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

Forty-second Annual Meeting
May 8-10, 2001
Newport , Oregon
U.S.A

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

Compiled by the Northwest Fisheries Science Center, National Marine Fisheries Service

Table of Contents

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EXECUTIVE SUMMARY

The Technical Sub-Committee of the Canada/U.S. Groundfish Committee (TSC) met May 8-10, 2001 in Newport, Oregon. Representatives from the Canadian Department of Fisheries and Oceans (DFO), NOAA Fisheries (the National Marine Fisheries Service - NMFS), the Pacific States Marine Fisheries Commission (PSMFC), the Alaska Department of Fish and Game (ADF&G), the Washington Department of Fish and Wildlife (WDFW), and the Oregon Department of Fish and Wildlife (ODFW) attended. Cyreis Schmitt (NOAA Fisheries), served as Chair and Jim Bottom (NOAA Fisheries) served as Secretary. During the 2001 meeting, the TSC exchanged information on research, stock assessment, and management activities conducted during 2000 and work planned for 2001. 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.

Background

The Canada/US Groundfish Committee (Parent Committee) was established in 1959 by the Second Conference on Coordination of Fisheries Regulations Between Canada and the United States and is sanctioned as an advisory group by the State Departments of both nations. The TSC was established at the first Parent Committee meeting as a technical advisory group to the Parent Committee. It is the only coast-wide forum for official exchange of information on the status of groundfish stocks and groundfish research among US federal and state agencies and the Canadian Department of Fisheries and Oceans. The terms of reference for the TSC, which are reviewed and approved at each annual meeting, are as follows:

1. Exchange information on the status of Groundfish stocks of mutual concern and to 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 impacts of existing or proposed management strategies and their component regulations relevant to

conservation of stock 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 US governments to encourage implementation of these recommendations.

The TSC discusses issues of concern regarding west coast groundfish with emphasis on stocks. Although the TSC has no regulatory authority, the group makes recommendations both to itself and to the Parent Committee. The Parent committee has one member from each country who have the authority to contact appropriate officials in their respective countries to request action on recommendations made by the Parent Committee and/or the TSC.

Working Groups

Once the TSC identifies an issue, a working group is formed to further research the issue and, if possible, recommend a solution. Three such groups are currently active. The Committee of Age Reading Experts (CARE) is an on-going working group which meets biennially to discuss groundfish age reading issues. Their primary objective is to promote coastwide consistency and precision in groundfish age reading. The other two are stock assessment working groups formed to address stock issues regarding Pacific whiting, and yellowtail rockfish.

Discussion at the 2001 Meeting

As has been the meeting format for recent years, the 2001 discussion centered on highlights and questions brought up regarding each agenda item, rather than exhaustive reviews of agency reports. These reports contain the detailed information on agency organizational changes, stock status, research, and management. They can be found as listed in the Table of Contents on page 2. Highlights included:

Working Groups

A discussion of whether yellowtail rockfish require a working group resulted in dropping that species from further group study. Further discussion centered around which fish should have working groups. Linkages to outside groundfish groups was thought to be a means to stimulate interest in more working groups.

Groundfish Forum

A groundfish forum may be proposed by NOAA Fisheries to discuss the future for West Coast groundfish research and how various West Coast fisheries related agencies can better coordinate and integrate information. Chair Cyreis Schmitt told the TSC a suggestion was made to modify the meeting so that managers rather than researchers actually meet. Managers then would then pass on to researchers current needs. It was pointed out that the states prefer to defer the forum for a year so work to streamline it could be done.

Groundfish Research Plan

A coordinated research plan effort was undertaken by the NWFSC, SWFSC, and the AFSC to determine research needs and the various levels of funding necessary to meet various priorities. Public meetings were conducted for California, Oregon, and Washington with anonymous reviews pursued and the results finalized by managers.

Age Validation

An updated and prioritized list of species for ageing may be available by next year's meeting. The NWFSC is developing an inventory of species and then intends to review which should be aged first. The TSC needs to give direction to CARE on the validation of some species partly because some samples are done differently at a different time of year. Chair Cyreis Schmitt told the TSC that assessment work will be shifted back six months to meet PFMC requirements.

Marine Reserves

The Department of Interior and the Department of Commerce share responsibilities for Marine Protected Areas (MPA) under the presidential order for an inventory to be done and the establishment of two MPA centers at Santa Cruz, Calif. and Charleston, S.C. However, the transition of presidents has left questions about what it is we will do with no policy in place. The issue of MPAs has become an important topic with the PFMC.

Meeting Attendance

The TSC continues to have difficulty attracting the SWFSC, California Fish and Game, and the north and south Councils to its meetings. It is hoped that there will be a greater incentive next year with a California location selected for the 2002 meeting.

Progress on 2000 Recommendations

A. Recommendations from the TSC to itself

1. Regarding enabling exchanges and participation in CARE workshop proceedings: The TSC will continue to encourage lines of supervision to age reading programs.

2. Regarding holding a meeting of a survey planning working group for sablefish as suggested at the Western Groundfish Conference: A meeting did not take place, so this item will be continued.

3. Regarding the Chair sending a letter to Mr. Pearson inviting his participation in CARE: This was accomplished.

4. Regarding the effort to explore with various agencies the potential to coordinate efforts to collect and catalogue tissue samples from genetic studies of critical groundfish species: This will be continued.

