. Fisheries

Regulations adopted by Alaska Board of Fisheries in 1998 restricted all shark fisheries to bycatch-only.

7. Lingcod

a. Research

In 2003, the **Southeast Region** continued a lingcod mark/recapture study, conducting one cruise for the purpose of tagging fish for a movement and migration study, and to estimate exploitation rate. Because the movement of local stocks of lingcod in Southeast Alaska is not well understood, a tagging study was launched in the spring of 1996; we plan to continue tagging lingcod in 2003. Over the past seven years 8,340 lingcod have been tagged and 261 fish recovered. A total of 1,654 lingcod were tagged during the 2003 reporting period: 1,187 lingcod were tagged using dinglebar gear, and sport fishermen tagged 443 young fish. Length and sex were recorded for all tagged fish. Research surveys to obtain catch per unit effort independent of the fishery have been conducted seasonally since 1993. Catch per unit effort data from these surveys indicates a moderate increase in 2003 for all areas except NSEO (Contact Cleo Brylinsky).

In the **Central Region**, skipper interviews and port sampling were conducted in Cordova, Whittier, Seward and Homer. Data obtained included date and location of harvest, length, weight, sex and age. Gonad condition was generally not determined as nearly all fish delivered were already gutted (Contact Willy Dunne).

The **Division of Sport Fish—Southeast Region** continued to collect catch, harvest, and biological data from lingcod as part of a marine harvest survey program with lingcod harvests tabulated back to 1987 in some selected ports. Data collected in the program include statistics on effort, catch, and harvest of lingcod taken by Southeast Alaska sport anglers. Ports sampled in 2003 included Juneau, Sitka, Craig/Klawock, Wrangell, Petersburg, Gustavus, Elfin Cove, Yakutat, and Ketchikan. Length and sex data were collected from 817 lingcod in 2003 (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. Approximately 750 lingcod were sampled from sport harvest at Seward, Valdez, Whittier, Kodiak, and Homer in 2003. These ports accounted for the majority of recreational lingcod harvest in Southcentral Alaska (Contact Scott Meyer).

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. The directed commercial fishery data are indicative of stock declines and serial depletion. Analysis of catch per unit effort data (CPUE), in terms of fish per hook-hour for 1988–1998, show that CPUE had declined between 21 to 62% in areas where a directed fishery has developed. There appears to be some serial

depletion in the CSEO and NSEO and the commercial fleet has moved into the EYKT and SSEO. For these reasons the AHOs for lingcod were reduced in all areas, an action taken at the 1999 BOF meeting. Commercial logbook data shows a decline in CPUE in 2001, followed by an increase in 2002 and in 2003 there was a slight increase in overall CPUE.

c. Management

The BOF made significant changes in lingcod management in the **Southeast District** during 2000. These changes included a total winter closure for all users except longliners between December 1 and May 15 in an effort to protect nest-guarding males. Guideline harvest limits were greatly reduced in all areas and allocations made between directed commercial fishery, sport fishery, longline fisheries, and salmon troll fisheries. The 27" minimum 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. In 2003 the Board of Fish established a super-exclusive directed fishery for lingcod in the IBS Subdistrict.

Regulations for the **Central Region** lingcod fishery include open season dates of July 1 to December 31 and a minimum size limit of 35 inches (89 cm) overall or 28 inches (71 cm) from the front of the dorsal fin to the tip of the tail. More recently, the Board of Fisheries adopted a jig only gear requirement for the directed lingcod fishery in the Cook Inlet Area. Beginning in 1997, the department set commercial lingcod fishery GHL's for the Central Region at 50% of the average harvest for the period 1987 to 1996. However, GHL's were increased to 75% of this average in 2001 for PWS and in 2003 in Cook Inlet.

.In 2000, **sport** harvests of lingcod in **Southeast Alaska** were incorporated into a region wide lingcod management plan, which set GHL's for 7 areas, and sport harvest in pounds was allocated for each of these 7 areas. The opening date of the lingcod sport fishery as of 2000 was also moved back about 2 weeks from May 1, and is now open from May 16 through November 30. In addition, harvest of sport-caught lingcod in 2002 and 2003 was prohibited during June 16 to August 15 in northern Southeast Alaska and the outer coast of Prince of Wales Island. There was no mid-season lingcod sport harvest closure in 2002 or 2003 for southern inside Southeast Alaska or for Yakutat. The bag and possession limits of 2 and 4 lingcod, respectively, were reduced to 1 and 2 lingcod, respectively, in Southeast Alaska in 2001 through 2003 to reduce harvests in this area to meet allocation guidelines. Guided and nonresident anglers in 2002 and 2003 were restricted to harvesting lingcod within a slot limit of 30 inches (minimum) to 40 inches (maximum) in northern Southeast Alaska and the outer coast of Prince of Wales Island and a slot limit of 32 inches (minimum) to 42 inches (maximum) in Yakutat; furthermore, all lingcod caught by guided and nonresident anglers in these areas with slot limits in 2002 and 2003 could only be landed by hand or landing net. There were no slot limit restrictions for any anglers in southern inside Southeast Alaska area (Ketchikan) in 2002, but in 2003 the guided and nonresident anglers in this area

(i.e., Ketchikan area) were restricted to harvesting within a slot limit of 30 inches (minimum) to 40 inches (maximum). Lingcod caught by guided and nonresident anglers in 2001 were restricted to harvesting fish with a minimum size of 39 inches in northern Southeast Alaska (including Yakutat) and a 34 inch minimum size along the outer coast of Prince of Wales Island; furthermore, all lingcod caught by guided and nonresident anglers in these two areas with minimum size restrictions in 2001 could only be landed by hand or landing net. There was no minimum size limit in the inner area of southern Southeast Alaska for guided and nonresident anglers in 2001. Resident anglers fishing from private vessels throughout Southeast Alaska have never had a lingcod size restriction imposed upon them. Since the department wished to increase biological sampling of lingcod for better determination of length and sex composition, heading or filleting of lingcod prior to offloading was also prohibited in all sampled ports to enable the department to maximize fishery information obtained. The only area totally closed to lingcod sport fishing was the Pinnacles area near Sitka, which is closed to sport fishing year-round for all groundfish (Contact: Tom Brookover).

Conservative harvest strategies have been established for recreational lingcod fisheries in **Southcentral Alaska** in light of the lack of quantitative stock assessment information. Resurrection Bay is closed to lingcod fishing year-round to rebuild the population, although no formal rebuilding plan is in place. The season is closed region-wide from January 1 through June 30 to protect spawning and nest guarding lingcod. Daily bag limits are 2 fish in all areas except the North Gulf, where the daily bag limit is one fish. All areas except Kodiak have a minimum size limit of 35 inches to protect spawning females (Contact: Scott Meyer).

d. Fisheries

Lingcod are the target of a "dinglebar" troll fishery in **Southeast Alaska**. Dinglebar troll gear is salmon power troll gear modified to fish for groundfish. Additionally lingcod are landed as significant bycatch in the DSR longline fishery and as a limited bycatch in the halibut fishery. The directed fishery landed 111 mt of lingcod in 2003 and an additional 83 mt was landed as bycatch in other fisheries. The halibut longline fishery accounted for roughly 24% of lingcod bycatch in the Southeast Region and the salmon troll fishery accounted for 8%.

Central Region lingcod harvests have primarily occurred in the North Gulf District of Cook Inlet and the Outside District of PWS. The Cook Inlet GHL was 24 mt and the PWS GHL was 11 mt in 2003. Lingcod harvests in 2003 totaled 12 mt in Cook Inlet and 11 mt in PWS. The majority Cook Inlet Area lingcod harvest was by directed jig fishing, while the PWS harvest was mainly from longline bycatch to other (primarily halibut) fisheries.

No directed effort occurred for lingcod in the **Westward Region** during 2003. Incidental harvest in other fisheries totaled 10 mt for the year. The majority of the harvest occurred in the Kodiak Area with a minor amount occurring in the Chignik Area.

Recreational lingcod harvest is estimated in numbers of fish. Estimates of the 2003 harvest are not yet available from the statewide mail survey, but the average estimated annual harvest for the most recent five-year period (1998-2002) was 17,800 fish in Southeast Alaska and 9,800 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. At this time most other groundfish species taken in state waters are taken as bycatch in fisheries for other more valuable groundfish and halibut. The State also has a regulation that requires that the bycatch rate of groundfish be set by fishery annually by emergency order unless otherwise specified in regulation.

A commissioner's permit is required before a directed fishery may be prosecuted for skates and rays. This permit may restrict depth, dates, area, and gear, establish minimum size limits, and require logbooks and/or observers, or any other condition determined by the commissioner to be necessary for conservation and management purposes. In 2003, interest in a fishery for skates occurred in the Kodiak Area. Thirty-seven vessels obtained commissioner's permits and prosecuted target fisheries for skates in state-waters; several additional vessels participated exclusively in federal waters. The majority of these vessels targeted the big skate *Raja binoculata* and Longnose skate *Raja rhina.* The 2003 harvest from state waters was 527 mt. In addition to the permit requirements listed above, vessel operators were required to notify ADF&G of deliveries. This was done to ensure that ample opportunity occurred to collect biological data from the landed catch. Dockside samplers performed species identification and obtained sexed lengths from the catch. In addition, vertebrae were collected for age analysis. A commissioner's permit is also required before any trawl fishery besides the existing beam trawl fishery for flatfish may be prosecuted in the Southeast District.

As part of a cooperative research study, tissue samples were collected from approximately 40 longnose skates in Prince William Sound for contaminant analysis. A "Developing Fisheries" policy is being drafted for new fisheries which will reduce the possibility that a fishery can escalate beyond management control and will also outline which species may be restricted from being harvested in a directed fishery.

The recreational halibut fishery is the focus of a statewide research and management effort. Data on the recreational fishery and harvest are collected through port sampling effort in Southcentral Alaska and creel surveys and port sampling in Southeast Alaska. These data are provided annually to the International Pacific Halibut Commission for use in an annual stock assessment, and to the North Pacific Fishery Management Council. The council has used the information in the design and analysis of regulations governing the sport charter fishery.

As stated earlier in this report, the BOF took action in 2000 prohibiting the development of a live fish fishery for groundfish in the Southeast District.

C. Other Related Studies

Staff in the **Central Region** has implemented a multi-year study to explore the utility of a remotely operated vehicle (ROV) as a stock assessment tool for a variety of groundfish resources. Initial efforts are focusing on identification of suitable rockfish and lingcod habitat along the northern Gulf of Alaska, and comparing ROV study results with habitat available in a GIS format form NOAA (contact Mike Byerly).

The Department of Fish and Game manage state groundfish fisheries under regulations set triennially by the Board of Fisheries. The department announces the open and closed fishing periods consistent with the established regulations, and has authority to close fisheries at any time for justifiable conservation reasons. The department also cooperates with NMFS in regulating fisheries in the offshore waters.

By regulation, fish tickets are required for all shore-based landings in Alaskan ports and for all landings from state-managed fisheries. The catch data from the fish tickets is used as the primary means of tracking the in-season harvest levels. Groundfish fish tickets are collected from as many as thirty or more processors within the state. The fish tickets are edited for accuracy and the data is entered on microcomputers in Petersburg, Sitka, Ketchikan, Homer, Kodiak, and Dutch Harbor. Because of the intensity of many of the groundfish fisheries, a "soft data" accounting system using processor contacts is also utilized, when necessary, to track landings during a fishery.

In 1997 at the Southeast Groundfish meeting, the Board of Fisheries adopted a regulation that requires all groundfish fishermen to complete mandatory logbook pages while fishing. These logbook pages must be submitted as part of their landing record and attached to their fish ticket at delivery. The Board also requires that fishermen obtain a conditional use permit when fishing for any species for which specific regulatory language is not in effect. This will allow ADF&G to deny permits for some species and allow exploratory or controlled fishing for others.

1. Dixon Entrance Area

Total removals from the Dixon Entrance area (Alaska statistical areas 325431, 315431, 325401, and 315401) have declined in recent years, due mostly to reductions in sablefish quotas. The table below lists the catch by species group from 1988 through 2003 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

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*, bryazoans and other fragile invertebrate communities, which attracts and shelters an extremely high density of juvenile rockfishes. The area is used seasonally by lingcod for spawning, nest-guarding, and post-nesting feeding. Yelloweye rockfish and pelagic rockfish species as well as large numbers of prowfish and Puget Sound rockfish also densely inhabit the pinnacles. This closure protects the fragile nature of this rare habitat, and prevents the harvest or bycatch of these species during critical portions of their life history. In February 1998 the BOF approved of the reserve and the NPFMC approved of the reserve at their June 1998 meeting. The NPFMC recommended to the BOF that they consider closure of the area to salmon trolling which would make the area a complete-no take zone. In February 2000 the BOF rejected closing the area to salmon trolling. The area is an important "turn-

around" area for commercial trollers and the BOF did not believe there was sufficient conservation benefit to warrant closing the area to salmon fishing.

In 2004 a movie of the Edgecumbe Pinnacles Marine Reserve was created because of increased public interest in our work, and to give others an opportunity to learn about, and view the pinnacles from below the waters surface. This movie is available in either VHS or DVD format for schools or non-profit organizations through the Sitka office of the Alaska Department of Fish and Game.

3. User Pay/ Test Fish Programs

The state of Alaska Department of Fish and Game receives receipt authority from the state legislature that allows us to conduct stock assessment surveys by recovering costs through sale of fish taken during the surveys. Receipt authority varies by region. In **Southeast Alaska** we have several projects that are funded through test fish funds (total allocation approximately 300k), notably the sablefish longline assessments, the king crab survey, and the herring fishery and dive surveys. Also in 1995 the Southeast Region was given a separate receipt authority for $250,000 to conduct sea urchin research using test fish funds. In the case of sea urchins the industry placed bids on the right to harvest and market sea urchins. The low bidder was responsible for paying for the department's expenses in research and management of this fishery and was limited to a 12% profit after state expenses were paid.

4. GIS

ADF&G Commercial Fisheries is currently using ArcView version 3.x and 8.2 and MapInfo version 4.5 and 5.1 for general map production, project planning and spatial analysis. More advanced spatial analyses are performed using ArcView's Spatial Analyst and 3-D Analyst and MapInfo's Vertical Mapper.

The Division currently maintains its basemaps in both ArcView and MapInfo format; however, beginning in 2002 the ArcView shapefile format will be the Division's standard data distribution format. The Division is also supporting data in both the NAD27 and NAD83 datums. The NAD27 datum is primarily used for terrestrial-based mapping and the NAD83 datum is used for marine-based mapping. Because the Division's managed fisheries span both the terrestrial and marine environments, both datums will be supported. Basemaps, which originated in the NAD27 datum, are being converted to the NAD83 datum. Most of the conversion was completed by mid-2001.

In 2000, the Division developed new hardcopy and digital groundfish and shellfish statistical area charts. These charts became effective January 1, 2001, and hardcopy charts were distributed to processors in early January. Digital versions of the charts are available in two forms. Adobe PDF versions of the charts can be viewed or downloaded at http://www.cf.adfg.state.ak.us/geninfo/statmaps/charts.htm. ArcView- and MapInfo-compatible charts can be downloaded from the ADF&G CF GIS Maps and Data Server at http://maps.cf.adfg.state.ak.us. This server will be the home for all publicly available GIS

maps developed by the division. In the future this server will also feature online maps using ESRI's ArcIMS (Internet Map Server) software (contact Tim Haverland).

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 2003 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	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

Since 1998, marine recreational charter operators have been required to log port of landing, effort and harvest, and ADF&G statistical area for every charter trip made. The 2003 logbook was similar to the 2002 logbook format. Data collected for each vessel trip included port of landing, location(s) fished, angler residency, effort for salmon and bottomfish, and harvest and/or release (in numbers) of chinook, coho, sockeye, pink, and chum salmon, pelagic rockfish, other rockfish, lingcod, and salmon sharks. Information that has been dropped from collection in the saltwater charter vessel logbook program is angler residency (as of 2000) and halibut harvest and release data (as of 2002). In 2001 the **Sport Fish Division** conducted an initial evaluation of the 1998-2000 charter logbook data, including comparisons of data from the logbook, the statewide mail survey, and on-site interviews.

Web Pages

ADF&G Home Page: http://www.adfg.state.ak.us/
Commercial Fishery Division Home Page: http://www.cf.adfg.state.ak.us/
News Releases: http://www.adfg.state.ak.us/news/dept_news.php
Sport Fish Division Home Page:
http://www.sf.adfg.state.ak.us/statewide/sf_home.cfm
Sport Fish Division Southcentral Region Halibut and Groundfish Program:
http://www.sf.adfg.state.ak.us/region2/groundfish/gfhome.cfm
Mark Tag Age Lab Home Page: http://tagotoweb.adfg.state.ak.us/ADU/default.asp
Region 1 Groundfish Home Page:

http://www.cf.adfg.state.ak.us/region1/finfish/grndfish/grndhom1.php
Commercial Fisheries Entry Commission: http://www.cfec.state.ak.us/
State of Alaska home page: http://www.state.ak.us/
Gene Conservation Laboratory Home Page:
http://www.cf.adfg.state.ak.us/geninfo/research/genetics/genetics.php
Adobe PDF versions of groundfish charts can be viewed or downloaded at
http://www.cf.adfg.state.ak.us/geninfo/statmaps/charts.php
ArcView- and MapInfo-compatible charts can be downloaded from the ADF&G CF GIS Maps and Data Server at http://maps.cf.adfg.state.ak.us/. This server will be the home for all publicly available GIS maps developed by the division. In the future this server will also feature online maps using ESRI's ArcIMS (Internet Map Server) software (contact Tim Haverland).