5. Regarding sending the TSC letter to Liza Bauman praising her website work: Stephen thanked and praised her in person.

6. Regarding a new document developed by Mark that updates the TSC accomplishments year-by-year since 1995: He requested TSC members review and comment on it.

B. Recommendations from the TSC to parent committee

1. Regarding the TSC request that the PSMFC post the PFMC draft Groundfish Strategic Plan on the TSC website and keep them updated: This was done.

2. Regarding the TSC request that the parent committee write to Dr. Michael Tillman requesting annual participation of the SWFSC and an annual report to the TSC. This was accomplished.

3. Regarding 1) the recommendation to the parent committee that bilateral negotiations be encouraged between Canada and the U.S. to solve the problem of hake harvests continuing to exceed adopted coastwide yield option, and 2) the recommendation that the parent committee ask Canadian and U.S. mangers to develop a process to discuss yield options to prevent over harvest of trans-boundary stocks: This is ongoing.

C. Recommendations from the TSC to CARE

1. Regarding TSC encouraging CARE to timely complete self assessments

though interagency age-structure exchanges: CARE is working to accomplish this.

2001 Recommendations

A. Recommendations from the TSC to itself

1. The TSC understands that the age structure exchange requests to the CARE are an integral statement of standardization of age-reading criteria, and require time to complete. CARE members must be supported and encouraged to complete these exchanges in a timely manner, and participate fully in workshop proceedings to resolve differences. TSC members should periodically encourage lines of supervision to age-reading programs, to enable both exchanges and participation in CARE workshop proceedings.

2. The TSC continues to believe that a sablefish survey-planing working group would be of benefit to member agencies. The TSC recommends convening a meeting to review methodology, examine potential survey coordination, and discuss other topics of mutual interest. It may be most convenient to schedule this meeting in conjunction with the Alaska Department of Fish and Game's external review of their sablefish assessment program, tentatively scheduled for February 2002.

3. TSC recommends that the committee explore with the various agencies the potential for a coordinated collection and cataloguing of tissue samples for genetics studies of critical groundfish species. The program would lead to a tissue sample bank. Access to the samples could be controlled by a representative advisory panel. Rick Stanley will communicate with the participating agencies to assess support for and feasibility of the concept.

4. The TSC would like to express its appreciation to Mr. Rick Stanley (DFO) and Dr. Jack Tagart (WDFW) for their many years of service as members of the Yellowtail Rockfish Working Group. This working group has been successful in facilitating a bi-national collaboration of research efforts, and an exchange of information that has been of great utility to the Canadian and United States yellowtail rockfish stock assessments used in their respective nations for fisheries management. In addition TSC would like to thank Tom Jagielo (WDFW) for his years of excellent service on the Lingcod Working Group. At this time, the TSC recommends that t he Yellowtail Rockfish Working Group and the Lingcod Working Group should be disbanded, since they have fulfilled the objectives for which they were formed.

5. The TSC recommends that, as working groups are constituted, they shall be initiated with a written Terms of Reference. The Terms of Reference will specify objectives for the purpose of clarifying the intended purpose of the working

group and will also facilitate an annual review of working group activities.

6. Groundfish researchers increasingly seek to incorporate physical and biological oceanography information as components of stock assessments and other investigations. Some scientists have expressed frustration at the difficulty of finding and assembling this information. The TSC recommends that we begin to index pertinent oceanographic data sources, along with the names and contact information of the institutions or individuals who have developed or are currently managing the data sources.

B. Recommendations from the TSC to parent committee

1. The TSC notes that the combined Canadian/U.S. harvest of hake continues to exceed the adopted coast wide yield option and recommends to the Parent Committee that the bilateral negotiations be encouraged to arrive at a solution. Further, Canadian and U.S. managers have adopted divergent yield options for trans-boundary stocks including yellowtail rockfish and lingcod. The TSC asks that the Parent Committee recommend that the Canadian and U.S. managers develop a process to discuss yield options to prevent over harvest of trans-boundary stocks.

2. The Canadian groundfish catch databases are now organized so they can provide catch data summaries to the PacFIN system. The TSC recommends that the PacFIN project solicit Fisheries and Oceans Canada for groundfish catch summaries for BC waters. The information to be incorporated will include all data back to those years that are missing from the database. Annually the Canadian and U.S. catch data will be combined and available for the TSC annual report.

C. Recommendations from the TSC to CARE

1. The TSC recognizes substantial time is required to complete self-assessments through inter-agency age-structure exchanges. These assessments provide valuable information to our processes. The TSC encouraged CARE to complete these exchanges in a timely manner.

Plans for the 2002 Meeting of the TSC

The next TSC meeting will be held within a two-day period beginning at 9 a.m., May 7 and 8 in Point Lobos or Santa Cruz, California. Cyreis Schmitt of the Northwest Fisheries Science Center was reappointed Chair to host the event.

Minutes of the Technical Sub Committee
of the
Canada-United States Groundfish Committee

Forty-second Annual Meeting
May 8-10, 2001
National Marine Fisheries Service
Northwest Fisheries Science Center
Newport Research Station
Newport, Oregon

I. Call to order

Chair Cyreis Schmitt called the meeting to order at 1:20 PM Tuesday, May 8.

II. Secretary

Jim Bottom served as secretary.

III. Introductions

Introductions were made around the table. Participants signed a sheet indicating their affiliation, address, and email address. Those attending were:

Canada:

Rick Stanley, Fisheries and Oceans Canada (CDFO), Pacific Biological Station (PBS), Nanaimo, BC
Diana Trager, CDFO, Vancouver, BC
Lynne Yamanaka, CDFO, Pacific Biological Station (PBS), Nanaimo, BC

United States:

Tory O'Connell, Alaska Department of Fish and Game (ADFG), Sitka, AK

Brenda Erwin, Committee of Age Reading Experts (CARE), Belmont, CA
National Marine Fisheries Service(NMFS):

Dave Clausen, Alaska Fisheries Science Center (AFSC), Auke Bay, Juneau, AK
Mark Wilkins, AFSC, Seattle, WA
Michael Schirripa, Northwest Fisheries Science Center (NWFSC), Newport, OR

Cyreis Schmitt, NWFSC, Newport, OR

Oregon Department of Fish and Wildlife (ODFW):

Bill Barss, Newport, OR
Bob Mikus, Newport, OR

Pacific States Marine Fisheries Commission (PSFMC):

Stephen Phillips, Gladstone, OR

Washington Department of Fish and Wildlife (WDFW):

Tom Jagielo, Olympia, WA

IV. Approval of 2000 Report

The 2000 TSC report, compiled by Mark Saunders, CDFO, was approved. The TSC wishes to commend the work of Mark and Leslie McDougall and thank them for their outstanding efforts.

V. Approval of 2001 Agenda

The 2001 agenda was approved with the following changes.
1.The Groundfish Research Plan discussion was moved to the end of the day following Genetics and Stock Structure;
2. Nearshore Rockfish Research Plan was added; and
3. A discussion on ways in which to interface TSC with other groundfish activities was suggested by Tom Jagielo.

VI. Working Group Reports: Discussion (Full Reports in Attachment A)

A. Committee of Age Reading Experts (CARE)

Brenda Erwin made the following report.

There wasn't a lot of information available. She added the exchange table to this version and updated some of the work for the web page. The Glossary and Manual Committee have not done anything new; a new logo and otolith exchange document was added to the web page. Marion Mann is taking over as chair of the web page committee since Brenda is currently chairperson of CARE.

There were some missing sections from the minutes of the last CARE meeting, so Brenda will need to contact those who promised to provide this.

Don Pearson of NMFS Santa Cruz Laboratory has drafted a paper on sablefish, basically saying that sablefish are difficult to age and may not be "ageable." CARE's consensus is that they can be aged and that their age agreement is not that bad; they worked on this at the last CARE workshop. The individual work at the microscopes at the workshop has not been included. Michael Schirripa said he received a paper from NMFS that didn't present the issue as having as many problems.

A discussion then developed regarding how the CARE sablefish data affect assessments because the readings vary.

B. Pacific Whiting Working Group.

Cyreis provided an update:
1) The AFSC continues to conduct the whiting survey in 2001 and a schedule has been developed. The transition of West Coast surveys to the NWFSC includes aging of whiting.
2) The NWFSC is adding a new reader to bring the number of readers in Newport to six.
3) The NWFSC also plans to develop a hydroacoustics group.
4) Tom Helser (NWFSC) will be working with the AFSC on whiting.

Mark Wilkins said the NMFS whiting survey is not expected to go as far north this year.

C. Lingcod Working Group.

This has not been a very active working group. Tom Jagielo said, "work goes on and information is exchanged."

D. Yellowtail Rockfish Working Group.

The group has been collaborating and the question was raised, "Does it need a working group?" After some discussion, it was decided to drop the idea of a

working group for yellowtail rockfish.

The discussion then turned to which fish need working groups. Tom said linking up with other groundfish related activities and groups might make the idea of working groups more worthwhile.

E. Pacific Sardine Working Group.

Stephen said that out of the Sardine Symposium 2000 an international group (Canada, U.S., Mexico) was formed — the Forum for International Sardine Collaboration and Information Exchange. This group met in Mexico in late November 2000. Dr. John Hunter of the Southwest Fisheries Science Center is the contact.

F. Other

The value of working groups was discussed. Michael asked whether a working group on ocean environment might be an appropriate group to form. Cyreis suggested a discussion be held during the next day's meeting regarding the need for new working groups.

Cyreis said a GIS database for the West Coast groundfish is being developed.

Mark suggested forming a working group and recommended that they report back on their progress and what they are working on.

Tom said every working group should have terms of reference. He suggested one way to "get more out of this process" is to have other groups attend the TSC meetings on a separate day. "The way we work it now, we could meet every other year and have working groups continue as is," he said.

Tom also suggested having CARE hold its annual meetings closer to the time of the parent (TSC) committee's meeting.

Cyreis said she will be proposing an annual Groundfish Forum, discussing future research on groundfish, and getting the most from the research that is done. Mark suggested having this forum during the Western Groundfish Conference might better attract attendance from the Southwest Fisheries Science Center (SWFSC).

Cyreis said that it was suggested that "a managers' meeting" be held to discuss needs rather than a research forum. The results would be passed on to researchers.

VII. Other Topics

A. IJFA Funding

Stephen said that funding to the states for 2001-2002 should be similar to the previous year's amount.

B. Groundfish Research Plan

This topic was deferred until later in the meeting.