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APPENDIX I: ALASKA DEPARTMENT OF FISH AND GAME PERMANENT FULL-TIME GROUNDFISH STAFF DURING 2002

COMMERCIAL FISHERIES DIVISION HEADQUARTERS

P.O. Box 25526, Juneau, Alaska 99802-5526

Fish Ticket Programmer/Analyst Vacant (907) 465-6110	GIS Programmer/Analyst Vacant (907) 465-6147	Fish Ticket Research/Analyst Gail Smith (907) 465-6157
AKFIN Program Coordinator Vacant (907) 465-6109	Age Determination Unit Kristen Munk Box 25526 Juneau, AK 99802 (907) 465-3054	

SOUTHEASTERN REGION

Project Leader Tory O'Connell 304 Lake St. Rm. 103 Sitka, AK 99835 (907) 747-6688 tory_oconnell@fishgame.state.ak.us	Fishery Biologist Eric E. Coonradt 304 Lake St. Rm. 103 Sitka, AK 99835 (907) 747-6688 eric_coonradt@fishgame.state.ak.us	Fishery Biologist Cleo Brylinsky 304 Lake St. Rm. 103 Sitka, AK 99835 (907) 747-6688 cleo_brylinsky@fishgame.state.ak.us
Project Biometrician Sherri Dressel Box 240020 Douglas, AK 99824-0020 (907) 465-4216	Fishery Biologist Mike Vaughn 304 Lake St. Rm. 103 Sitka, AK 99835 (907) 747-6688	

CENTRAL REGION

Groundfish Research Biologist William R. Bechtol 3298 Douglas Street Homer, AK 99603-7942 (907) 235-8191	Management Biologist Charlie Trowbridge 3298 Douglas Street Homer, AK 99603-7942 (907) 235-8191	Groundfish Sampling Coordinator William Dunne 3298 Douglas Place, Homer AK 99603-7942 (907) 235-8191
Fish Ticket Entry Technician Morris Lambdin 3298 Douglas Place,	Fishery Biologist Mike Byerly 3298 Douglas Street Homer, AK 99603-7942	PWS Management Biologist Robert Berceli PO Box 669 Cordova, AK 99574-0669

Homer, AK 99603-7942 (907) 235-8191	(907) 235-8191	(907) 424-3212

WESTWARD REGION

Shellfish/Groundfish Biologist Wayne Donaldson 211 Mission Rd. Kodiak, AK 99615-6399 (907) 486-1840	Area Management Biologist Mike Ruccio 211 Mission Rd. Kodiak, AK 99615-6399 (907) 486-1840	Groundfish Research Biologist Dan Urban 211 Mission Rd. Kodiak, AK 99615-6399 (907) 486-1849
Groundfish Sampling Coordinator Kally Spalinger 211 Mission Road Kodiak, AK 99615 (907) 486-1840	Assistant Area Management Biologist Mike Cavin 211 Mission Road Kodiak, AK 99615 (907) 486-1840	Assistant Area Management Biologist Barbi Failor-Rounds P.O. Box 920587 Dutch Harbor, AK 99692 (907) 581-1239
Assistant Groundfish Research Biologist Carrie Worton 211 Mission Rd. Kodiak, AK 99615-6399 (907) 486-1871		

SPORT FISH DIVISION

HEADQUARTERS, P.O. Box 25526, Juneau, Alaska 99802-5526

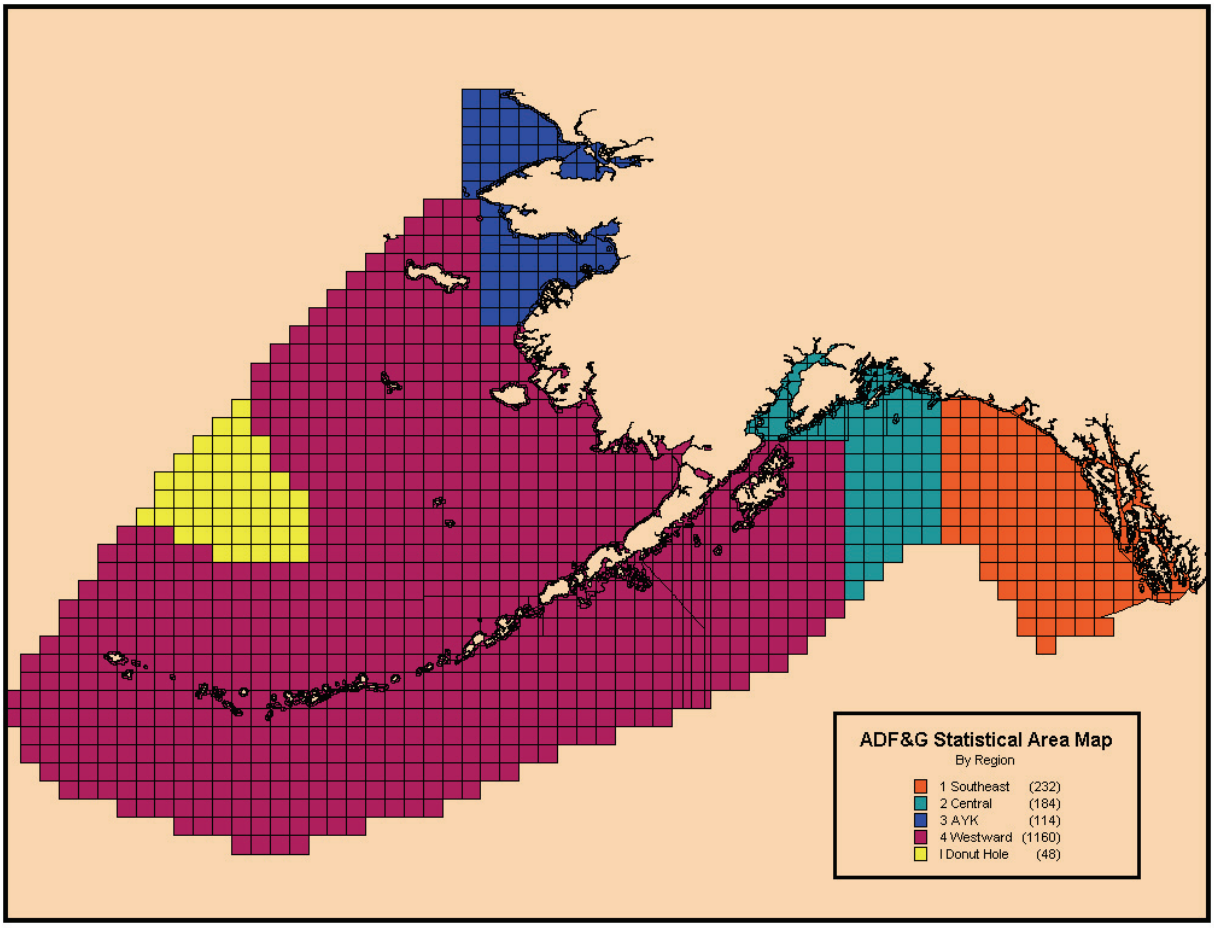
Rob Bentz Deputy Director Division of Sport Fish PO Box 25526, Juneau, AK 99802-5526 (907) 465-6187		

SOUTHEAST REGION

Mike Jaenicke, Project Leader Marine Harvest Studies Division of Sport Fish 802 3rd Street PO Box 240020 Douglas, AK 99824-0020 (907) 465-4301	Tom Brookover Regional Management Coordinator Division of Sport Fish 304 Lake Street, Room 103 Sitka, AK 99835 (907) 747-3881	

SOUTHCENTRAL REGION

Scott Meyer Groundfish Management and Research Biologist Division of Sport Fish 3298 Douglas Place Homer, Alaska 99603-8027 (907) 235-8191 scott_meyer@fishgame.state.ak.us	Matthew Miller PWS and North Gulf Management Biologist Division of Sport Fish 333 Raspberry Road Anchorage, AK 99518-1599	Len Schwarz Kodiak, Alaska Peninsula, and Aleutian islands Management Biologist Division of Sport Fish 211 Mission Road Kodiak, AK 99615-6399



Appendix II: Map Depicting State of Alaska Management Regions.

Appendix III. Tissue samples of *Sebastes* species collected for genetic analyses and stored at Alaska Department Fish and Game, Gene Conservation Laboratory, Anchorage. Species, sampling location and collection ID, year collected, sample size, and tissue type are given.

Species	Silly Name - Location	Year	Size	Tissue Type
Yelloweye Rockfish *S. ruberrimus*	YERFLAM98 - Flamingo, British Columbia.	1998	46	fin clips; larvae
	YERTASU98 - Tasu, British Columbia.	1998	50	fin clips
	YERTOPK98 - Topknot, British Columbia.	1998	49	fin clips
	YERTRI98 - Triangle, British Columbia.	1998	63	fin clips; larvae
	YERSE298 - Sitka	1998	49	fin clips
	YRSE99 - Stat areas 355601, 365701	1999	100	fin clips
	YERYAK99 - Fairweather grounds	1999	100	fin clips
	YEPW91 – Prince William Sound; Gravina, Danger, Herring	1991	27	muscle, liver, eye
	YERGA98 – Prince William Sound, Knight Is./Naked Islands area	1998	100	fin clips
	YERPWS100 - Whittier	2000	97	fin clips
	YERPWS200 - Whittier	2000	50	fin clips
	YERRES99 – Resurrection Bay	1999	100	fin clips
	YERKACH99 - Kachemak Bay	1999	58	fin clips
	YERKOD99 – Kodiak Island	1999	115	fin clips
Black Rockfish *S. melanops*	BRORE99 – Pacific Northwest; Oregon	1999	50	muscle, liver, heart
	BRWASH98 - 47°08' / 124°37'; Washington	1998	20	fin clips
	BRSIT98 - Sitka	1998	50	fin clips

BRSIT99T - Sitka Sound	1999	200	fin clips
BRSIT99 – Sitka	1999	83	fin clips
BRPWS100 - Valdez	2000	13	fin clips
BRPWS200 - Whittier	2000	16	fin clips
BRRESB97 - Resurrection Bay	1997	82	muscle,liver,heart,eye,fin
BRRESB98 – Resurrection, North Fox Island	1998	24	fin clips
BRKOD96 - Kodiak Island	1996	2	muscle, liver, heart, eye
BRKOD197 - Ugak Bay	1997	100	muscle,liver,heart,eye,fin
BRKOD398 - Westside Kodiak Island	1998	114	fin clips
BRKOD198 - Eastside Kodiak Island	1998	100	fin clips
BRKOD298 - Southwest side Kodiak Island	1998	86	fin clips
BRSAND98 - Carpa Island near Sand Point	1998	40	fin clips
BRSAND99 - Castle Rock near Sand Point	1999	60	fin clips
BRKOD00 - Chignik	2000	100	fin clips
BRBERS99- Akutan	1999	100	fin clips
BRDUTS00 - Dutch Harbor	2000	6	fin clips
BRYAKU03- Yakutat	2003	130	fin clips

OREGON'S GROUNDFISH FISHERIES AND ASSOCIATED INVESTIGATIONS IN 2003

Prepared For the May 4 -5, 2004 Meeting of the Technical Sub-Committee of the Canada-United States Groundfish Committee

OREGON DEPARTMENT OF FISH AND WILDLIFE
2003 AGENCY REPORT

Compiled by
William H. Barss

Contributions by
D. Bodenmiller, R. Hannah, J. McCrae, R. Mikus,
Keith Matteson, S. Parker, C. Sowell and L. Zumbrunnen

Oregon Department of Fish and Wildlife
Marine Resources Program
2040 SE Marine Science Drive
Newport, OR 97365

April 2003

Review of Agency Groundfish Research, Assessments, and Management

A. AGENCY OVERVIEW - Marine Resources Program

Major sections, and the section heads are:

MRP Program Manager	Dr. Patricia M. Burke
Resource Assessment and Analysis	Dave Fox
Management and Monitoring	Rod Kaiser

The Program Manager and two assistant program managers supervise several Supervising Fish and Wildlife Biologists and Natural Resource Specialist-3 project leaders with specific, supervisory, management and/or research and assessment responsibilities. MRP has about 45 full-time permanent staff and 60-70 seasonal employees. The program's headquarters is located at Newport. Additional field staff is located at offices in Astoria, Tillamook, Corvallis, Newport, Charleston, Gold Beach and Brookings.

The MRP is responsible for assessing and managing Oregon's marine stocks of fish, shellfish, and marine mammals and their habitats, report on species status and make policy recommendations as appropriate through both state and federal management structures.

B. MULTISPECIES STUDIES

1. Recreational Fisheries Project:

Sampling of the ocean boat recreational fishery by MRP's Ocean Recreational Boat Survey (ORBS) continued in 2003. Based on the results of year round sampling in 1999-2000, less than 5 percent of the annual fishing effort and catch occurred during the winter period (Nov - Feb). Oregon plans to continue sampling the March through October period during 2004.

Black rockfish remains the dominant species caught in the ocean boat fishery. Lingcod, several other rockfish species (blue rockfish, China rockfish and other nearshore species), cabezon and greenling are also commonly landed. Oregon's fishery for Pacific halibut continues to be very popular, high profile fishery requiring International Pacific Halibut Commission (IPHC), federal, and state technical and management consideration and management.

The ORBS continued its species composition and biological sampling of groundfish species at Oregon coastal ports during 2003. Black rockfish and blue rockfish otoliths were gathered, in addition to lingcod fin rays, for ageing studies. ORBS continued collecting of length and weight data from groundfish species.
During May through September, a portion of recreational charter vessels were sampled at sea for species composition, discard rates and sizes, location, depth and catch per angler (CPUE) using ride-along samplers.

Other ODFW management activities included participation in the U.S. West Coast Recreational Fish International Network (RecFIN) process, data analysis and sponsoring public hearings to discuss changes to the management of Pacific halibut, lingcod and rockfish fisheries. See the specific section for more details. **Contact:** Don Bodenmiller (541) 867-0300, ext 223; don.bodenmiller@oregonstate.ed

2. Marine Recreational Fisheries Statistics Survey/Shore and Estuary Boat Sampling (SEB):
Through June 2003, port samplers continued conducting the federal Marine Recreational Fisheries Statistical Survey (MRFSS) by collecting demographic and creel data from boat and shore anglers in the ocean and estuaries. Species composition, length and weight data were collected.

Starting in July 2003, the program was changed to Shore and Estuary Boat (SEB) sampling program with much of the same duties as under the former MRFSS program. The main difference was that coastal estuary sampling was focused on non-salmonid and non-sturgeon fisheries away from the ocean boat fishery sampled by ORBS. Sampling in lower river tidal waters was mostly discontinued.

Black rockfish continued to dominate estuary boat groundfish landings and surfperch made up the majority of shore-based catch by weight. Salmon dominated estuary boat landings by weight. Pacific herring made up the majority of both shore-based and estuary boat landings by number of fish.

ODFW is funding a pilot project to determine if phone angler surveys for effort and trip type from shore and estuaries can be estimated based on an angler license frame. **Contact:** Don Bodenmiller (541) 867-0300 ext. 223; don.bodenmiller@oregonstate.edu

3. Species Composition Sampling:
Species composition sampling from rockfish, thornyheads and other groundfish continues on commercial trawl landings, commercial fixed-gear landings and recreational landings. **Contact:** Mark Saelens (commercial) or Don Bodenmiller (recreational) - (541) 867-0300 ext. 251 & 223; mark.saelens@oregonstate.edu, don.bodenmiller@ oregonstate.edu

4. Groundfish Maturity Study:
In 2003, we continued to collect maturity data on a number of nearshore and offshore rockfish, including yelloweye, vermillion, copper, tiger, quillback, China, aurora and yellowmouth rockfish. **Contact:** Bob Hannah at (541) 867-0300 ext. 231: bob.hannah@oregonstate.edu

5. Whiting Bycatch Sampling:
ODFW continued to coordinate a cooperative observation program to monitor bycatch and collect biological samples of unsorted Pacific whiting landings made at shoreside processors. Cooperators included:

Washington, Oregon and California fishing industry,
California Department of Fish and Game

Washington Department of Fish and Wildlife
National Marine Fisheries Service
Pacific Fishery Management Council
Pacific States Marine Fisheries Commission

Observers and staff obtained age samples from 720 yellowtail rockfish, 16 widow rockfish, 330 sablefish, 450 jack mackerel, and 1,580 Pacific whiting. Additional length frequency samples were taken on 2,608 Pacific whiting. **Contact**: Steve Parker or Brett Wiedoff (541) 867-0300 ext. 256 or 258; steve.parker@oregonstate.edu or Brett.L.Wiedoff@state.or.us

6. Cooperative Nearshore Project:
During 2003, Carla Sowell at Brookings worked on developing a cooperative research project with the Oregon South Cost, Port Orford Ocean Resource Team (POORT). The extended sampling project is scheduled to start in early 2004 and continue through December of 2004, and extend through 2005 if POORT funds are available. The project involves POORT contracting a commercial fishing vessel to catch three nearshore species of fish, china rockfish, kelp greenling, and cabezon. POORT will also hire a sampling crew to record the species, length, and weight of the fish. The crew will collect biological samples, otoliths for aging, gonad samples for histology, and fin-clips for genetic sampling. The ODFW will supply most of the sampling equipment, train the sampling crew and monitor the project. Biological samples will be stock piled until funding is available to analyze the data collected. **Contact:** Carla Sowell at (541) 412-7395; odfwbrookings@wave. net

7. Development and Testing of a Selective Flatfish Trawl
The ODFW selective flatfish trawl project was developed with two major objectives during 2003. We tested trawl efficiency at bycatch reduction in the DTS fishery and conducted a fishery-scale test of the trawl in the shelf flatfish fishery using a special authorization via an Exempted Fishing Permit (EFP). We tested the potential of a selective flatfish trawl to reduce rockfish bycatch in the upper continental slope bottom-trawl fishery. The trawl we tested differed from typical slope trawls in that it was a low-rise, two-seam trawl with a severely cut-back headrope. The study used an alternate haul, randomized block design to compare catches of the experimental trawl with those of a typical 4-seam, high-rise design. A similar protocol was used to investigate diurnal changes in catch rates for both trawls. The experimental trawl had similar catches of all commercially valuable flatfish except arrowtooth flounder *(Atheresthes stomias)*, which was reduced 24%. Catches of most rockfish and roundfish were significantly reduced (50-94% depending on species). However, the catches of darkblotched rockfish (*Sebastes crameri)* and redbanded rockfish *(Sebastes babcocki)* were not reduced significantly in the experimental trawl. Diurnal comparisons showed nighttime catches were reduced 30-99% for most rockfish species, with the experimental trawl showing greater reductions. The nighttime catch reduction for darkblotched rockfish with the control trawl (-86%) along with no reduction in Dover sole catches, suggests that fishing only at night may be a viable bycatch reduction strategy for darkblotched rockfish.