C. Age Validation

1. Updated List of Species and Techniques
2. Review Prioritized List of Species

Tom asked whether the TSC should review the PFMC groundfish STAR panel work to see about priorities for the list. Cyreis said the Northwest Center staff is beginning to develop an inventory and then will look at what will be aged. A list may be available by next year's meeting.

Bob Mikus indicated the age readers are working on all ages of shortspine thornyhead. It involves a lot of work, "but they are ageable." The committee needs to give guidance to CARE on the validation of some species.

The importance of aging is continually mentioned in each TSC report; validation samples are done differently at a different time of year.

Cyreis: We'll be shifting back six months all of our assessment time lines for the PFMC.

Tom said a way to solve the problem is to have assessment authors identify a list of research needs in the STAR Panel report. A link should be established between TSC and the STAR panels to encourage common research needs and "put them on the record." He said the stock assessment authors don't have control over funding, but to some extent can help to identify the needs.

Cyreis: ODFW received some new funds for groundfish research in 2001, and they came to her, requesting input on priority research needs for groundfish. She suggested they look at the recommended research needs in past STAR panel reports. They did so and followed some of the recommendations, as funding and other constraints allowed.

Cyreis said research may be prioritized through the groundfish research plan. It should be beneficial to the TSC because it will indicate who is doing what

research and ongoing relationships.

D. Marine Reserves.

Cyreis explained the presidential order for an inventory of those areas that may be considered marine protected areas (mpas) and the establishment of two MPA centers at Santa Cruz, CA. and Charleston, S.C. The Department of Interior and Department of Commerce share responsibilities. The transition between presidents has left it in question as to what we will do. Some research is still being done, but there is not policy in place. NOAA has committees, and there has been a lot of attention given to it by the press.

PFMC has a strategic plan with marine reserves as a part. A strategic plan over-sight committee is working on how to address all the issues. Environmental groups and other constituencies are helping and there is a lot of interest from private funding sources. The issue has been growing in importance with the PFMC.

Tom said because it's such a new management tool, it's going to take a great effort to develop it.

Mark stated that work on surveys are affected; he has to do more work to get permission to do a survey in sanctuaries, but a commercial trawler is much less restricted.

Lynne Yamanaka said Canada has designated four pilot areas for reserves. These are being used as management tools. Fishermen were brought in to help pick the areas to close; quotas were reduced by 25%. An area is closed to fishing for rockfish habitat. Diana Trager pointed out the Strait of Georgia closures are near parks and "enforcement is a challenge." Four areas along the coast that contain sponge reefs will be closed; however, there is not a lot of trawl activity in three of those areas.

E. GIS

Cyreis: The Electronic Fish Catch Logbook currently is being tested. It automatically feeds back position information that can be entered in a GIS database to indicate where fishing effort occurs.

F. Web Pages

Canada has a very successful presentation on a server for monitoring. Each fishing trip is bar-coded and fed to a satellite. Mark: This is much cheaper than having an observer.

G. Genetics and Stocks Structure

Canada is collecting samples of rockfish in the Strait of Georgia, north coast, and south coast areas.

California Fish and Game has been looking at buying fish to get enough samples.

Sampling sharing is needed but no one wants to share. A list of samples and where they are stored would be helpful. Cyreis said groundfish survey crews have been asked by researchers outside of FRAM to provide specific samples, which has been done as much as possible. She said she has also heard from researchers who aren't aware that others are doing the same work with samples.

H. Groundfish Research Plan

Cyreis discussed the multi-center, coordinated research plan effort undertaken by the NWFSC, SWFSC, and the AFSC to determine what research is needed and what funding would be required. Public meetings were conducted for Oregon, California, and Washington. Anonymous reviews were conducted and it was finalized by managers. The plan deals with five research areas. A research forum was suggested with the states coordinating it. The states would like to defer the forum for a year and to streamline it so there is not a single, large meeting that people forget about afterwards. She said the group wants it goal-oriented and has hired a consultant to identify gaps in the research so at the forum we can identify who can do what. We are looking for more coordinated, integrated West Coast research. There is some interest in having the TSC meet near the time of the forum.

I. Nearshore Rockfish Research Plan

The team members want it integrated with the PFMC Data Needs Summary (which is not prioritized); there is intent in the Council to prioritize and develop one coordinated effort. They want to use work products of the TSC. They would want research and exchange of information with Canada, although the Council hasn't said anything about this. We should start small, but there will be opportunities for including Canada, Alaska, and Mexico.

J. Future Direction for the TSC

Tom asked several questions:
What can be done to make the TSC more relevant?
What have individuals gotten out of the TSC?

Where does it fit in the scope of research activities?
Do we need to meet every year?
Can TSC be How can it be integrated with the West Coast Groundfish Conference?

Cyreis: We can go beyond record keeping to address future work. Research Forum issues could work well for the TSC. The funding for research will be discussed and this can help the TSC.

Tory O'Connell said she found the research reports from other agencies to be useful.
Tom raised the issue of a two-year summary of activities which could be of as much use as a one-year summary.

It was also stated that a less frequent meeting could possibly encourage attendance by California.

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

A. Agency Overviews.

1. AFSC
Mark: The AFSC publications are not included in the report, rather they have been placed on the web site. It has been "business as usual". Dr. Art Kendall, Fisheries Oceanography, retired this year, and we don't have a Center Director.

Dave Clausen said they have done a supplemental E.I.S. in response to some lawsuits last year. It basically addresses the environmental impacts of the groundfish fishery in Alaska and took up a good part of the summer to produce.

2. Washington
Tom: A coastwide lingcod stock assessment with a northern and southern component was done for the first time. Also yellowtail rockfish and black rockfish assessments were done. WDFW has also been active in Puget Sound research and marine reserves.

3. Oregon
Bill Barss said a hiring freeze was on and Lindsey Ball of the Oregon State Police was Acting Director. Jim Golden is acting head of the Marine Resource Program. ODFW was successful in getting a person for the live fishery in Brookings and is still reorganizing Marine Resources. They are getting ready for nearshore work and are optimistic that they will have some money available for

this effort. The Department is also looking for a sablefish assessment person.

4. Canada
Lynne: We are just getting the player in place. We hired Ph.D. for the Center and will have a workshop.

Rick Stanley: Almost half the assessments last cycle were done by consultants hired by industry. Canada is increasing the observer coverage in hook-and-line fisheries. A newspaper report on groundfish published in February was critical of B.C. groundfish management; we are in the process of responding.

5. NWFSC
Cyreis said partial funding of an observer program was received. Coordinators will be in each state. The trawl fleet is helping design the pilot project on landing trip limit overages. It is expected observers will be on board in July. Last year was a building and recruiting year for the FRAM Division. Dr. Elizabeth Clarke is the new FRAM Division director.

The division focused on developing the West Coast groundfish research plan last year and a plan to transition the West Coast surveys to the NWFSC. We are working with the AFSC on the transition. We also completed an ESA status review for seven species in Puget Sound.

We also completed our third year of the cooperative slope survey with industry.

6. California Fish and Game
Brenda: The Department is decentralized. Units had been located up and down the coast, each with groundfish responsibilities. Groundfish has taken a back seat and one groundfish biologist position is vacant. Marine Life Management Act gave the Department the ability to make regulations with regard to monitoring and the collapse of certain species.

B. Multispecies Studies

1. Canada
Lynne: Hecate Strait was expanded into an ecosystems systems study and funded for three years.

2. Alaska
No multispecies studies to add to the report

3. Oregon
This is covered in the report. We started some projects using our ROV and

doing estuary studies and indices with juvenile rockfish. The study involved black rockfish, blue and copper and a few unidentifiable rockfish.

We have stock assessment concerns because we are missing older black rockfish from the sampling. We plan to do some tagging.

4. Washington
Tom: PSMFC (IJFA) funds a nearshore rockfish project. WDFW has used these funds to purchase equipment for future quantitative surveys for groundfish. We have contracted with Harbor Branch Oceanographic Institute (HBOI) in Ft. Pierce, Florida, to develop a three-laser video camera system with associated software to automate the process of accurately estimating the area swept by the camera.

5. AFSC

Mark: We did a Bering Sea continental slope survey to get a idea of gear needed and what the terrain looked like. It's going to go forward in a year. We also did winter surveys (February, March 2001) in the Bering Sea. It is Interesting because they will be used to were relate to the distribution of cod, pollock, and other groundfish found near Steller sea lions. The surveys looked at how the fishery competes with the resources Stellers eat during the time the fisheries are normally operating and when they aren't. The analyses are being worked on. We agree there is enough fish globally for fishing and sea lions, but locally there is a problem. The Center had to drop some of the bottom trawl survey in the Eastern Gulf of Alaska done mostly for rockfish data because there are not enough resources, and it scaled back the number of days spent on the West Coast triennial trawl survey.

6. NWFSC
Cyreis: The FRAM Division does not have sufficient staff or other resources to meet all the survey needs. It is partnering with the SWFSC and the Pacific Whiting Conservation Cooperative to broaden the coverage of field surveys of juvenile rockfish and whiting. In addition, Jean Rogers is trying to document historical foreign catches of all groundfish species to produce a consistent set of statistics for all the stock assessments.

Also, an environmental impact statement will be produced for the entire West Coast groundfish fishery.

C. By species

<u>Pacific cod</u>

1. Canada

Rick: An assessment for Hecate Strait was done last year (northern most stock). There was a consensus that the stock was at extremely low levels. Fishermen agreed that significant management efforts will be necessary.

2. Alaska

Tory: Historically, fishers use cod as a bait in the crab fishery. They are suppose to report this on their crab tickets.

3. AFSC

Mark: We are seeing the continued decline in the stock assessments for the Bering Sea and Gulf of Alaska, but it's about what many expected to see. It's expected to continue declining for another three or four years.

4. Oregon

Cod assessment is down 70% from previous years.

<u>Nearshore rockfish</u>

1. AFSC

Nothing to add to the report.

2. Oregon

Bill: There is increasing concern for nearshore rockfish. A change is the new market for live black rockfish. It's a high value fish, so this raises concerns. The market—Asia, San Francisco, and Portland— wants small fish, and in China greenlings are popular.

3. Alaska

Tory: There is no market in the Southeast for black rockfish. No live fish are allowed. We're looking at the population based on features along the coast. Closed areas along the coast are expected to be discussed next Council meeting. We'll look for changes in abundance of yellow eye, which has been closed for the past eight years. In the Southeast internal waters we have a full retention agreement with overages sold, or it goes to a food bank. In the Eastern gulf we have no trawl, only longlining.