Also in 2003, the Oregon Department of Fish and Wildlife and the Northwest Fisheries Science Center of NOAA conducted an EFP fishery test of a new selective flatfish trawl to estimate bycatch rates in the continental shelf flatfish fishery. Eight vessels participated, with observer coverage from May through October 2003. We observed a total of 112 trips and 1,125 tows; with 721 tows in the RCA, and 404 shallower than the RCA. The trawl performed well and reductions in bycatch observed were consistent with the effects previously demonstrated in the controlled experiments. We recommended that a flatfish target fishery using this trawl be developed for use on the continental shelf off the west coast as a mechanism to reduce bycatch of some critical rockfish species. The results of the research and EFP activities were presented to the Pacific Fishery Management Council's Groudfish Management Team and Scientific and Statistical Committee. A fishery using this trawl is undergoing council analysis for implementation in 2005-2006 management measures. **Contact:** Bob Hannah or Steve Parker at (541) 867-0300 ext.231 or 256; bob.hannah@oregonstate.edu; steve.parker@oregonstate.edu

8. Nearshore Reef Habitat Studies:
Nearshore reef habitat studies continued on subtidal rocky bottom habitats off the Oregon coast. ODFW contracted with SeaVisual Consulting Inc to conduct a multi-beam sonar survey of Siletz reef north of Newport OR in October 2003. Over 31 km^2 of rocky reef habitat was mapped in this survey as a component of a larger study to characterize fish populations and fine-scale habitat usage on a large, heavily fished nearshore reef complex.

ODFW staff returned to Cape Perpetua for a fourth year to conduct ROV surveys of fish populations and habitat associations. Twelve transects, nearly all of them repeats of previously surveyed transects, were surveyed over two days in August 2003. We expect the analysis of these transects to document the continued recovery of this reef following the hypoxia event of July 2002.

a. GIS Description:
The Marine Resources Program GIS was summarized in the 1997 TSC report. Additions to the GIS in 2002 are listed below.

b. Base Maps and Baseline Data:
Base Maps
No additions for 2003 Baseline Data

Fish densities by habitat type at Cape Perpetua reef.

c. Software
No additions for 2003.

d. Bathymetric Data Sources
Multibeam sonar survey of the Siletz reef complex, 31 km^2.
Contact: Hal Weeks at (541) 867-0300 ext. 278; Hal.Weeks@state.or.u

9. Pelagic Species:
Refer to section on Pacific sardine - **Contact:** Jean McCrae for more information (541)-867-4741.

10. Developmental Fisheries Project:
The ODFW Developmental Fisheries Program was created to allow for controlled development of new species and fisheries. Each year, the Developmental Fishery Board recommends to the Oregon Fish and Wildlife Commission a list of food fish species that are considered to be developmental and a harvest program which includes a limited entry system. The Developmental Fishery Board is made up of members from a broad range of fishing interests (harvesters, processors, and state agencies).

In 2003, a total of 215 permits were issued for all species; 136 permits for finfish species. The main finfish of interest were nearshore rockfish (added to the developmental species list in 2003), for which there were 70 permits issued. Other finfish species for which we issued permits were hagfish (25), sardines (20), anchovy/herring (14), swordfish (4), blue shark (1), slender sole (1), and pomfret (1).

Most developmental species were landed as bycatch in other established fisheries. However, landings of sardines increased again in 2003. Seventeen vessels landed 55.7 million pounds (25,258 mt); an 11% increase from 2002. We were, again, unable to hire a seasonal worker to conduct ride-along trips to observe bycatch, but staff made a few observed trips. From observed trips and logbook data, bycatch consisted of sharks and some salmon. Salmon averaged 0.8 per trip, with 63 % being released alive. Logs (accounting for 92% of the landings) show 65 % of the harvest was taken off Oregon and 35 % off southern Washington. Incidental landings of mackerel accounted for approximately 0.6 % of the catch.

> Market samples of sardines were collected for length, weight, maturity, and age data. The average length and weight for all samples was 217 mm (standard length) and 175 gm**.** Industry had some problems marketing fish harvested in 2003 because of large sizes. This larger size is not reflected in the overall averages because there was also an increase in smaller fish. For example, in 2002, there was very few fish less than 200 mm in length. In 2003, almost 22% were smaller than 200 mm.
> **Contact**: Jean McCrae for more information (541) 867-4741.

11. Cooperative Ageing Unit:
ODFW ended their supervisory relationship with the NOAA's Northwest Fishery Science Center Cooperative Ageing Unit at Newport in September of 2003. Since that time, the ODFW age and growth biologist has continued working with the Cooperative Ageing Unit on Dover sole. In addition, a new age reader was trained to age various species of perch (redtail, silver, striped, white and pile). Work is being done on black rockfish, kelp greenling, English sole, and shortraker rockfish. ODFW has provided information and samples for part of a permanent exhibit at OMSI on age and growth in nature, and recently added more information and samples for the OMSI traveling exhibit that begins

its national tour at the beginning of May. ODFW is collaborating with scientists from NMFS on a series of age-validation studies (one in review, others in the planning stages). ODFW also participated in the annual Dover sole workshop in Eureka, California. **Contact:** Bob Mikus (541) 867-0300, ext. 247; bob.mikus@oregonstate.edu

12. Logbooks:

Status of Oregon logbooks is as follows:

Type	Years	Entered	Verified
1) Trawl Log	'76 – '03	Thru '03	'02
2) LE Sable Logs	'79 – '03	None	None
3) H&L Volunteer Logs	'88, '92 &'94 – '00	Thru '99	None
4) Nearshore Logs* *new in '04	2004	None	None

C. BY SPECIES

1. Pacific cod:

No work was conducted on Pacific cod. Usually, few fish are found in the trawl landings, but 2003 was one of the best years for Pacific cod in recent years. Total Oregon Pacific cod landings were up over 1,000% at 634,894 pounds (288 mt) in 2003 compared to 59,352 pounds (27 mt) in 2002. **Contact:** Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222; mark.saelens@oregonstate.edu William.H.Barss@state.or.us

2. Nearshore:

a. Oregon Nearshore Permit:

In 2003, a new permit was required to land 21-nearshore species in Oregon. These species included buffalo sculpin, red Irish lord, brown Irish lord, cabezon, kelp greenling, rock greenling, whitespotted greenling, painted greenling, kelp rockfish, brown rockfish, gopher rockfish, copper rockfish, black and yellow rockfish, calico rockfish, quillback rockfish, vermilion rockfish, china rockfish, tiger rockfish, grass rockfish, olive rockfish, and treefish. Seventy vessels qualified for this permit.

b. Black rockfish:

1) Coastwide sampling continues on recreational catches of black rockfish. Black rockfish are the most frequently caught fish in the ocean boat recreational fishery, and about 250,000 to 350,000 fish have been harvested annually in recent years. Port samplers take market samples from commercial landings. Recreational and commercial sampling includes biological sampling for age, length, sex and maturity. Age determination is done by ODFW. **Contact**: Don Bodenmiller (541)867-0300 ext.223don.bodenmiller@oregonstate.edu

2) Total commercial Oregon landings were 259,291 pounds (118 mt) which was slightly down from the 2002 landings of 280,227 pounds (127 mt). **Contact**: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222; mark.saelens@oregonstate.edu; William.H.Barss@state.or.us

3) Black rockfish PIT tagging

Oregon's primary recreational groundfish fishery targets the nearshore species, black rockfish (*Sebastes melanops*). Previous assessments relied on the relative CPUE trends derived from recreational fishery sampling programs. These data are not robust to problems of sampling bias or changes in fishing distribution, and can result in errors in the trend of relative population abundance. The need to independently estimate exploitation for black rockfish off Oregon prompted us to investigate the use of passive integrated transponder (PIT) tags for a mark-recapture program. Because PIT tags are invisible to anglers, there is no tag non-reporting problem, and tag detection rates can be estimated directly. We tagged 2,550 fish in 2002, and 3,000 fish in 2003 (29 – 54 cm) with PIT tags (12mm x 2mm) during 20 days of fishing each year near Newport, Oregon. Tags were injected in the hypaxial musculature below the gill arches, determined to be the best site by a previous PIT tag retention study. At tagging, categorical barotrauma symptoms were noted and each fish was recompressed by immediate submersion in a cage and release at depth. During the fishing seasons (May – October), carcasses of almost all black rockfish landed by charter vessels in Newport and Depoe Bay were counted by samplers and electronically scanned for tags. We have had good recoveries each year (52 and 86) and exploitation rates are within expected assessment values of approximately 5%. This program design will integrate well with the current tagging program used by Washington state and may result in a valuable abundance index for a combined Oregon – Washington assessment. We have begun the third year of tagging and will likely continue the project for the next 5 years.

Contact: Bob Hannah, Steve Parker or Don Bodenmiller (541) 867-0300 ext 256 or 223: bob.hannah@oregonstate.edu steve.parker@oregonstate.edu don.bodenmiller@oregonstate.edu

4) Barotrauma in rockfishes

We have built three pressurized aquaria that can hold up to 6 rockfish each and simulate depths of up to 30 m. We have documented the acclimation rates for black rockfish to increases and decreases in ambient pressures along with the physical symptoms associated with this barotrauma. We have also conducted process-oriented experiments to simulate hook and line capture and ascent to document physiological symptoms and mortality associated with capture. This information is intended to address assumptions in our PIT tagging program related to tagging mortality.

Contact: Steve Parker or Bob Hannah at 541-867-4741
Steve.parker@oregonstate.edu: bob.hannah@oregonstate.edu

5) **Oregon House Bill 3108**

In 2003, Oregon House Bill 3108 was passed by the Oregon Legislature. This bill established a black rockfish and blue rockfish vessel permit is required for commercial harvesters to land black rockfish and blue rockfish in Oregon beginning on January 1, 2004, except for minor exceptions. Vessels qualified for this permit by historically landing a minimum of 750 pounds of nontrawl caught black rockfish, blue rockfish or nearshore fish in any one calendar year between January 1, 1995 and July 1, 2001, to a licensed Oregon fish processor. About 180 vessels qualified for this permit. In 2004, this permit with a nearshore fish endorsement will be required to land the 21 nearshore species listed under Oregon's 2003 nearshore permit.

Contact: Bill Barss at 541-867-0300 ext. 222;
William.H.Barss@state.or.us

3. Shelf rockfish:

a. Widow rockfish - coastwide sampling continues for age, length and sex. Age determination is done by NMFS, Tiburon. Oregon landings in 2003 were 126,710 pounds (57 mt) which is considerably down from 557,190 pounds (253 mt) in 2002.

b. Canary rockfish - coastwide sampling continues for age, length and sex. Age determination is done by ODFW. Oregon landings continued to be extremely low. In 2003, they were only 8,111 pounds (3.7 mt) which down from the 38,190 pounds (17 mt)) in 2002.

c. Yellowtail rockfish - coastwide sampling continues for age, length and sex. Age determination is done by WDFW. Oregon landings in 2003 were about 123,547 pounds (56 mt) which was a big decrease from about 774,214 pounds (351 mt) in 2002. C**ontact**: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

4. Slope rockfish:

In 2003, most sampling was limited to species composition sampling. Length frequency samples and age structures were taken on selected. Pacific ocean perch landings were 215,516 pounds (98 mt) which was down from 235,660 pounds (107 mt) in 2002. Darkblotched rockfish were 146,514 pounds in 2003 (66 mt) which is a modest increase from 116,158 pounds (53 mt) in 2002. **Contact**: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

5. Thornyheads:

Sampling included sampling for species composition, length frequency, age and sex. Oregon landings of longspine thornyhead decreased to 1,623,489(736 mt) in 2003, which was about a 12% decrease from 1,835,958 (833 mt) in 2002. In 2003 Oregon landings of shortspine thornyhead were 652,488 pounds (296 mt), which was about a 13% increase from 577,238 pounds (262 mt) in 2002. **Contact**: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

6. Sablefish:

a. Routine age samples were obtained on sablefish. Otoliths were sent to the NMFS Ageing Unit in Newport, Oregon for age determination. Oregon landings were 4,797,600 pounds (2,176 mt) in 2003, which was up 51% from 3,184,824 pounds (1,445 mt) in 2002. **Contact**: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

b. Stress and Reproductive Physiology of Deepwater Sablefish
We collaborated with Michael Schirripa of NOAA, NWFSC to collect blood samples at sea from sablefish captured using pot gear as part of his survey expansion into deep water experiments. We collected plasma samples from over 60 fish, all from relatively deep depths, and subjected to varying periods of thermal stress during retrieval. In addition to stress physiology, we plan to measure sex steroids to evaluate reproductive status of fish inhabiting deep water (>700m). **Contact:** Steve Parker (541) 867-0300 ext. 256steve.parker@oregonstate.edu

7. Flatfish:

a. Nearshore flatfish
We saw a reverse of the previous year, with most Oregon nearshore flatfish landings were down in 2003 while landings of flatfish from deep water were generally up. Dover sole were 8,034,308 pounds (3,644 mt) up 34% from 6,001,276 pounds (2,722 mt) in 2002. Landings of English sole were 777,840 pounds (353 mt) down 19% from were 960,016 pounds (435 mt) in 2002. Landings of petrale sole were 2,510,664 pounds (1,139 mt), up 28% from 1,967,931 pounds (892 mt), in 2002. Landings of arrowtooth flounder were up by 60% at 1,786,095 pounds (810 mt) compared to 1,113,097pounds (505 mt) in 2002. Pacific sanddab landings were down 53% at 237,096 pounds (108 mt) compared to at 500,621 pounds (227 mt) in 2002. Contact Mark Sealens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

b. Pacific halibut
1) Weekly harvest in the recreational and also the commercial fishery were monitored for quota tracking purposes. The majority of recreational caught fish continue to be landed into Newport and Garibaldi. In 2003, the directed recreational fishery was open over 20 days, which was drastically down from a decade age when it was open nearly year round. The commercial

directed fishery was open for three 10-hour periods. In 2003 as in recent years, the recreational and commercial fisheries received equal allocations.

2) Public meetings were held to discuss 2003 recreational fishery structuring and proposed changes to the 2004 catch sharing plan for Oregon recreational fisheries.

3) In 2003, Oregon commercial fishers landed 341,521 pounds (155 mt) down 35% from 529,194 pounds (240 mt) in 2002. **Contact:** Don Bodenmiller (541) 867-0300 ext. 223on.bodenmiller@oregonstate.edu

8. Pacific whiting:

The Shoreside Hake Observation Program (SHOP) was established in 1992 to provide information for evaluating bycatch in the directed Pacific hake (*Merluccius productus)* fishery and for evaluating conservation measures adopted to limit the catch of salmon, other groundfish and prohibited species. The PFMC's optimum yield (OY) increased from 129,600 mt to 148,200 mt metric tons (mt) in 2003 (Table 1). The tribal fishery was allocated 16.9% of the OY (25,000 mt) and began harvesting on June 13th, 2003. Commercial fisheries received 83.1% f the U.S. OY. Allocations were 42% to vessels landing at shoreside processing plants (50,904 mt) (up from 44,906 mt in 2002), 34% to catcher/processors (41,208 mt), and 24% to catcher vessels delivering to motherships (29,088 mt). As of September 25, 2003 the mothership, catcher/processor and tribal fisheries continue to harvest the allocations. The mothership fishery has completed 89.4% (26,021 mt), catcher/processor fishery 89.7% (36,981 mt) and the tribal 89.0% (22,274mt). It is expected that the at-sea sectors will harvest their full allocations. Even though the shoreside allocation was increased, the 30-day shoreside season is the shortest since 1992 or program inception. The shoreside directed fishery closed on July 14th at 12:00pm and harvested 51,061 mt (0.31% over the allocated amount). . Samplers measured 2,608 Pacific hake for length-frequency information, and collected 1,580 Pacific hake otolith samples, along with length and weight information. . Yellowtail rockfish otoliths and length-frequency information are provided to Sandra Rosenfeld at the Department of Fisheries Marine Fish & Shellfish Division in Olympia, Washington for future stock assessments on this species. Biological samples of Pacific mackerel are provided to the CDFG for their stock assessment work on this species. Biological samples of widow rockfish are sent to Don Pearson NMFS in Santa Cruz, California. Sablefish, jack and pacific mackerel, darkblotched, bocaccio and canary rockfish have been retained at ODFW and are available for future assessment efforts. Past shoreside hake observation reports are available on the internet at http://hmsc.oregonstate.edu/ odfw/reports/whiting.html
Contact: Brett Wiedoff or Steve Parker at 541-867-4741, Brett.L.Wiedoff@state.or.us; steve.parker@oregonstate.edu

9. Dogfish:

No work was conducted on dogfish. Landings were very small in 2003 and decreased to 22,021 pounds (10 mt), down 34% from to 33,424 pounds (15 mt) in 2002.
Contact: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

10. Lingcod:

a. In 2003, Oregon commercial landings were 152,628 pounds (69 mt) which is down 16% from 2002 landings of 181,071 pounds (82 mt).
Contact: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

b. Age samples were collected from the commercial fishery and sent to Washington Department of Fish and Wildlife, Seattle for age determination. ODFW continued collecting age samples from the recreational fishery in 2003. In 2003, ODFW staff finished ageing the lingcod fin rays sampled in the 2001-2002 recreational fishery, and processed about 1/2 of the fin rays from 2002-2003 recreational fishery.
Contact: Bob Mikus (541) 867-0300 ext. 247 bob.mikus@oregonstate.edu

11. Mackerel and Sardines:

a. Mackerel
In 2003, landings of Pacific mackerel and jack mackerel combined were up at 515,006 pounds (234 mt), up 72% from 298,922 pounds (136 mt), in 2002. Almost all Oregon mackerel landings are landed as bycatch from the Pacific whiting fishery. **Contact:** Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu; William.H.Barss@state.or.us

b. Pacific Sardine
In 2003, landings for sardine continued to increase. Seventeen vessels landed 55.7 million pounds (25,258 mt); an 11 % increase from 2002. Most of the sardine catch was by seine gear (99 %), and fish were landed into Astoria and processed as bait for a Japanese longline fishery. Incidental landings of mackerel accounted for approximately 0.6 % of the catch.

We were, again, unable to hire a seasonal worker to conduct ride-along trips to observe by-catch, but staff made a few observed trips. From observed trips and logbook data, bycatch consisted of sharks and some salmon. Salmon averaged 0.8 per trip, with 63 % being released alive. Market samples were collected for length, weight, maturity, and age data. The average length and weight for all samples was 217 mm (standard length) and 175 gm. Industry had some problems marketing fish harvested in 2003 because of large sizes. This larger size is not reflected in the overall averages because there was also an increase in smaller fish. For example, in 2002, there was very few fish less than 200 mm in length. In 2003, almost 22% were smaller than 200 mm. **Contact:** Jean McCrae for more information (541) 867-4741.