4. California

Brenda: There are plans for more nearshore research. Their monitoring program is sorting nearshore species as much as possible.

5. Washington

Nothing to add to the report.

6. California

Brenda: There are plans for more nearshore research. Their monitoring program is sorting nearshore species as much as possible.

7. Canada

Quillback rockfish are now being collected for study. There is a new combination halibut and fixed rockfish allocation fishing trip options; prior to 2000 they couldn't combine these. There have been fishery closures on rockfish. Observers are hired on separate boats and do day trips on fishing boats.

Shelf rockfish
Slope rockfish

1. AFSC

Dave: We have been trying to improve POP trawl surveys in Alaska by using echosounder fish sign data to optimally determine whether or not a trawl haul should be made. This methodology looks promising, and we want to pursue it. A graduate student will go on this summer's Gulf of Alaska trawl survey to collect additional echosounder data to more fully investigate this technique. We are also in the process of doing genetic studies on rougheye rockfish to determine if two different species exist (i.e., light and dark forms). In terms of stock assessment, this year we plan to expand the use of an age-structured model to include rougheye, shortraker, and light dusky rockfish in the Gulf of Alaska; previously, only POP and northern rockfish have been assessed with this model.

Mark: POP were found in good numbers during the Bering Sea slope bottom trawl survey. The NOAA ship *Miller Freeman*, conducting an acoustic survey in the area, was diverted briefly to assess the magnitude of the school, which was estimated to be approximately 10,000 metric tons.

2. Washington

Tom: The fishery was closed December 2000. It's illegal to land a life fish outside of three miles.

3. Oregon

Bill: Limits are so small for some, it's difficult to get samples for aging.

4. NWFSC:

Cyreis: The PFMC will be reviewing the rebuilding analyses of the seven species declared overfished so far at their next meeting. We're trying to move on to learning what we can about the other species we haven't looked at yet. One of the subjects of the upcoming STAR Panel next June is the first phase of a method to utilize trends for species we have assessed and applying it to those

we haven't assessed. We probably will have more to add to the overfished list as we go through this process.

5. Alaska

Tory: I covered shelf species when I talked about nearshore species. Aging from some of our longline surveys showed 20 percent of the sample over 125 years old. However, I think we're seeing pockets of old fish rather than over all older fish everywhere. We'll be doing this again this year.

6. Canada

Rick: Shelf and slope species are covered in the document, except for two items: Mike Kent, at Oregon State, and Simon Jones, at PBS, are working on diseases in rockfish. They found a fungus that has a 50% prevalence rate in yellowtail rockfish. A high rate was also found in POP. They have found some data originally reported in the 1970s that weakly indicates that the fungus wasn't present then. It's a disease considered to have caused epidemics in Atlantic herring.

Cyreis: The NWFSC and ODFW are providing funds for this effort.

Rick: Shelf rockfish highlights were done in the report. Silvergrey is a nuisance fish within the context of IVQs. So if the population increases but not quotas, it causes difficulties in the prosecution of the fishery. There was a major discussion last year because quotas were lowered. Of interest, for silvergray rockfish, is that they do not appear to mature until age10 but do not fully recruit until age 20. In theory, that makes them hard to "recruit-overfish. There's an extensive write up on slope rockfish in the report. A thornyhead survey is planned for this summer.

<u>Thornyheads</u>

1. Canada

Nothing to add to the report.

2. Alaska

Tory: We're tagging our thornyhead bycatch on ours sablefish longline survey because I'm interested in survival. We started last year and haven't gotten any recoveries back.

3. NWFSC

Nothing to add to the report.

4. Washington

Nothing to add to the report.
Not currently working with thornyheads.

5. AFSC

There is nothing on thornyheads in the report. The Bering Sea slope survey found one occurrence of *Sebastolobus macrochir*.
There is nothing in the report. The Bering Sea slope survey found one of that third species but only one occurrence.

Sablefish

1. AFSC

Dave: We started a logbook program a couple of years ago in response to fishermen who wanted to include some of their catch and effort data in our assessments instead of totally relying on the sablefish longline survey. A database should be operational by this summer. We included the fishermen's CPUE in our assessments and are using those. Mike Sigler is switching his emphasis from sablefish to sea lion prey/interaction studies, but will still be doing the sablefish assessment. I think some of our sablefish projects may be scaled back as a result. This year, we are again releasing sablefish with archival tags (electronic) during the sablefish longline survey. As before, these tags are paid for by our longline charter vessel as part of the charter agreement.

2. Washington

Nothing to add to the report.

3. Oregon

Bill: In the October of 1998 and the spring of 1999 we did a pot and longline survey between 600 and 1000 fathoms and found pot gear selected for larger sablefish.

4. Alaska

Tory: We seem to have a situation where we are getting fewer tag recoveries the year we tag than we do the following year. So the fish tagged are not available to the fishery that year for some unknown reason. Last year we tried pots, but they were smaller fish and they put a lot of tags in a few areas. We used that for exploitation rate. This showed our exploitation rate to be high (20%). So the quota was reduced, creating quite a controversy. We going to do another pot tagging effort. An external review will be done next February on our sablefish program. We have a grant to use pit tags.

5. Canada

Rick: The assessment is driven for the most part by the tag recovery rate. Sablefish have been picked as the species for the objective based management plan.