12. Other:

a. Surfperch
Surfperch activity was limited to biological sampling of carcasses and processing recaptured tagged surfperch. Carcasses and tags were provided by cooperating

sport fishers. **Contact:** Don Bodenmiller (541) 867-0300 ext. 223 don.bodenmiller@ state.or.us

Processors reported receiving only 134 pounds of surfperch in 2003, which is a similar to the low 100 pounds in 2002. Interest continues for the commercial harvests of surfperch, especially in Oregon's south coast area. In 2003, commercial harvest of surfperch was again prohibited in the months of August and September to protect redtail surfperch during the months that they spawn off Oregon. **Contact:** Bill Barss (541) 867-0300 ext. 222, William.H.Barss@state.or.us

b. Pacific herring

The Yaquina Bay commercial roe herring seine fishery landed 207,203 pounds (94 mt). The herring in the bay spawned before fishers reached the quota of 277,200 pounds (126 mt). An additional 8,987 pounds (4 mt) of herring were landed in Astoria and Winchester Bay, destined for the bait market. **Contact:** Keith Matteson (541) 867-0300 ext. 244; keith.matteson@oregonstate.edu.

c. Hagfish

In 2003, Oregon commercial landings of hagfish were 955,562 pounds (433 mt) up 38% from the 691,085 pounds (313 mt) in 2002. This is the highest catch on record for Oregon hagfish landings. The previous record landing was 751,281 pounds in 1992. **Contact:** Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222; mark.saelens@oregonstate.edu William.H.Barss@state.or.us

d. Skates

In 2003, landings of skates were 2,077,456 pounds (942 mt) which was up 91% from 1,087,592 pounds (493 mt) in 2002. Species composition and length frequency samples were taken. **Contact**: Mark Saelens or Bill Barss (541) 867-0300 ext. 251 or 222 mark.saelens@oregonstate.edu William.H.Barss@state.or.us

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Hannah, R. W., S. J. Parker and T. V. Buell. (in review at Fisheries Research). Tests of a selective flatfish trawl in the deepwater complex fishery off the U. S. west coast.

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Parker, S. J., P. S. Rankin, R. W. Hannah, and C .B. Schreck. 2003. Discard mortality of trawl-caught lingcod in relation to tow duration and time on deck. North American Journal of Fisheries Management 23:530-542.

Parker, S. J., M. R. Saelens, S. A. Kupillas and R. W. Hannah. 2004. Using an exempted fishing permit for a large-scale test of a selective flatfish trawl in the continental shelf flatfish fishery. Oregon Dept. Fish Wildl., Information Rept.Ser., Fish. No. 2004-01. 22p.

Projects planned for year 2004:

1. An EFP will be conducted to test a market-based discard reduction strategy in the deepwater complex trawl fishery. **Contact:** Bob Hannah (541) 867-0300 ext. 231 bob.hannah@oregonstate.edu.

2. Maturity data will continue to be collected for several nearshore and offshore rockfish species. **Contact:** Bob Hannah (541) 867-0300 ext. 231 bob.hannah@oregonstate.edu.

3. Black rockfish Telemetry: A study to document the use of space by black rockfish off Oregon will use a moored acoustic receivers and pressure sensitive acoustic transmitters to show hoe range size, scale of local movements, degree of vertical movement of a daily basis, and possible seasonal movements along shore or into deeper water.
Contact: Steve Parker at 541-867-4741 Steve.parker@oregonstate.edu

4. Barotrauma in rockfishes: We will continue work to document mortality rates, determine acclimation rates, and study physiological effects of barotrauma in black rockfishes and plan to expand to other nearshore rockfishes. This work is intended to supplement our black rockfish tagging study and also to develop and test rockfish re-pressurization release devices for use in the recreational groundfish fishery.
Contact: Steve Parker or Bob Hannah at 541-867-4741 Steve.parker@oregonstate.edu

5. Nearshore Reef Habitat Studies in 2004 will include limited ROV surveys of rocky reefs in the Newport area. Study sites have not been selected at this time. **Contact:** Hal Weeks, (541) 867-0300, ext 279; Hal.Weeks@state.or.us

6. The cooperative sampling project with the Port Orford Ocean Resource Team (POORT), will start in February of 2004 and will continue through December of 2004, with the possibility of extending through 2005 if POORT funds are available. The project involves POORT contracting a commercial fishing vessel to catch three nearshore species of fish, china rockfish, kelp greenling, and cabezon. ODFW will supply most of the sampling equipment and POORT will supply the crew from the fishing industry to sample the retained nearshore species. Our Brookings Port Biologist, Carla Sowell, will train the sampling crew. The sampling crew will record the species, length, and weight of the fish, and then collect biological samples, including otoliths for aging, gonad samples for histology, and fin-clips for genetic sampling. The biological samples will be stock piled until funding is available to analyze the data collected. **Contact:** Carla Sowell at (541) 412-7395 odfwbrookings@wave. net.

7. In February 2004, Marine Resources Program will begin developing a comprehensive, nearshore marine resource management plan. The planning project involves three primary components: information-gathering, public process, and plan development. The public process includes a stakeholder advisory committee and public meetings to guide plan development. Participation will also be solicited from representatives of academia, government agencies, environmental organizations, and other interested groups. Individual experts will be consulted on specific issues as necessary. The product will be a plan

document outlining conservation strategies, management regulations, and biological and ecological information on nearshore species. The nearshore plan is being developed in conjunction with a larger statewide wildlife conservation planning effort.
Contact: Maggie Sommer at (541) 867-0300, ext 237, Maggie.M.Sommer@state.or.us

Washington Contribution to the 2004 Meeting of the Technical Sub-Committee (TSC) of the Canada-US Groundfish Committee

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May 4-5, 2004
Coupeville, Washington

Review of Agency Groundfish Research, Assessment, and Management

A. Puget Sound Area Activities

1. Puget Sound Management Activities *Contact: Greg Bargmann (360) 902-2825)*

Recreational Catch Estimation

In 2003, and continuing into 2004, we have spent considerable effort improving our catch estimation procedures for recreational fisheries for groundfish. In coastal waters we have instituted a monthly catch report. Landings by species in both numbers and weight are reported for each month between March and September (fishing effort is very low in the other months). The report is due one month after the period of fishing: i.e. landings in March are reported by the end of April. Estimates of discards are also included. The reports are posted on the Pacific States Marine Fisheries Commission RecFIN web site - http://www.psmfc.org/recfin/data.htm.

In Puget Sound we have instituted a new survey technique using a telephone survey to estimate fishing effort and an angler interview program to estimate catch rates, species composition and gather biological data. The telephone survey is based on fishing licenses where a random survey of license holders are telephoned at two month intervals and asked to describe their saltwater fishing trips during the previous two months. Through our new electronic license system (WILD) we know the total number of fishing licenses sold. By combining the total number of licenses and the average number of fishing trips per license holder we can estimate fishing effort by area. The effort estimates are expanded by the interview results to account for unlicensed anglers and CPUE estimates are applied to determine total catch. Estimates of fishing effort and catch are made for two month intervals. Estimates of discards are also provided.

During the telephone survey we estimate fishing areas for all marine waters of Washington thus providing a check on the amount of fishing effort in coastal areas during months when the coastal sampling program is not active.

The present program, in both Puget Sound and coastal areas, is limited to boat based fishing. Estimates of catch and effort from shore, pier and jetty fishing are not being made currently. This is a hole in the catch estimation that we hope to address in the upcoming years.

The number, species, size and fate of fish discarded in recreational fisheries is becoming an increasingly important component in management of recreational fisheries. Until recently, we have estimated the number of fish discarded without knowing their mortality rate or weight. We are now in the process of obtaining this information.

Our efforts include placing observers on charter vessels to closely observe the fish that are discarded. Additionally we are asking anglers when they return to shore about their

discards. Part of the interview process includes showing anglers color photos and asking them to identify the number and species discarded.

We are now asking anglers about the depth of water where discarded fish were captured. Due to time constraints during the interview process, we cannot determine the depth for each fish discarded. Rather we ask anglers whether most of the discarded catch was caught in waters deeper or shallower than 60 feet. We are currently developing mortality estimates by species, or species groupings, for depths greater or less than 60 feet. We intend to apply these mortality estimates by depth to estimate mortality of the discarded catch. Note that the 60-foot depth level was chosen on little information and we would welcome suggestions for a more appropriate depth level.

We are also attempting to measure discarded groundfish seen during observed fishing trips. Additionally, we are asking selected anglers the reason for discard- i.e. the fish was too small, undesirable etc.

We are placing our initial emphasis on the discard of lingcod. Recreational fisheries for lingcod are an important factor in management and considerable numbers of lingcod are discarded.

Sixgill Shark Studies

In 2003, we instituted a study of sixgill sharks in Puget Sound. Current regulations prohibit the retention of sixgills in Puget Sound and there is interest in allowing both commercial and recreational fisheries for this species. Harvest is not allowed as we have insufficient information to establish any sort of a management plan or set an acceptable level of harvest.

As part of the study we tagged sharks in Puget Sound during the spring and summer of 2003. Sharks were caught by longline gear (except one caught by trawling and one caught by sport fishing gear). The tags used were FLOY disk tags applied to the dorsal fin. We plan to revisit the initial tagging area during the summer of 2004 and tag more fish and look for recaptures.

To date we have caught 140 sixgill sharks, tagged 129 and dissected 11. None of the dissected sharks was mature. Muscle and liver tissues from the dissected sharks were sampled for analysis for chemical contaminants.

As a sidelight to this project, we attempted to tag sixgill sharks in Willapa Bay, along the southern coast of Washington. While we did not catch any sixgill sharks we did encounter sevengill sharks in the bay. According to local fishermen, the sevengills enter the bay during the summer months and the protected waters may be used as a birthing/nursery area. During August and September of 2003 we caught 28 sevengill sharks in 8 days of fishing. 24 fish were tagged and released.

Rockfish in Puget Sound

The Department of Fish and Wildlife has undertaken a major effort to develop conservation/rebuilding plan for rockfish in Puget Sound. This effort was initiated at the request Governor, who asked the agency to develop plans for all groundfish species in Puget Sound by the end of 2004. After consultation, we all agreed that that task was too large to be accomplished in the allowed time and that rockfish were the species most in need of improved management. During 2004 we will be developing rebuilding plans for rockfish and we intend to draw heavily on the work done in California and British Columbia for inshore rockfish.

Dogfish Sharks

During 2003 and early 2004 we continued our management interest in dogfish shark. A key part of this was collaboration with Dept of Fish and Oceans to re-examine the harvest model currently in use for the "inside" waters of British Columbia and Washington State. A major output of the joint work was a presentation at the annual meeting of the AAAS in Seattle during February 2004.

As part of our continuing efforts on dogfish the Department of Fish and Oceans, the University of Washington and the Washington Department of Fish and Wildlife are planning a symposium of dogfish sharks to be held during April 2005 at the University of Washington in Seattle. Preliminary plans call for sessions on the following topics:

1. Age, growth and reproductive biology of dogfish
2. Ecosystem impacts of increasing or decreasing dogfish populations
3. Dogfish management throughout the world- unfortunately a series of case failures
4. Stock identification and/or movement studies
5. Fisheries biology of dogfish

Pacific Herring

In January 2004, NOAA-Fisheries received a petition from a number of environmental groups to list the "stock" of herring that spawn in the vicinity of Cherry Point as threatened or endangered under the U.S. Endangered Species Act. NOAA-Fisheries has not yet acted on this petition but should do so by the spring of 2004.

The group of herring that spawn near Cherry Point has undergone a dramatic and consistent decline in abundance over the past 15 years. Combined with the shrinking abundance the age composition has been compressed with few spawning fish over the age of 4 years.

Ecosystem Management *Contact: Mary Lou Mills (360) 902-2834)*
The Georgia Basin/Puget trough/Willamette Valley Eco-regional assessment is close to being released. The eco-regional assessment assembled data throughout the eco-region

and used the SITES algorithm to select areas of high biodiversity. These areas are most relevant to efforts aimed at protecting biodiversity and associated land use decisions. The ECA has been a collaborative project among various state and provincial organizations and The Nature Conservancy. The next eco-region that will be looked at is the North Coast area including the offshore waters.

2. Puget Sound Groundfish Monitoring, Research, and Assessment *(Contact: Wayne Palsson, Marine Fish Science Unit (425) 379-2313, palsswap@dfw.wa.gov)*

The Puget Sound staff of the Marine Fish Science Unit includes Wayne Palsson, Robert Pacunski, Tony Parra, Karl Mueller, and Jim Beam. Their tasks are primarily supported by supplemental funds from the Washington State Legislature for the recovery of Puget Sound bottomfish populations. Most of the work of the staff is associated with the Puget Sound Ambient Monitoring Program (PSAMP) and is tasked by the Puget Sound Action Team. The main activities of the unit include the assessment of bottomfish populations in Puget Sound and the evaluation of bottomfish in marine reserves. This year, additional grants and contracts were received for special studies regarding marine fish habitat modifications and marine reserves in Puget Sound.

Puget Sound Marine Habitat Studies

Wayne Palsson is collaborating with Professor Gary Greene and his students who are mapping the San Juan Archipelago with a multi-beam echosounder. A grant has been funded by NOAA's Center for Coastal Services to further augment surveys collecting detailed bathymetric and backscatter data (Figure 1). As maps are developed and habitats are identified, trawl, video and ROV surveys will be correlated with fish abundance. In late 2002, Robert Pacunski and Jim Beam collaborated with Greene and Janet Tilden in an ROV survey funded by the National Undersea Research Program with the purpose of examining specific identified habitats and the associated fish fauna. In 2003, Pacunski and Palsson collaborated with Janet in the interpretation of the video tapes that were used to verify habitat classifications and develop data on fish and habitat associations. Most of remaining deep-water habitats were mapped in the San Juan Archipelago and the data are being processed.

Wayne Palsson collaborated with Professors Don Gunderson of the University of Washington and Gary Green of Moss Landing Marine Labs in successfully obtaining a Washington Sea Grant to examine the distribution of marine fishes in relation to the distribution of different sea floor habitats that were mapped Dr. Greene through the NOAA/CCS and other grants. The work will make use of the ROV at Friday Harbor Laboratories, scuba transects, and other quantitative methods to estimate the densities of juvenile and adult rockfishes, lingcod, and greenling in San Juan Channel. These densities will be mapped by life history phase in relation to the different habitat types and in relation to the marine reserves that already exist in San Juan Channel. With the work commencing in 2004 and ending in 2005, a model of fish and habitat associations will be developed for the study area and will be used to evaluate the performance of the reserves.

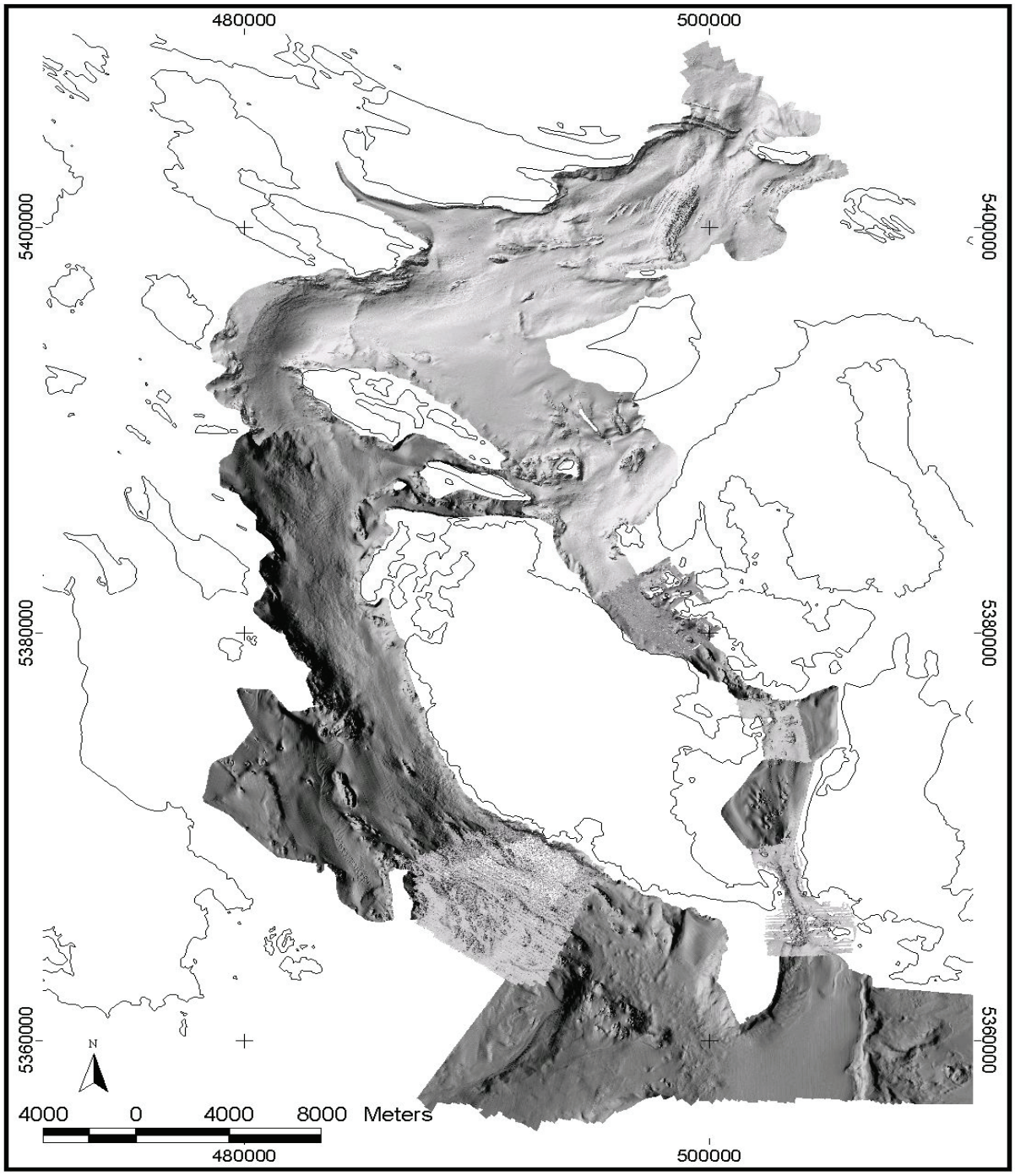

Figure 1. Preliminary map of the western San Juan Archipelago depicting backscatter data from multibeam surveys (Courtesy of Gary Greene, MLML).

Evaluation of No-Take Refuges for Reef Fish Management

WDFW has developed a system of 18 fully and partially protected marine reserves in Puget Sound (Figure 2). As the system has expanded, MFSU staff has developed a plan

to monitor a core series of the marine reserves on a frequent basis and visit other subtidal reserves on a periodic basis. This plan builds upon field research at many of these sites that was begun as early as 1986. The field work primarily consists of scuba divers' conducting visual censuses along strip transects. Along with estimating fish density, divers' measure individual fish and in the case of lingcod, quantify nesting activity.

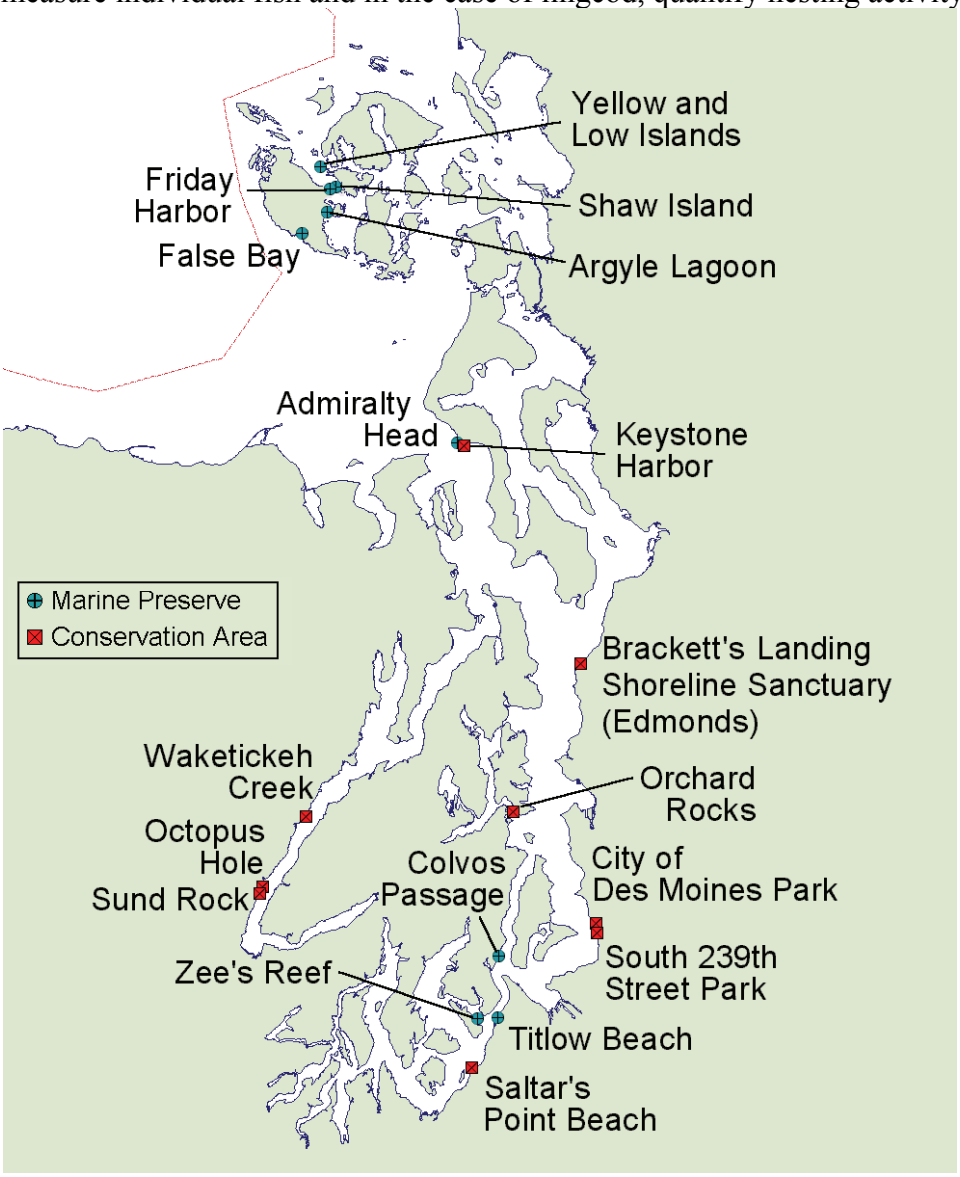

Figure 2. WDFW non-tribal marine reserves in Puget Sound. Conservation Areas are fully-protected; Marine Preserves are partially-protected.

Specific monitoring activities in 2003 included surveying many of the Puget Sound reserves and comparable fished sites. Several reserves in central Puget Sound were visited six times during 2003 as an extension of a study initiated in 1999 that takes advantage of the previous information collected at Orchard Rocks. This site was declared as a fully-protected reserve in 1998 but was a fished site monitored in 1986, 1987, and from 1995-1997. With the addition of a new fished site treatment at Point Glover, the newly created refuge in a formerly monitored fished area is an excellent opportunity to

evaluate the before and after impacts of refuge creation with a comparable fished site treatment. WDFW also created several new reserves in 2002. These included subtidal reserves at Admiralty Head and Keystone Jetty in Admiralty Inlet and Zee's Reef in Southern Puget Sound. Monitoring was initiated at Zee's Reef in 2002 with six surveys conducted again in 2003. The reserve at Colvos Passage was also monitored during the same survey series.

The marine reserve monitoring studies conducted in the San Juan Islands, Hood Canal, and Central Puget Sound were analyzed and the results presented at the 2003 Georgia Basin/Puget Sound Research Conference held in Vancouver, B.C. The results confirmed those previously reported that most marine reserves had higher densities of copper rockfish and lingcod than comparable and nearby fished areas. These fishes were also larger in the long-term reserve at Edmonds (Brackett's Landing) than at the fished areas. In Hood Canal, where the existing reserves amount to almost 20% of the available nearshore rocky habitat, increasing sizes of copper rockfish have been observed since 1996 at a site set aside as a reserve in 1994. However, recent comparisons among fished and reserves sites has found similar size compositions between reserve and fished area treatments. The densities of copper rockfish are significantly greater in the Hood Canal reserves than the fished area. In the San Juan Islands, rockfish and lingcod densities in the reserves are also greater than at nearby fished areas, but there have not been any discernable trends in size or density for copper rockfish over a span of ten years of monitoring and 12 years after reserve creation. For lingcod at these sites, the winter-time densities are substantially greater than in fished areas, but densities in both reserve and fished area treatments have been increasing. At Orchard Rocks, the central Sound reserve created in 1998, there has not been any increase in copper rockfish abundance, but lingcod abundance has increased.

The analysis also found a major change at the long-term reserve at Edmonds. The study site once harbored a large school of large copper rockfish that accounted for a high estimated reproductive advantage for the long-term reserve compared to fished areas. Since 1999, this school has disappeared with a resulting decrease in the density of copper rockfish at the site. During the same period, lingcod abundance has dramatically increased simultaneously with the decline in copper rockfish. While a number of competing hypotheses can not be ruled out to explain these patterns, the shift to a site dominated by large piscivores may reflect a shift in the trophic dynamics of the reserve. Co-incidentally, a new study on the ecological succession and trophic dynamics in Puget Sound reserves was initiated in 2002 (See Below).

Ecological Succession and Trophic Cascades in Puget Sound Marine Reserves

With major funding from the Conservation and Re-investment Act Fund, administered by the U.S. Dept. of the Interior, the MFSU received a grant to examine the prey and predator relationships the array of long-term and newer reserves within Puget Sound as well as nearby fished areas. Karl Mueller is the lead biologist for this project. The grant was initially developed for a three-year study but was cut back to 1.25 years during the first year. The amended work plan therefore included the following objectives: 1.)

Develop protocols for monitoring prey species in an array of old and new marine reserves, 2.) Implement biodiversity monitoring in a range of old to new reserves, 3.) Interface biodiversity monitoring with existing surveys for managed species, and 4.) Review predator-prey literature for northwest rocky habitat species, identify data gaps, and recommend further studies. We completed or made progress on all of these goals during 2003. Protocols for monitoring unclassified species in marine reserves were developed during a pilot study completed in September 2003. Several transect and quadrat sampling techniques were tested using scuba visual census methods, and we selected a 0.5 m^2 quadrat placed randomly within rocky habitats to estimate the density of small supra-benthic fishes and invertebrates that are known prey items of rockfish, lingcod, and other predaceous bottomfish. By December 2003, we completed the first season ("fall") of biodiversity monitoring using the methods developed during the pilot study, and we collected at least 30 samples from each of seven reserves and four fished areas. These sampling activities were conducted while other WDFW scuba teams surveyed the same sites for lingcod, rockfish and other, larger rocky habitat fishes. Finally during 2003, we conducted a literature survey to identify existing knowledge on diet, abundance, trends, and succession of marine species.

Low Dissolved Oxygen Conditions at Sund Rocks Marine Reserve

Hood Canal is a fjord connected to Puget Sound in the north and extending 100 km to the south (Figure 1). The steep sides of the canal extend to depths of 180 m in the north and range to depths of over 125 m for most of the water body. Hood Canal is one of the water bodies identified in the Pew Ocean Commission report as a hypoxic dead zone. Dissolved oxygen (DO) concentrations of less than 2 mg/l have been observed for decades in deep and shallow waters in the southern portion of the canal (Warner et al. 2002; Collias 1974), and these low concentrations have been attributed to naturally poor circulation resulting from low estuarine flow and bottom water replacement. In recent years, low DO concentrations have become chronic, extending into nearshore waters and possibly becoming worse due to eutrophication (J. Newton, Wash. Dept. of Ecology, pers. comm). Mass mortality events of fishes and invertebrates (Fish Kills) in 1926 and 1963 likely have resulted from poor water quality.

Beginning in 2001, WDFW began surveying marine fishes with respect to depth at the Sund Rocks Reserve. Two discrete and prominent rocky habitats located north and south of each other were surveyed independently. A team of three divers conducted the visual surveys. One diver swam the 9 m isobath and oriented the two recording divers along the longitudinal axis of each survey area. The two divers swam along predetermined depth zones and identified, counted, and measured key fish species along the rocky outcropping. The divers swam close together to coordinate their observations and not double count fishes. Total length measurements to the nearest 10 cm meter were made with the aid of a graduated plastic rod.

DO concentrations were obtained from the Washington Department of Ecology's Marine Water Monitoring group, the University of Washington's PRISM program, and citizen monitors with the Hood Canal Salmon Enhancement Group. The data were collected by

calibrated continuous oxygen sensors or with water samples and subsequent laboratory titration.

Dive surveys at both the North and South Sund Rocks sites in November 2001 found that copper rockfish were distributed evenly from a depth of 5 m to a depth of 20 m and were generally not present in depths of less than 5 m. Monthly monitoring by WDOE revealed that DO concentrations were at least 3 mg/l in waters shallower than 20 m. In October 2002, we found rockfish were almost exclusively concentrated in depths of less than 7 m during a period when DO concentrations were greater than 5 mg/l in shallow water and less than 2 mg/l at greater depths. Rockfish were distributed evenly to 20 m in depth again by November 2002 when rains restored circulation and DO concentrations were once again greater than 4 mg/l in the nearshore zone.

During the 2002 low DO event, dead fish were not observed. On October 10, 2003, a fish kill was observed along the western edge of southern Hood Canal. WDFW divers observed dozens of dead copper rockfish, 24 other fish species, and many invertebrates along the shore and during census dives. Eighty dead copper rockfish were measured and they tended to be smaller than the live fish observed during the survey dives. The dive surveys also revealed that only half of the previous counts of copper rockfish were present (Figure 7). These numbers remained low during the subsequent November survey.

These field observations revealed that copper rockfish are hypoxia intolerant and cannot tolerate DO concentrations below 3 mg/l. The observed avoidance behavior is similar to the response of other marine fishes to low dissolved oxygen in Chesapeake Bay and other coastal waters where low dissolved oxygen limits the amount of available habitat (Breitburg 2002). The widespread occurrence of poor water quality in southern Hood Canal has many ramifications for sustainable fisheries pursued by tribal and recreational fishers and for the location and design of marine reserves in the area. Further work is planned for determining the causes of worsening water quality and the impact on marine resources.

Second Narrows Bridge Mitigation Study

In March 2003, the Washington Department of Transportation (WSDOT) and the Washington Department of Fish and Wildlife (WDFW) established a contract to fulfill part of the terms of the mitigation agreement for the construction of a second bridge at Tacoma Narrows, connecting Tacoma with the Kitsap Peninsula across Puget Sound. The contract establishes that staff from WDFW will conduct sampling at the bridge site to determine the impacts of the disruptive activities associated with the construction of the bridge upon marine fish communities at the bridge site. Primary areas of interest include the two caisson and pier sites, the proposed anchor sites, and the rip-rap fields that will be placed at the footings of the existing and new tower piers. As part of the mitigation, a new artificial habitat will be created at Toliva Shoal. This habitat will be configured as a structure that will potentially attract juvenile rockfishes and improve the existing artificial rocky habitat that was intended to attract adult rockfishes and lingcod.

The first quarter of work was focused upon obtaining video and diving observations at the SNB site before construction activities began disrupting the existing habitats. A plan was submitted to WSDOT detailing the plan for the construction of a juvenile reef at Toliva Shoal as a mitigation measure for the bridge construction. Third quarter activities included indexing videotapes collected during the first quarter, developing protocols to analyze those tapes, and beginning to quantify the habitat, fishes, and invertebrates in those tapes. The fourth quarter of work was focused upon obtaining video and diving observations in the vicinity of the SNB construction site, and establishing line transects to evaluate the proposed juvenile rockfish habitat at Toliva Shoal.

Wolf-eel Life History SCUBA Surveys

Field work was concluded in 2002 on a study of wolf-eel *Anarrhichthys ocellatus* in Puget Sound. While this is an identified species managed under the Puget Sound Groundfish Management Plan (Palsson et al. 1998), little is known about their life history, population status, or vulnerability to fishing. As a result of this study, the Fish and Wildlife Commission closed the harvest of wolf-eel in all Puget Sound waters. The basic study was initiated at two sites in South Puget Sound known to have wolf-eel colonies. Scuba transects were established at each site and individual den locations mapped. These sites at Day Island and Sunrise Beach, lie at the southern and northern ends of the Tacoma Narrows, respectively, and are separated by a distance of approximately 7 nautical miles. A monthly dive schedule was developed to gain information on den occupancy, consistency of counts, and basic biological observations. Individual wolf-eels were anesthetized with clove oil and marked by implanting visible elastomer tags *in-situ* in the lip region of the animal. In addition, naturally occurring marks were used to identify non-tagged fish. During the survey dives, 35 mm still and digital video cameras were used to capture high quality images of both tagged and non-tagged wolf eels. These spotting patterns around the eyes of wolf eels along with scars and color are unique and were used as natural marks to identify individuals. By identifying individual animals it was possible to track den and mate fidelity during the year and among spawning seasons.

The methods and interim results were presented by Tony Parra in a paper titled "Abundance, Mate, and Den Fidelity of Wolf-eel (*Anarrichthys ocellatus*) in Puget Sound, Washington which was published in the conference proceedings in 2002 (www.psat.wa.gov). Differences in mate fidelity between sites were observed for the over two years, with wolf-eels at Day Island exhibiting lower fidelity rates than those at Sunrise Beach. We observed a considerable decline in mate and den fidelity through subsequent spawning seasons at both survey sites. Only one of the original eight pairs that were observed at the beginning of the study remained together and five of twenty-one individuals remained in the same den throughout the duration of the study. Our results contrast with total mate and site fidelity resulting from captive observations and the generally accepted belief that wolf-eels mate for life. Factors that may contribute to a decline in mate and site fidelity of wolf-eels include the harvest management of competing and prey base species. Pacific giant octopuses have been observed displacing

wolf-eels from their dens and we have observed evidence of such occurrences at our study sites.

Work in 2003 was aimed at refining the use of natural marks for the identification of individual wolf-eel. Tony Parra developed a matrix of spot and scar patterns and catalog of individuals akin to those used by marine mammalogists for the identification of humpback and orca whales. In addition, Parra had several independent observers use the catalog and a series of photographs to determine the consistency of using these marks. Initial results indicated that 80% of the individuals were consistently recognized by the observers. Further development of the catalogue of recognition marks will occur with a subsequent reanalysis of mate and den fidelity determinations.

Quantitative Video Surveys for Assessing Rocky Habitat Fishes

Since 1994, Marine Fish Science staff has been conducting quantitative video surveys of nearshore rocky habitats in order to estimate population abundances of rockfishes, lingcod, greenlings, and other rocky habitat species. The survey was originally designed as the Video-Acoustic Technique (VAT) that consisted of a quantitative video camera to survey fishes within 2 m of the bottomfish and a scientific echosounder to survey fishes in the water column above rocky habitats. Beginning in 2002, the acoustic portion of the survey was dropped because of spending reductions. The remaining Video Assessment Techniques is based upon the area-swept method of quantitative surveys. The camera mounted on a platform is anchored at randomly-selected sites on identified rocky habitats. The camera is panned three times during the deployment and the video information is taped. The visual range of the camera is the radius of the area sampled by the camera and the fishes identified and enumerated during the last pan are used with the area to determine a density. The density observations are averaged and then multiplied by the amount of nearshore rocky habitat in the region.

Analysis of video data collected in the past and the estimation of population abundance has been limited by difficulties in estimating the visual range of video plots. Since 1998, two parallel lasers mounted on the camera aid in the determination of the visual range, but range estimates beyond three meters and during previous surveys are difficult and comparisons between observers and with previous determinations of the visual range have resulted in differences between 0.5 m and 1.5 m. Robert Pacunski led an effort in 2003 to develop criteria and tests of the observer's ability to determine visual range. A series of grids and plots were set up underwater around the video platform to measure the visual acuity of the camera. In separate tests without the grid field, wooden fish models were placed around the camera at random but known locations within and outside of the expected range of the camera without the knowledge of the observers. Their observations were then compared to the known locations. Generally, observer agreement was good within 3 m of the camera but became progressively poor to 6 m. which was near the functional limit of the camera. These tests will be refined in the future and past video range determinations will be reviewed for consistency before final population estimates are made.