Diana: The objective based management plan is a new initiative where its clear what the objectives of the fishery are and how we aim to achieve them. It's a pilot program that hasn't really begun yet. The other fish in the initiative is herring. They're going to try to get a 10% observer coverage starting this August.

A new effort has begun by fishermen to catch live sablefish and pen them to put weight on the for the "fresh" market.

6. NWFSC

Cyreis: We've had an ongoing sablefish research effort with OSU in recruitment, growth, feeding and other areas. Michael Schirripa is doing our assessment this year and Ray Hilborn is doing his version, and they are sharing data sets.

Michael: There is evidence of a strong 1995 year class showing up in the 1998 shelf survey as age three, the 1999 slope survey as age four, and the 2000 survey as age five. The surveys and the industry also saw a lot of small fish. We can't use the ODFW pot pilot survey because there's only one year's data. One thing we can use: there are some sablefish beyond the slope survey (in deeper waters). If so, these could be contributing significantly to the spawning stock.
Michael: there is evidence of a strong 1999 year class showing up in the shelf survey as age three, the slope survey as age four and in the 2000 survey as age five. The surveys and the industry also saw a lot of small fish. We can't use the ODFW pot pilot survey because there's only one year's data. One thing we can use is that there are some sablefish beyond the slope survey (in deeper waters). If so, these could be contributing significantly to the spawning stock.

<u>Flatfish</u>

1. AFSC

Most is in the report. Mark: In general they are in good shape except for the ongoing problem with Greenland Turbot that "doesn't follow the rest of the crowd."
There's no research done since they are in good shape.

2. NWFSC

Cyreis: A University of Washington student is just getting started on flatfish. ODFW is starting to experiment with modified nets that allow rockfish to escape but not flatfish. We are providing some funds for this. Fishermen are reportedly beginning to target these fish because of the decline in rockfish.

3. Alaska

Tory: We have a small flatfish fishery; no one has participated in it for a several years.

4. Canada

Rick: It's mostly covered in our report . There is an effort to look at our discard data collected now for four years and talking about wastage with arrowtooth flounder.

Diana: We've had a policy finalized this winter that outlines for each of the fisheries time lines for dealing with such things as wastage, counting for all mortality, ecosystem impacts. So a two day workshop on responsible fishing has been arranged this week by the trawl industry. These plans for groundfish must be in place by 2003.

Lingcod

1. Washington

Nothing to add to the report.

2. Oregon

Bill: The interesting points of our work on lingcod or in the report. We're working with discard mortality from bottom trawl fishery and found approximately 50% mortality occurred on deck after 30 minutes.

3. Alaska

Nothing to add to the report. There is an internal, sonic tagging study underway with about 150 fish tagged. Data will be difficult to analyze, because there are no clear trends.

Pacific whiting

1. Canada

A new regulation may be in the offing to allow U.S. fishermen to off load whiting in Canadian ports. It could happen this summer.

2. Alaska

Nothing to add to report.

3. Oregon

Nothing to add to report.

4. Washington

Nothing to add to report.

5. NWFSC

Cyreis: We did a prerecruit field experiment with the Pacific Whiting Conservation Cooperative (PWCC) in conjunction with the SWFSC rockfish prerecruit survey. Also this year, we partnered with PWCC and DFO to conduct a winter survey of whiting spawning biomass. The AFSC will be conducting the triennial whiting abundance survey again this year. The whiting stock assessment should be completed by March. Last year the NWFSC conducted the ESA Status Review on the whiting stock in Puget Sound, and we will reexamine this issue this year. New information will be available that may enable us to better evaluate whether the stock in Puget Sound is part of a larger stock in the Strait of Georgia or a separate stock.Cyreis: We did a prerecruit field experiment with the Pacific Whiting Conservation Cooperative (PWCC) in conjunction with the SWFSC rockfish prerecruit survey. Also this year, we partnered with PWCC and DFO to conduct a winter survey of whiting spawning biomass. With AFSC, we plan to do the annual whiting abundance survey again this year. The whiting stock assessment should be completed by March. Last year the NWFSC conducted the ESA Status Review on the whiting stock in Puget Sound, and we will re-examine this issue this year. New information will be available that may enable us to better evaluate whether the stock in Puget Sound is part of a larger stock in the Strait of Georgia or a separate stock.

Walleye Pollock

1. Canada

Nothing to add to the report.

2. Alaska

Nothing to add to the report.

3. Washington

Tom: Dr. Jack Tagart, in his capacity as WDFW's NPFMC representative, has been working quite a bit recently on aspects of the sea lion-pollock issue.

4. AFSC

Mark: One notable thing in our report; Last year a feasibility study was completed to evaluate the suitability of an area around Kodiak for a study. The study, which will go on this summer, will evaluate the affects of commercial fishing activity on the availability of pollock to Steller sea lions. Assessments are indicating recruitment is at the lowest level since the late 60s. In the Bering Sea, it seems to be fine.

Mark: One notable thing in our report; Last year a feasibility study to look at an area around Kodiak for a study that will go on this summer to look at evaluating the affects of commercial fishing activity on the availability of pollock to Steller sea lions. Assessments are showing in the Gulf of Alaska with recruitment at the lowest level since the late 60s. In the Bering sea it seems to be fine.

4. NWFSC

Cyreis: During the ESA status review, the status of pollock stocks also was not clear, such as the extent of environmental influence, how they are related to northern stocks, and so forth.