2003 Trawl Survey of the Strait of Juan de Fuca

With support of the PSAMP, sufficient resources were pooled with Supplemental Recovery Funds to stage and execute an extensive survey of benthic fish populations in the Washington Strait of Juan de Fuca and portions of the Canadian Strait. The eastern WA and BC Strait was surveyed in 2000 but the western portion of the Washington Strait has never been adequately surveyed. The WDFW conducted a bottom trawl survey in four sub regions of the Strait during spring 2003. The goals and objectives of this survey were to estimate the abundance and describe the distribution of recreational and commercial groundfish and macroinvertebrate species, collect biological information from key species, and evaluate the relationship of abundance and distribution of key species to oceanographic features and the need for transboundary management. The sub regions included the eastern WA Strait (JE), the eastern BC Strait (CJ), Discovery Bay (DB), and the western WA Strait (JW).

The chartered *F.V. Chasina* was used as the sampling vessel which towed a 400 mesh Eastern net fitted with a 3 cm codend liner. Stations were selected with a stratified random approach based upon four depth zones for each of the sub regions. The area sampled at each station was measured with a differential GPS and known net width openings. The catch from each trawl was identified, weighed, and enumerated, and the weights and numbers of each species were divided by the area sampled to estimate species densities. Abundance will be estimated by averaging station densities within each stratum and multiplying these by the stratum area.

A total of 120 of 125 planned trawl stations were occupied and completed. Twenty-seven stations were occupied in British Columbia and 93 stations were sampled in the WA. There were 202 living taxa identified including 91 species of fish and 111 species of invertebrates. There were over 2,800 records of species catch which comprised a catch weight of almost 18 mt and represented 267,000 individuals. Canadian collections resulted in 4.8 mt of specimens including 40,000 individuals and 118 taxa. Almost 75,000 individual fish were collected from all areas and these weighed 14 mt. Spotted ratfish, spiny dogfish, walleye pollock, and Pacific cod were the four most frequently captured species. There was a series of samples collected for later analysis or archives. These collections included almost 725 fin clips for the genetic analysis of lingcod, quillback rockfish, copper rockfish, cabezon, spiny dogfish, walleye pollock, Pacific whiting and Pacific cod. Samples of up to 25 English sole and starry flounder were retained for laboratory analysis from each trawl sample. Approximately 27 species of specimens were collected for positive fish identification at a permanent museum collection. Vessel space offered to Canadian scientific staff was declined.

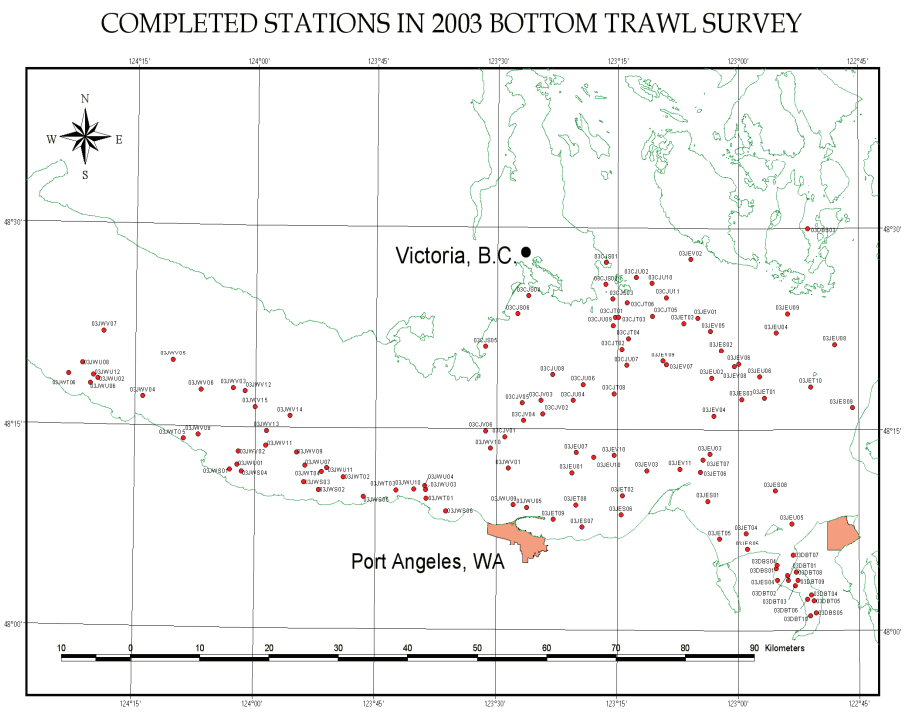

Figure 3. Completed bottom trawl stations for the 2003 bottom trawl survey.

Analysis of Past Transboundary Trawl Surveys

A retrospective analysis was conducted for the bottom trawl surveys that were conducted by WDFW between 1997 and 2001 in the Washington and British Columbian southern Strait of Georgia, San Juan Islands, and eastern Strait of Juan de Fuca. The survey goals were to estimate the abundance of demersal fishes and macroinvertebrates in the Washington and adjacent British Columbian portions of the transboundary waters. The spring-time surveys consisted of trawling at stations that were stratified by depth and selected on a systematic or random basis. At each station, a research bottom trawl fitted with a fine-mesh codend liner was towed from a chartered fishing vessel for approximately 10 minutes at a speed of 1.5 to 2 knots. In all, 210 trawls were conducted in Washington portions of the survey area, and 156 stations were occupied in the British Columbian portion.

In 1997 and 2000, extensive and synoptic surveys of the Washington and British Columbian Straits of Georgia and Juan de Fuca revealed that fish biomass was roughly distributed between the two areas in proportion to the area surveyed. However, individual species were not proportionately distributed. Species with affinities to shallow and unconsolidated sand and mud substrates were relatively more abundant in the Washington survey area where these habitats were more frequent. Species frequenting harder substrates were correspondingly more common in the British Columbian and San

Juan regions where these habitats were more common. Groundfish populations increased in the Washington Strait of Georgia from 11,000 mt in1997 to 18,000 mt in 2001. A long-term declining trend in total fish abundance was evident in the Washington Strait of Juan de Fuca.

Several distinct patterns in transboundary distributions were observed that have implications for coordinated fisheries management between the United States and Canada. In the Strait of Georgia, the deep Malaspina Trough confines shallow-water species to the rim around the basin. These species are less likely to be encountered by trans-border fisheries. Deep-water species, however, were distributed along the international border making them vulnerable to fisheries on either side of the border. The banks and troughs of the eastern Strait of Juan de Fuca presented a different pattern of species distributions. Shallow and deep-water species were distributed on either side of the international boundary making them both likely to be encountered by transboundary fisheries.

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3. Herring Stock Assessment *Contact: Kurt Stick (360) 466-4345 ext 243)*

Herring spawning biomass estimates were completed for nineteen spawning grounds in Puget Sound and two coastal grounds in 2003. Stock assessment field work for the 2004 spawning season is in progress. Spawning biomass is estimated for each area by spawn deposition surveys and/or acoustic-trawl surveys.

The herring spawning biomass estimate for all Puget Sound stocks combined in 2003 is 15,016 tons. This total is lower than the cumulative estimate for 2001 and 2002, but is relatively high for the last ten years. Population size for most stocks in central and south Puget Sound are currently considered to be at average or above average levels compared to the previous 25 year mean. As has been the case for several years, the Cherry Point and Discovery Bay stocks are the primary significant Puget Sound stocks that continue to be at critically low levels of abundance.

The combined total for Willapa Bay was just over 500 tons. Additional coastal herring spawning grounds surveyed in 2003 were located in Grays Harbor and were similar to 2002.

4. Puget Sound Ambient Monitoring Program (PSAMP) *Contact: Sandie O'Neill (360) 902-2843*

Ongoing Studies of PCBs in Puget Sound Fishes

The Puget Sound Ambient Monitoring Program (PSAMP) is a multi-agency effort to monitor the health of Puget Sound. The Washington Department of Fish and Wildlife participates by monitoring contaminant level in Puget Sound fishes. PSAMP has an ongoing monitoring program to assess contaminants of PCBs and other contaminants in Puget Sound fishes. To date, PCBs have been measured in edible muscle tissue of adult English sole (Pleuronectes vetulus), demersal rockfish (Sebastes spp.), chinook (Oncorhynchus tshawytscha) and coho (O. kisutch) salmon and whole body concentrations of Pacific herring (Clupea pallasi) to determine if concentrations reflected environmental exposure from the geographic areas in which they reside. English sole from urban bays accumulated higher concentrations of PCBs than from near- or non-urban bays and concentrations in tissue and sediments were positively correlated. Highest PCB concentrations in rockfish were also observed in fish from urban bays. PCBs accumulated in older males but not in older females, who likely loose PCBs during reproduction with transfer of nutrients (lipids) to larvae. Higher PCB concentrations were also observed in Pacific herring, from the central Puget Sound basin where most of the urban bays are located, suggesting that PCBs present in discrete areas of marine sediments can be transported to the pelagic food web, distant from their source. Possible transport mechanisms include maternal transfer of PCBs from benthic feeding biota. PCBs were also detected in Pacific salmon with higher concentrations in chinook than coho. PCBs in adult coho returning to rivers in Puget Sound were highest in the central basin followed by the southern and northern basins.

Based on our on-going monitoring results, Sandra O'Neill presented a paper at the Workshop on Contaminants in Fish held in San Diego in January 2004, highlighting the factors affecting PCB accumulation in fishes.

We have been developed a graphic conceptual model of PCBs in the Puget Sound food web that describes major trophic pathways in the Puget Sound/ Georgia Basin (PS/GB) marine ecosystem, through which PCBs might bio-accumulate or bio-magnify. Jim West presented this model at the 2003 Research Georgia Basin/Puget Sound held in Vancouver in the spring of 2003. This Lower Trophic Level sub-model identifies potential pathways among plants, invertebrates, and lower vertebrates, and comprises three modules: (1) a graphic image of the lower trophic levels food web (LTLFW Module) illustrating major ecological groups in the PS/GB ecosystem, and their trophic connections ("who eats whom"). (2) A text outline that describes assumptions and provides explanations of groupings and suggestions for indicator or representative species. (3) A spreadsheet that describes major pathways for uptake and elimination of PCBs within organisms. These descriptions are used to apply what we think are the dominant uptake and elimination pathways for each group in (2). Our intention is to link this Lower Trophic Submodel with two other submodels developed during the PCB Workshop held in September 2002, one dealing with loadings and abiotic transfer mechanisms, and the other with PCB pathways among higher trophic levels (birds, marine mammals, and humans).

English sole Home Range Tracking Study
A collaborative between NMFS and WDFW to study the home range of English sole by acoustically tracking fish with surgically implanted sonic tags is on-going in Eagle Harbor. Based on laboratory studies completed spring 2003, we decided to implant the tags on the eyed side of the fish.

English sole are suitable as a sentinel species for studies on effects of contaminants because they are broadly distributed in benthic habitats along the Pacific Coast where both juveniles and adults can contact contaminated sediment. Tagging studies have shown that, with the exception of a winter spawning migration and subsequent return to feeding grounds, adult English sole show site fidelity, tending to remain in Puget Sound bays for most of the year. Significant correlations between liver disease and other adverse health effects in English sole and chemical contaminants in sediments at the sites where these fish are captured support the hypothesis of high site fidelity. However, the home range is unknown and better information on home ranges and habitat utilization is needed to adequately characterize relationships between sediment contaminant exposure and fish health.

A two-year study was therefore initiated in the summer of 2003 to document movements by adult English sole tagged with acoustic transmitters. Twenty fish captured by trawling in Eagle Harbor, a small, contaminated bay, were implanted with transmitters and released at the site of capture, and another 20 will be tagged in April 2004. Stationary receivers equipped with omni-directional hydrophones were deployed to monitor fish moving in and out of Eagle Harbor. Individual fish moving within Eagle Harbor were also determined by active tracking from a small boat using a portable receiver with both directional and omni-directional hydrophones. 45% of the fish left the bay within 2 weeks of their release date and did not return. Fish that stayed in the bay generally remained near the areas where they were captured. When the study is complete, the data will help refine estimates of home range, habitat use, and migration timing of English sole so we can better understand their exposure to contaminated sediments.

Results of this Study were presented by Sandra O'Neill at the Western Groundfish Conference in Victoria B.C. in February 2004, and will be presented by Stephen Quinnell at the Northwestern SEATAC conference to be held in Port Townsend Washington, April 2004.

Study on Contaminants in Prey of Killer Whales
WDFW is working on a collaborative project with NOAA Fisheries to assess contaminant concentrations in known prey of killer whales, especially salmon species. We will be collecting 5 species of salmon from several locations along the west coast to determine whether fish returning to northern rivers (e.g. Skeena) have higher contaminant body burden than those returning to southern rivers (e.g., Fraser, Skagit, Columbia). Additionally, we will measure the nutritional quality of whole body samples of these salmon samples. The analyses will include caloric content, proximate composition, lipid analyses and lipid class profiles.

Analysis of Rockfish Growth Patterns
Identifying and quantifying spatial patterns in population structure of temperate marine fishes is important for their management. Two species of demersal rockfish, quillback

(*Sebastes maliger*), and copper rockfish (*S. caurinus*) have been important components of the commercial and recreational fisheries in the inland marine and estuarine waters of Puget Sound and Georgia Basin for the past 70 years. Populations of these long-lived, demersal carnivores are in serious decline. We used length-at-age (LAA) and a condition factor (CF) to identify specific patterns unique to oceanographic basins in these inland waters, comparing them with an oceanic population. For quillback rockfish, we observed the greatest LAA from oceanic samples, followed by fish significantly smaller-at-age from GB and still smaller from PS. This pattern was almost reversed for copper rockfish, with greatest LAA from oceanic and PS samples, and smallest from GB. For CF, we were only able to compare quillback rockfish from GB and PS, wherein PS quillbacks exhibited a lower CF than the Georgia Basin population. This difference was driven mostly by female rockfish from Puget Sound, which exhibited a significantly lower condition factor (CF) than Puget Sound males (not true between the sexes in the Georgia Basin), as well as a significantly lower CF than females from Georgia Basin. We discuss the significance of these findings, especially related to management of these species, as well as three potential factors that could have contributed to the patterns we observed: 1) basin-specific environmental or habitat-related factors (e.g., productivity, temperature, salinity and depth -- copper rockfish occupied significantly shallower depths than quillbacks), 2) pressures from fishing, and 3) effects on growth from toxic contaminants in Puget Sound, the most highly urbanized or industrialized of the basins we studied.

These results were presented by Jim West at a Lingcod and Rockfish Workshop held in Friday Harbor on September 25 – 27, 2003 and at the Western Groundfish Conference held in Victoria B.C. in February 2004.

B. Coastal Area Activities

1. Coastal Groundfish Management *Contact: Michele Robinson (360) 249-1211*

Council Activities
The Department contributes technical support for coastal groundfish management issues via participation on the Groundfish Management Team (GMT), the Scientific and Statistical Committee (SSC), and the Habitat Steering Group (HSG) of the Pacific Fishery Management Council (PFMC). The Department is also represented on the Scientific and Statistical Committee and Groundfish Plan Team 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.

Biennial Management for 2005-06
The Pacific Fishery Management Council has transitioned to a biennial management cycle for groundfish, beginning with 2005. The Council initiated this management cycle in November 2003, with preliminary decisions scheduled for April 2004, and final adoption of management measures in June. This results in 2005 being an "off year" for management, other than considerations for inseason adjustments. The biennial cycle also moves the assessment schedule such that 2004 is an "off year" for assessments, and 2005

will have an ambitious round of assessments that would be used for management in 2007-08.

2005-06 Management Considerations
The Pacific Council is considering exploring alternatives for regional management for canary, yelloweye, and black rockfish, and lingcod, rather than continuing with a coastwide management approach for 2005 and 2006. The acceptable biological catch (ABC) would likely remain coastwide unless there is genetic stock separation data available, with regional harvest guidelines or optimum yields (OYs) for management purposes. NMFS observer data for the trawl fishery and fixed gear fisheries is expected to be presented to the Pacific Council in April 2004 with preliminary management measures for West Coast commercial groundfish fisheries.

Relative to state recreational fisheries, the Department has held public meetings to solicit input on recreational management measures for 2005 and 2006. Input so far has indicated support for remaining at status quo–a 15 groundfish bag limit, with a sublimit of 10 rockfish, and 2 lingcod with a minimum size limit of 24", and no retention of canary or yelloweye rockfish.

Exempted Fishing Permits (EFPs)
The Department sponsored three EFPs in 2003 and plans to continue them in 2004. These EFPs include a trawl fishery targeting arrowtooth flounder, a longline fishery targeting spiny dogfish, and a midwater trawl fishery targeting pollock. The arrowtooth flounder EFP is based in Bellingham and Blaine, and takes place from May through August. Six vessels have participated in the EFP for the past three years; however, as a result of a federal buyback program that was implemented in November 2003, there will be only three vessels participating this year.

The spiny dogfish EFP is also based out of Bellingham during the months of February through May. There are three vessels that qualified to participate in the dogfish EFP, but only one vessel has chosen to do so.

The pollock EFP is based out of Westport and will have two participating vessels this year. In 2003, this EFP was scheduled for April through June, but there were only three EFP trips taken in the month of May. This EFP was terminated early as a result of higher than anticipated catches of Pacific whiting (~ 33% compared to < 10% in 2002). It was determined that pollock can be targeted more cleanly in the late summer; therefore, this EFP will occur from July through September this year.

The Department has initiated an effort to accommodate the arrowtooth flounder fishery in the federal fishing regulations, beginning in 2005, so an EFP would not be needed to access arrowtooth. The Pacific Fishery Management Council is currently considering this alternative. The results of the 2001 and 2002 arrowtooth flounder EFPs have been published, and a final 2003 arrowtooth flounder EFP report will be available in April. A report on the spiny dogfish EFP is expected to be completed by September.

2. Coastal Sardine Management *(Contributed by Michele Robinson, (360) 249-1211 and Brian Culver, (360) 249-1205)*

Experimental Purse Seine Fishery for Sardines

In Washington, sardines are managed under the Emerging Commercial Fishery provisions, which provide for the harvest of a newly classified species, or harvest of a previously classified species in a new area or by new means. From 2000 through 2002, the Washington Department of Fish and Wildlife had trial purse seine fisheries for Pacific sardines, under which the number of participants cannot be limited. Following an extensive public process which included establishing and meeting with a formal Sardine Advisory Board, the Director decided to advance the sardine fishery to an experimental fishery in 2003, under the Emerging Commercial Fisheries legislation, which mandates that permits be limited.

Pacific sardines are managed under the Pacific Fishery Management Council's Coastal Pelagic Species (CPS) fishery management plan. The Pacific Council develops and adopts a coastwide annual harvest guideline, which is then allocated between the two areas which take into account the biological and ecological impacts of harvesting forage fish. Earlier this year, the Pacific Council adopted an interim allocation regime with plans to develop a long-term allocation strategy over the next year.

The Northwest sardine fishery has rapidly expanded over the past few years, which was the primary reason the Department decided to convert from a trial to an experimental fishery. Oregon began its limited developmental fishery in 1999, which yielded 771 mt in sardine landings. Since then, the Northwest landings have increased with Oregon catching 22,711 mt and Washington landing another 15,212 mt, for a total of 37,923 mt in 2002. In 2003, the overall coastwide harvest guideline decreased slightly to 110,908 mt (from 118,442 mt in 2002), producing a northern allocation of 36,969 mt.

There were 17 fishermen who met all of the criteria necessary to obtain a Washington sardine experimental fishery permit in 2003. Out of the 17 permit holders, 10 made landings this year, for a total of 11,604 mt sardines landed into Washington. This is a decrease from the previous year (15,212 mt); it has been suggested that the decline in landings was the result of a slow startup, rather than fish availability. The size of the average landing was 40 mt.

Sixty-seven percent of the sardines landed were caught in waters adjacent to the Washington coast. This is an increase over past years in which about 43% of the sardines landed were caught off Washington. Sardines are landed into two coastal ports–Westport and Ilwaco. Westport is located on the south side of Grays Harbor and Ilwaco is located on the northern shore of the Columbia River. In 2003, 88% of the sardines were landed into the port of Ilwaco.

The Department provided observer coverage for the fishery and averaged about 24% coverage overall. Observers collected total catch data including species, amount, and

condition, and noted whether the fish were released or landed. Bycatch included Chinook and coho salmon, spiny dogfish, blue shark, and other species of fish.

Department staff also collected and processed biological samples. Otoliths were extracted and sent to the Department's lab in Olympia for age-reading. Data collected on the samples include standard lengths, individual weights, sex, and maturity.

3. Coastal Groundfish Monitoring, Research, and Assessment

Coastal Lingcod Stock Assessment for PFMC *Contact: Tom Jagielo (360) 902-2837)*
In 2003, WDFW provided an updated coastwide lingcod stock assessment for the Pacific Fishery Management Council (PFMC). The assessment applies to lingcod (*Ophiodon elongatus*) in the full Pacific Fishery Management Council (PFMC) management zone (the US-Vancouver, Columbia, Eureka, Monterey, and Conception INPFC areas). Separate assessment models were constructed to describe population trends in the northern (LCN: US-Vancouver, Columbia) and southern (LCS: Eureka, Monterey, Conception) areas.

Over the last two decades, trawl gear has made up the majority of commercial landings for the northern (83%) and southern (62%) coast. In recent years (1998-2002), commercial fishery restrictions constrained the trawl portion of the catch to 54% and 45% for the northern and southern coast, respectively. In 2002, coastwide commercial landings totaled 223 mt and were distributed as follows by INPFC area: U.S.-Vancouver 63 mt (22%), Columbia 52 mt (30%), Eureka 63 mt (27%), Monterey 35 mt (16%), Conception 10 mt (5%).

Recreational catch in southern waters has declined dramatically since catch peaked in 1980 at 2,226 mt. In contrast, recreational fisheries in northern waters catch peaked at only 236 mt in 1994 and in 2002, 127 mt was landed.

Historically, recreational landings have comprised a larger proportion of the total landings for the southern area, compared to the northern area. In recent years, the recreational portion of the total landings has increased substantially in both the southern and northern areas. In 2002, recreational fisheries harvested 83% of the total lingcod catch in the south and 52% in the north.

The new assessment updates the previous coastwide assessment (Jagielo et al. 2000) and is implemented in Coleraine using the executable code COLERA20.EXE (Hilborn et al. 2000). Coleraine is a statistical catch-at-age model programmed in AD Model Builder with a Microsoft Excel user interface.

A revised lingcod rebuilding analysis was prepared using the updated assessment results. The following table provides projected yield (mt) under the model allowing for domed fishery selectivity. Yields are shown for probability of recovery values ranging from P=0.5 to P=0.9, and for the 40-10 and ABC rules.

Model	Year	P= .5	P= .6	P= .7	P= .8	P= .9	Yr=Tmid	F=0	40-10 Rule	ABC Rule
Coastwide	**2004**	2825	2781	2732	2680	2609	2815	0	2674	3091
	2005	2677	2636	2588	2538	2467	2668	0	2694	2922
	2006	2497	2459	2414	2367	2299	2489	0	2618	2716
	2007	2339	2303	2261	2216	2150	2331	0	2511	2540
	2008	2250	2216	2175	2132	2069	2243	0	2437	2438
North	**2004**	2055	2055	2055	2055	2055	2055	0	2055	2055
	2005	1874	1874	1874	1874	1874	1874	0	1874	1874
	2006	1694	1694	1694	1694	1694	1694	0	1694	1694
	2007	1540	1540	1540	1540	1540	1540	0	1540	1540
	2008	1451	1451	1451	1451	1451	1451	0	1451	1451
South	**2004**	769	726	676	625	554	760	0	618	1036
	2005	804	762	714	664	594	795	0	821	1048
	2006	803	764	719	672	605	794	0	924	1021
	2007	799	763	721	675	610	791	0	971	1000
	2008	800	765	725	682	618	792	0	987	987

Evaluation of In-Situ Survey Methods for Demersal Groundfish *Contact: Tom Jagielo (360) 902-2837).*
In October of 2003, WDFW conducted further in-situ survey methodology development work using the new 3-Beam Quantitative Measurement System (3-Beam QMS). The 3-Beam QMS was affixed to the submersible Delta in a forward looking aspect. The operation was conducted on the *RV Velero IV* in the Channel Islands National Marine Sanctuary. Over a five day period, scientific colleagues from several federal and state agencies were invited to participate as we surveyed targets of known size for empirical verification of the systems performance in "real-world" conditions. In 2003, the system was upgraded to incorporate in-situ navigational capabilities using an Attitude Heading Reference System (AHRS), and measurement of the transect distance traveled using a Doppler Velocity Log (DVL).

Density of Demersal Groundfish in Untrawlable Habitat of the US-Vancouver INPFC Area
Contact: Tom Jagielo (360) 902-2837
Demersal groundfish densities were estimated by conducting a visual strip-transect survey via manned submersible on the continental shelf off Washington. The purpose of this study was to estimate the density of selected groundfish species in habitats not accessible to NMFS trawl survey gear, and to field test a new 3-Beam Quantitative Measurement System. Emphasis was placed on Yelloweye rockfish (*Sebastes ruberimus*), a species recently deemed to be overfished by the Pacific Fishery Management Council.

Nominally untrawlable habitat of the shallow (55-183m) stratum of the US-Vancouver INPFC area was used as the primary spatial sampling frame. Submersible transects were completed at 50 randomly selected dive sites selected *a priori* from a sampling grid prepared as an overlay to the spatial sampling frame. Bottom micro-habitat type was visually characterized for the sampled transects. The density of selected demersal groundfish species was estimated for the untrawlable habitat. Submersible survey density estimates for the untrawlable habitat were contrasted with recent trawl survey density

estimates derived from trawlable habitat. Yelloweye rockfish densities were used to derive an estimate of biomass for comparison with a recent PFMC stock assessment.

A manuscript containing the results of this study is near completion and will be submitted to a journal shortly.

Preliminary interpretation on stable isotopic data of yelloweye rockfish otoliths *Contact: Farron Wallace (360) 249-4628)*

In 2003 we analyzed 200 aragonite powder samples of otoliths of yelloweye rockfish (*Sebastes ruberrimus*) from the Washington (WA) and Oregon (OR) coast. For each otolith, one sample was taken from the nucleus (the starting time of otolith growth), and the other taken from the fifth annual zones of the otolith surface (assuming the year 5 in life history). Data of otolith nuclei will provide information on the natal development and spawning stock separation of the fish, whereas the isotopic signatures of age-1 and age-5 will indicate the behavior of the fish over the sampling period.

During the mass spectrometer analysis, three samples were failed because of the small amount of aragonite powder material. Overall, the $\delta^{13}C$ values of 197 otoliths of yelloweye rockfish ranged from -6.5 to -0.1 ‰ VPDB, whereas the $\delta^{18}O$ values of the same otoliths ranged from -0.5 to 2.2 ‰ VPDB. Isotopic values of otolith nuclei between WA and OR samples were slightly different (*t*-test, $p = 0.72$ for $\delta^{13}C$, and $p = 0.10$ for $\delta^{18}O$). However, the isotopic values of the fifth annual zones between the two areas were significantly different (*t*-test, $P < 0.0001$ for $\delta^{13}C$, and $p < 0.0001$ for $\delta^{18}O$).

Combination of $\delta^{18}O$ and $\delta^{13}C$ data showed no isotopic differences in otolith nuclei, suggesting there might be a single spawning stock for yelloweye rockfish along the WA and OR coast. For WA samples, there are distinct isotopic differences between samples from otolith nuclei and the fifth annual zones, indicating yelloweye rockfish might move to other habitat as they grew from age-1 to age-5. Similar isotopic trends or signatures were found in OR otoliths. Nevertheless, as compared within the fifth annual otolith zones between WA and OR samples, there were clear differences in $\delta^{13}C$, but not in $\delta^{18}O$ variations, suggesting that the food sources or composition of the two areas are slightly different.

In conclusion, the isotopic signatures from otolith nuclei showed there might be a single spawning stock for yelloweye rockfish along the WA and OR coast. From age-1 to age-5, the fish might change their habitat or associated bottom substrates for food.

Black Rockfish Tagging study *Contact: Farron Wallace (360) 249-4628)*
Since 1998, WDFW has conducted a multi-year mark-recapture survey near Westport Washington, the principal location of recreational landings of black rockfish along the Washington coast. The survey design involves five annual releases, and seven years of tag-recovery monitoring in the sport fishery. Approximately 2-3 thousand fish are released annually on pinnacles distributed throughout the area fished by the Westport charter fishing fleet. Each fish is tagged with two coded wire tags (CWT) placed in the

opercular musculature: one on each side of the fishes head. The tags are marked to allow for identification of specific individuals upon subsequent recapture. No tag shedding or tag related mortality was observed during holding experiments during 1998 and 1999.

On an annual basis, roughly 40% of the total Westport recreational black rockfish catch is sampled for tags by passing fish carcasses through a CWT tube detector. Cooperation of the charter boat industry has been very good and has enabled us to achieve the high sample proportion of the total number of fish landed (including those filleted at sea). Mark-recapture data will be used to produce estimates of abundance, survival, and mortality for black rockfish in the Westport coastal area. Population parameter estimates will be incorporated into the next black rockfish age structured model.

Data analyses show the importance of tagging as many fish as possible each year, and conducting an accurate and thorough sampling of as large a proportion of the catch as possible for tags. Study results so far are quite promising and efforts may be expanded to include the entire Washington coast in subsequent segments.

G. Report of the 2004 Committee of Age-Reading Experts

2004 Committee Report

Prepared for the Forty-fifth Annual Meeting of the Technical Sub-committee of the Canada-USA Groundfish Committee

May 4 – 5, 2004

Prepared by

Delsa M. Anderl

2002-2004 CARE, chairperson
Alaska Fisheries Science Center
National Marine Fisheries Service
7600 Sand Point Way
Seattle, WA 98115 USA

CARE 2004 Report to the Technical Sub-committee of the Canada-USA Groundfish Committee

A. CARE Overview, 2003-2004

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

1. The last biennial CARE Workshop/Conference was held April 20-22, 2004. The minutes are currently being drafted and should be available for the 2005 TSC. Workshop participants (Appendix I) and workshop agenda (Appendix II) are included in this report.

2. No dates have been set for the next biennial CARE Workshop but the workshop is expected to be held prior to the 2006 TSC meeting.

B. CARE Working Group Reports

1. Manual/Glossary Sub-committee- Shayne MacLellan (chair, report contributor), Betty Goetz, Kristen Munk, Bob Mikus

    a. The ageing manual is posted on the new CARE web site. At the 2002 workshop it was agreed to add chapters on lingcod and Pacific whiting.
    b. John Sneva from the Washington Dept of Fish and Wildlife is lead draft writer for the lingcod chapter with participation from the Canada Dept of Fisheries and Oceans. This chapter is nearly complete.
    c. Patrick McDonald from the Oregon Dept of Fish and Wildlife is lead draft writer for the Pacific whiting chapter with participation from the Canada Dept of Fisheries and Oceans. This chapter is nearly complete.
    d. Steve Wischniowski from the International Pacific Halibut Commission is lead for drafting a new design for the cover page of the manual. The new design was approved at the 2004 CARE meeting and will soon be available for viewing on the new CARE web site.
    e. At the 2004 workshop, it was agreed to add a chapter on statistical analysis/tools appropriate for age reading comparisons. Michael Shirippa is lead draft writer for this chapter.
    f. No new updates to the glossary.

2. Web Page Sub-committee- Jon Short (chair), Delsa Anderl, Brenda Erwin
    a. A new CARE web site will soon be updated to include 2002–2004 age-structure exchange results, 2004 minutes, age structure images onto the Ageing Methodology page and additions to the CARE manual. Suggestions from the 2004 meeting will be reviewed and posted by the web page sub-committee.
    b. The CARE web site is available at http://www.psmfc.org/care/CARE_Pub/index.htm.

3. Charter Sub-committee – Shayne MacLellan, Kristen Munk, Betty Goetz, Bob Mikus
    a. A completed draft of the charter was proposed to the CARE membership and approved at the 2004 workshop (see Appendix III).

b. The charter includes an overview of CARE, outlines the selection and duties of officers and membership, defines the role of sub-committees, and defines the format of the CARE biennial meeting, age structure exchange protocol and report protocols.

C. Agency Structure Exchanges

Additions have been made to the structure exchange table in the 2004 CARE to TSC report. However, the Dover sole age structure exchanges are currently in progress since the 2004 Dover sole workshop will not be held until later in May. All other exchanges prior to the 2004 CARE meeting are included in the CARE structure exchange table (see Appendix IV).

D. CARE Workshop Business

1. Status of 2003 Recommendations from TSC to CARE

   The CARE membership was advised of the 2003 recommendations from the TSC to CARE, in a summary report following the 2003 TSC meeting.

2. Status of 2004 Recommendations from CARE to TSC

   a. CARE recommends that TSC and its participating agencies support additional hands-on only workshops to address species specific age reading issues.

   b. CARE recommends to TSC that Appendix III (CARE Charter) be included in the 2004 CARE to TSC report.

APPENDIX I

CARE 2004 Attendees				
Agency	**Last**	**First**	**Email**	**Phone Number**
ADFG-Homer	Cowan	Philip	Philip_cowan@fishgame.state.ak.us	907 235-8191
ADFG-Juneau	Botz	Jeremy	jeremy_botz@fishgame.state.ak.us	907-465-3490
ADFG-Juneau	Constantine	Britt	Britt_constantine@fishgame.state.ak.us	907-465-3490
ADFG-Juneau	Munk	Kristen	kristen_munk@fishgame.state.ak.us	907-465-3054
ADFG-Kodiak	Brodie	Joan	joan_brodie@fishgame.state.ak.us	907-481-1902
CDFO	Campbell	Barbara	campbellba@pac.dfo-mpo.gc.ca	250- 756-7179
CDFO	MacLellan	Shayne	MacLellanSh@pac.dfo-mpo.gc.ca	250-756-7179 x7189
IPHC	Blood	Cal	Cal@iphc.washington.edu	206-634-1838 x228
IPHC	Forsberg	Joan	joan@iphc.washington.edu	206-634-1838 x224
IPHC	Tobin	Robert	robert@iphc.washington.edu	206-634-1838 x233
IPHC	Wischniowski	Stephen	SteveW@iphc.washington.edu	206-634-1838 x231
NMFS-AFSC	Anderl	Delsa	Delsa.Anderl@noaa.gov	206-526-4218
NMFS-AFSC	Benson	Irina	Irina.Benson@noaa.gov	206-526-4669
NMFS-AFSC	Brogan	John	john.brogan@noaa.gov	206-526-4219
NMFS-AFSC	Foy	Dan	Dan.Foy@noaa.gov	206-526-4267
NMFS-AFSC	Gburski	Christopher	Christopher.Gburski@noaa.gov	206-526-4268
NMFS-AFSC	Goetz	Betty	Betty.goetz@noaa.gov	206-526-4217
NMFS-AFSC	Hutchinson	Charles	Charles.Hutchinson@noaa.gov	206-526-6302
NMFS-AFSC	Johnston	Chris	chris.johnston@noaa.gov	206-526-4683

CARE 2004 Attendees				
Agency	**Last**	**First**	**Email**	**Phone Number**
NMFS-AFSC	Kastelle	Craig	craig.kastelle@noaa.gov	206-526-4266
NMFS-AFSC	Kautzi	Lisa	Lisa.Kautzi@noaa.gov	206-526-4701
NMFS-AFSC	Kimura	Dan	Dan.Kimura@noaa.gov	206-526-4200
NMFS-AFSC	Piston	Charlie	Charlie.Piston@noaa.gov	206-526-6524
NMFS-AFSC	Shockley	Wesley	wesley.shockley@noaa.gov	206-526-4684
NMFS-AFSC	Short	Jon	Jon.Short@noaa.gov	206-526-4685
NMFS-NWFSC	Coccetti	Susan	susan.coccetti@noaa.gov	541-867-0515
NMFS-NWFSC	Lysak	Lisa	lisa.lysak@noaa.gov	541-867-0516
NMFS-NWFSC	McDonald	Patrick	Patrick.J.McDonald@noaa.gov	541-867-0513
NMFS-NWFSC	Menkel	Jennifer	Jennifer.Menkel@noaa.gov	541-867-0517
NMFS-NWFSC	Rodriguez	Omar	Omar.rodriguez@noaa.gov	541-867-0512
NMFS-NWFSC	Schirripa	Michael	Michael.Schirripa@noaa.gov	541-867-0536
ODFW	Mikus	Bob	bob.mikus@hmsc.orst.edu	503-378-6925 x22
WDFW	Rosenfeld	Sandra	rosenslr@dfw.wa.gov	360-902-2851
WDFW	Sneva	John	snevajgs@dfw.wa.gov	360-902-2762
WDFW	Topping	Jennifer	toppijat@dfw.wa.gov	360-902-2795

APPENDIX II

COMMITTEE OF AGE-READING EXPERTS
A Sub-committee of the Technical Sub-committee of the
Canada-USA Groundfish Committee

2004 Biennial Meeting Agenda

April 20 – 22, 2004

NOAA-NMFS Alaska Fisheries Science Center

Seattle, Washington

DAY 1 Tuesday, 4/20/04

8:30 – 10:00 AM

I. Non-agenda Announcements, Introductions, Attendance
II. Approval of Agenda
III. Approval of 2002 Minutes
IV. Updates
    A. CARE email addresses and phone numbers
    B. Summary of age-reading methodology
    C. Standards

V. Working group reports
    A. Manual/Glossary (MacLellan, Goetz, Munk, Mikus)
    B. Charter (Munk, Goetz, MacLellan)
    C. Web site (Short, Anderl)

VI. Structure Exchanges (Patrick McDonald)

10:00 – 10:20 AM BREAK

10:20 AM – 12:00 Noon

VII. Age and Growth Lab overview and update by agency
    A. ADFG – Kristin Munk
    B. CDFO – Shayne MacClellan
    C. CDFG – Brenda Erwin
    D. IPHC – Joan Forsberg
    E. NMFS-AFSC – Betty Goetz
    F. NMFS-NWFSC (PSMFC) – Patrick McDonald
    G. ODFW – Bob Mikus
    H. WDFW – John Sneva
    I. Other agencies and labs

VIII. Similarities and differences between agencies/labs
    A. Databases

B. Reading sheets – what's on them and what's not
C. Statistical analysis
D. Standardization – what's possible and what's not
E. Same species ageing differences – address a protocol toward resolution.

IX. Ergonomics (Betty Goetz)

12:00 – 1:15 PM LUNCH

1:15 – 2:30 PM

X**.** Recommendations
A. 2002 CARE to TSC recommendations
B. 2003 TSC to CARE recommendations
C. 2002 CARE to CARE recommendations
D. 2004 CARE to TSC recommendations
E. 2004 CARE to CARE recommendations

XI. Election of 2004-2006 Officers
A. Chair (Patrick McDonald)
B. Vice Chair/Age Structure Exchange Coordinator
C. Secretary/Rapporteur

2:30 – 3:30 PM

XII**.** Presentations
A. Proposed new CARE web site – by Jon Short (AFSC)
B. Otometrics – by Kristin Munk (ADFG)
C. Research Projects at DFO – Shayne MacClellan (CDFO)
D. Ageing skate species using vertebrae thin sections – by Chris Gburski (AFSC)

3:30 – 3:45 PM BREAK

3:45 – 4:45 PM

E. The challenges of determining ageing criteria for the Greenland turbot – by Jake Gregg (AFSC)
F. Age validation of canary rockfish using bomb radiocarbon dating – Jennifer Menkel (ODFW)
G. Walleye pollock radiometric age validation – by Craig Kastelle (AFSC)
H. Sufficient sample size to measure bias between two age determinations – Michael Shirripa (NWFSC)

<u>DAY 2</u> Wednesday 4/21/04

On-going scope work from 8:00 AM – 5:00 PM at scheduled stations

8:00 – 8:30 AM **Working group review of sablefish ageing** in preparation for the upcoming TSC initiated international sablefish workshop

8:30 – 9:00 AM **Working group review of Pacific cod ageing** specifically on the determination of the first three annuli.

9:00 – 9:30 AM **Working group review of Walleye pollock ageing** specifically to document differences in ageing criteria.

10:00 – 10:20 AM **BREAK**

10:30 – 11:00 AM **Working group review of Pacific hake ageing**

11:00 – 11:30 AM **Working group review of shortspine thornyhead ageing** specifically to collaborate on developing ageing criteria

12:00 – 1:15 PM **LUNCH**

1:30 – 2:30 PM Thin section prep/demo using P. cod and sablefish otoliths

3:00 – 3:20 PM **BREAK**

3:20 – 5:00 PM Microscope collaborative work and discussions

6:00 PM Evening social event and potluck dinner hosted by Cal Blood and family.

DAY 3 Thursday, 4/22/04

8:00 – 9:30 AM Wrap-up group session

9:30 – 10:00 AM Microscope collaborative work and discussions

10:00 – 10:20 AM **BREAK**

10:20 – 12:00 Microscope collaborative work and discussions

12:00 – 1:15 PM **LUNCH**

1:30 – 3:30 PM Microscope collaborative work and discussions

3:30 PM Conclusion of conference

APPENDIX III

CHARTER OF THE COMMITTEE OF AGE READING EXPERTS

A WORKING GROUP OF THE TECHNICAL SUBCOMMITTE TO THE CANADA-US GROUNDFISH COMMITTEE

OVERVIEW

The Committee of Age Reading Experts (CARE) was initiated after a series of meetings in 1982 by the Technical Subcommitte (TSC) of the Canada-US Groundfish Committee. The first two workshops were convened in 1983 (April 27-29 and August 3-5) to document and standardize current methods used to age groundfish. These workshops discussed use of appropriate age structures, preparation of samples, equipment required, and reading procedures. Additional issues discussed were development of procedures for interagency calibration and methodology for age validation work. The primary objectives of these meetings were to reduce variation in age reading between agencies and to produce a manual of standard techniques. Target species for these initial meetings were rockfish of "regional management concern". From 1986 through 2002, CARE meetings were held every two years and included participation by agencies (state and federal) and institutions involved in age determination work. Participants were from agencies in the USA (California, Oregon, Washington, Alaska) and Canada (British Columbia). Focal topics are provided by the TSC and member agencies. Throughout the history of CARE, the primary issue of concern continues to be interagency calibration and the validation and standardization of age reading criteria.

The membership of CARE has seen little turnover in its history. These longterm members provide a stabilizing force for continuing CARE responsibilities within their original intent. In the event of member turnover or simply in the interest of promoting long term consistency, this charter, initiated in 2000, provides a framework within which the original intent of CARE may continue. This charter also expedites familiarization of new CARE Members to the responsibilities and function of CARE.

ADMINISTRATION OF CARE

Selection of Officers

Three positions will administer to CARE responsibilities. Officers will be volunteer CARE Members, or CARE Participants as approved by CARE Members. Positions will begin July 1 of the rotation year, and will last for two years. No person shall hold responsibilities of one position for more than 1 term. These terms shall rotate among agencies. Rotation will be from Vice-chair to chair for subsequent workshops, with no one agency supporting both Vice-chair and Chair positions. The position of secretary rotates among agencies every two years. One agency may support both the Secretary and either the Vice-chair or Chair. If an individual vacates their role prior to completion of

their term, it is recommended that a replacement be identified according to the following: the departing person should submit the name of an individual within their agency to the CARE chair (or vice chair if the chair is vacating); and/or the CARE chair should submit a request to the Age Lab supervisor of the agency of the departing individual, to submit a name of someone within their agency. Upon submission of a name the CARE chair will apprise the Membership and request confirmation or objection. If these events do not result in a candidate the CARE chair will request a volunteer from the Membership, and will then request of the Membership confirmation of or objection to the candidate.

Responsibilities of Officers

Chair:

- acts as formal liaison with the Chair of the TSC
- ensures that recommendations of CARE and TSC are documented, considered, and acted upon
- interacts with Vice-chair, Secretary and sub-committees of CARE providing information, advice and direction to ensure that responsibilities are met
- organizes biennial CARE meeting, sets agenda, and chairs meeting
- guides meeting according to set agenda facilitating documentation and discussion
- prepares the annual report to the TSC
- distributes final minutes, recommendations status, etc, to the TSC and CARE Members

Vice-chair:

- liases with Chair to assist organization of CARE meetings
- directs and initiates Primary Exchanges
- receives and collates results of Primary and Secondary Exchanges.
- monitors and collates all exchange information twice per year
- provides Chair with table of exchange results in time for annual TSC meeting/report and or CARE meeting
- attends to other formal responsibilities as assigned by Chair

Secretary:

- acts as rapporteur for the biennial CARE meeting
- distributes a draft of CARE meeting minutes in appropriate format to all CARE Members within one month of the meeting
- incorporates appropriate edits to minutes and submits final meeting minutes to the CARE Chair

Sub-committees (Working Groups):

Working groups serve a valuable purpose by focusing on specific issues of concern to CARE and the TSC. Committee members are CARE Members or CARE participants as approved by CARE Members, and should be volunteers of appropriate experience and interest. Committee members should serve for the life

of the working committee or a maximum of 2 terms or longer, as approved by the CARE membership. The identified working committee selects a chair to lead the group and direct the process. The sub-committee chair should:

- coordinate the work of the group to ensure progress and completion of the task
- update the Chair on status of work as appropriate
- upon notification by the CARE Chair, provide a written summary of work on an annual basis in time for inclusion into the CARE Annual Report

CARE MEMBERSHIP

CARE Member

- a Member of CARE is one who has an agency representative on the TSC or approval of an agency which has a representative on the TSC
- a Member of CARE actively participates in mandated CARE activities, CARE functions, or serves as an officer of CARE

CARE Participant

- a Participant of CARE meetings or functions is one who does not have an agency representative in the TSC
- a Participant does not serve as an officer of CARE, unless approved by the CARE Membership
- a Participant may advise CARE Members regarding mandated CARE activities

Member Responsibilities

- CARE Members must work with CARE Officers to address issues of concern to TSC and CARE
- Members are encouraged to promote and apply standardized methodologies and criteria
- Members should participate in CARE activities in a manner which advises and educates the membership.
- Members are required to expedite processing of structure exchange samples
- A member agency that drafts written materials which characterize the methodologies and/or protocols of other agencies with intent for distribution and/or publication, are encouraged to allow the agencies involved to review and comment on the final draft prior to distribution.

CARE MEETINGS & WORKSHOPS

Duration of Meeting

The purpose of the meeting will define the duration, though a minimum of 3 days is strongly encouraged for accomplishing CARE business and workshop exercises.

Structure of Meeting

Meetings will follow the agenda set by the officers and membership. The format should remain relatively informal to promote discussion, exchange of information and calibration of age-reading criteria.

Chronicle of Meeting

Meeting minutes will be recorded in writing. A draft will be available for review by all Members one month after the meeting. Following review by all Members, this draft will have tentative standing for distribution to the TSC by the CARE Chair. This draft will be "accepted" or "rejected" at the next meeting of CARE.

AGE STRUCTURE EXCHANGE PROTOCOL

Primary Structure Exchanges/Species

Primary exchanges are initiated by the TSC, for those species of heightened interest. These are inter-agency exchanges. These exchanges are required, and must be conducted well in advance of the next CARE workshop. Exchange results must be submitted to include in the "Structure Exchange Table".

Secondary Structure Exchanges/Species

Secondary exchanges are initiated by CARE Members for those species of interest, and while of interest to the TSC, are not mandated for exchange. These are interagency exchanges. Exchange results may be submitted for inclusion in the "Structure Exchange Table".

Primary Exchange Protocols:

- The Vice-chair, as advised by the CARE Chair, will inform the membership to initiate Primary Exchanges (species and numbers of fish) as identified by the TSC.
- Exchanges should be initiated in a reasonable amount of time prior to the CARE workshop or whenever recommended by the TSC, and should be completed in a timely manner.
- Exchanged samples should be processed by each agency within two weeks, or longer if agreed on by all when sample size is large. Members unable to quickly process samples should rotate their turn to the end of the exchange and send the sample to the next cooperating lab.
- Appropriate agencies (those who are in production reading status for that species) should allow at least 1 production reader to participate in Primary Exchanges.
- Precision test results from the Exchange should be submitted to the Vice-Chair in time for the CARE Chair to include in the CARE annual report to the TSC and/or at the CARE meeting. .

Secondary Exchange Protocols:

- CARE members initiating Secondary Exchanges between agencies should notify the Vice-chair and expedite results to the Vice-chair upon completion.
- These exchanges should be initiated throughout the two year interim between CARE meetings.
- Species and numbers of structures exchanged are to be set by CARE members.
- Samples may be processed at a pace agreed upon by the participants; however, members are encouraged to carry out all exchanges expeditiously.

General Exchange Protocols:

- The Vice-chair receives and reposits results for all exchanges in a standardized EXCEL table format (see "Product Format"), and next submits them to the CARE Chair who will then submit them to the Web Site Committee for publication to the CARE Web site.
- To facilitate a timely exchange, limit the number of agencies to four. Limiting the number of agencies involved also avoids excessive degradation of broken and burnt otolith specimens.
- Each agency should submit an "agency age estimate" that is resolved for all readers participating within that agency (intra-lab readings should be maintained in-house).
- When exchanging otolith samples, each agency should "conserve" structures, and burn only one-half of potentially four surfaces for each specimen. This assures adequate and ideally "equal" growth information available to all participants.
- Exchanges that require involvement of more than four agencies should be conducted in a way to assure integrity of structures so as to allow more than 4 comparable opportunities.

PRODUCT FORMAT

Meeting Minutes

CARE Meeting minutes should be prepared and submitted according to the following (see example in Appendix A):

- Use the meeting agenda outline for headings and subheadings (discussion should be prefaced by the speaker's full name (first occurrence) and subsequently last name, and may be quoted or paraphrased.
- Dynamic discussion should be summarized as to the theme, recognizing all participants, and with key points discretely credited.
- Other non-agenda items should be prefaced as "Non-Agenda Item:", and noted in the minutes in their sequence of occurrence.

Annual Report to the TSC

The CARE annual report (see example in Appendix B) to the TSC is submitted at the annual meeting of the TSC. The Chair should solicit status reports (paragraph) from sub-committee chairs, or other points of interest raised by CARE, and at the discretion of the Chair.

Age Structure Exchange

The Age Structure Exchange precision results will be submitted to the Vice-chair in a manner consistent for inclusion into the "Summary of Structure Exchange Table" (see example in Appendix C). The type and formulation of reported statistics should be calculated according to current convention.

Precision Test Statistics and Formulation

Precision testing is routinely conducted to measure the "readability" of a sample. Several statistics are routinely calculated to describe this precision. Some of the most commonly used statistics (noted below), and their mathematical formulation are presented in Appendix D.

- average percent error (APE)
- coefficient of variation (CV)

Computer Software Standards

To expedite exchange of documents or spreadsheets, the following software standards were approved to be standard, circa 2000. Updates to these standards will be frequently made to reflect evolution of software.

- Word Processing ~ Microsoft WORD (documents saved as "WORD 97-2002&6.0/95-rtf(*.doc)")
- Spreadsheet ~ EXCEL (documents saved as "Microsoft EXCEL97-2002&5.0/95")

H. 2003 Groundfish Landed Catch Data

For Groundfish catch data please visit the Pacific Coast Fisheries Information Network on the web at: **www.psmfc.org/pacfin.**

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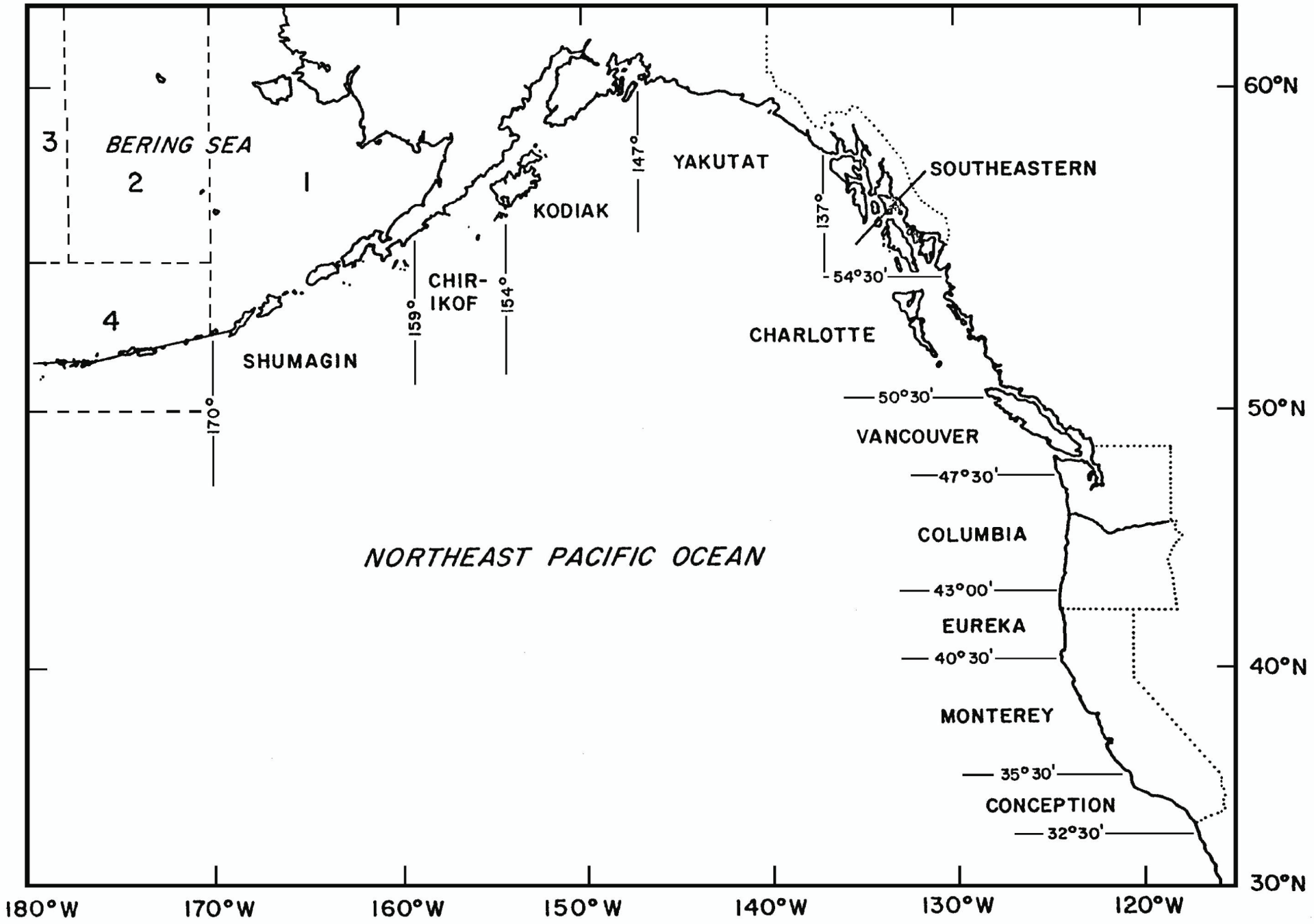

Figure 1.--International North Pacific Fisheries Commission (INPFC) statistical areas in the north Pacific Ocean.