Dogfish

1. Canada

Nothing to add to the report.

2. Alaska

Nothing to add to the report

3. Oregon

Nothing to add to the report

4. Washington

Nothing to add on dogfish. There is some work with other sharks.

5. AFSC

Nothing to add to the report

6. NWFSC

Cyreis: A Washington University student is planning to do an assessment of dogfish.

Pacific mackerel and sardines

These were dropped as a groundfish agenda item.

Other species

This item is moved to D.

D. Other related studies

1. AFSC

Mark: We included some Atka mackerel work. Bob Lauth and others have been working on the identification and characterization of user activities on Atka mackerel reproductive habitat. This program is continuing, but no field work will be done this year. This topic is in our report.

Dave: We have four people working full time on the effects of trawling on benthic habitat. The studies are listed in the report. They include scuba diving studies on both corals and sponges. Also, we will have a manned-submersible study this summer to determine the effects of fishing on the bottom near Kodiak in an area that has been closed to trawling for 18 years. This will be a comparative experiment in which the submersible will be used to examine bottom transects before and after a chartered trawler tows along the bottom.

Mark: We're also continuing some research on catchability of our survey trawl, and in particular, escapement under our footrope of the trawl as well as speed over ground. There is evidence in the early years of the West Coast triennial shelf bottom trawl survey (1977-1983) that the trawl net may not have been in contact with the bottom. We've identified benthic animals known to be on the bottom so that, if trawl doesn't contain these animals, then it's suspected of not reaching the bottom.

2. NWFSC

Cyreis: A research program is being developed for socioeconomic issues in the fisheries for West Coast groundfish.

3. Oregon

Bill: We've recently done work on groundfish excluders in shrimp trawls. The Fish and Wildlife Commission is requiring these.

4. Canada

Rick: Markets for skates have improved over the past 4 or 5 years and catches have gone down in last couple of years.

Cyreis: Jim Golden of ODFW mentioned that the status of skates is a concern, with some 1.8 million pounds landed last year. Bill: This is a notable increase.

E. <u>Other items</u>

1. California

Brenda: California Fish and Game has a new ageing lab. In the past groundfish ageing was done for only a few species. I let them know about CARE and the activities of the other agencies.

2. Western Groundfish Conference

Wayne Palsson notified Cyreis that he is looking at Feb. 12 to Feb 14 with an

extra half day session on Feb. 15 for any special interests. The meeting would be held at Ocean Shores, Washington.

IX. Progress on 2000 Recommendations

A. From TSC to itself

1. TSC will continue to periodically encourage lines of supervision to age-reading programs to enable both exchanges and participation in CARE workshop proceedings.

2. At the Western Groundfish Conference it was brought up again that the member agencies convene a survey planning working group for sablefish. But a meeting did not occur. This item will be continued.

3. The recommendation that the TSC chair send a letter to Mr. Pearson inviting him to participate in CARE was done.

4. The effort to explore with various agencies the potential for a coordinated collection and cataloguing of tissue samples for genetics studies of critical groundfish species will be continued.

5. The TSC letter to Liza Bauman for the considerable effort and expertise that she devoted to creating and maintaining the TSC website was delivered verbally by Stephen.

6. Mark provided a draft updating the accomplishments of the TSC. He added year-by-year accomplishments from 1995 on, items under workshops, and other accomplishments. He asked for others to review and make comments.

B. TSC to Parent Committee

1. The TSC requested that the PSMFC post the PFMC draft Groundfish Strategic Plan on the TSC website and post updates to the plan in a timely manner. This was accomplished

2. The TSC requested that the parent committee write a letter to Dr. Michael Tillman explaining the importance of the TSC and requesting his annual participation and provide an annual report to TSC by the SWFSC. CC the request to the NWFSC Director Usha Varanasi, to Rod Maclnnis (SW Reg. Dir.), and director of Santa Cruz lab, Churchill Grimes. This was done.

3. The TSC noted that the combined Canadian/U.S. harvest of hake contin-

ues to exceed the adopted coast wide yield option and recommends to the Parent Committee that the bilateral negotiations be encouraged to arrive at a solution. Further, Canadian and U.S. managers have adopted divergent yield options for trans-boundary stocks including yellowtail rockfish and lingcod. The TSC asks that the Parent Committee recommend that the Canadian and U.S. managers develop a process to discuss yield options to prevent over harvest of trans-boundary stocks. This is ongoing.

C. TSC to CARE

1. The TSC recognizes substantial time is required to complete self-assessments through inter-agency age-structure exchanges. These assessments provide valuable information to our processes. The TSC encouraged CARE to complete these exchanges in a timely manner. CARE is working to accomplish this.

X. 2001 Recommendations

A. From TSC to itself

1. The TSC understands that the age structure exchange requests to the CARE are an integral statement of standardization of age-reading criteria, and require time to complete. CARE members must be supported and encouraged to complete these exchanges in a timely manner, and participate fully in workshop proceedings to resolve differences. TSC members should periodically encourage lines of supervision to age-reading programs, to enable both exchanges and participation in CARE workshop proceedings.

2. The TSC continues to believe that a sablefish survey-planing working group would be of benefit to member agencies. The TSC recommends convening a meeting to review methodology, examine potential survey coordination, and discuss other topics of mutual interest. It may be most convenient to schedule this meeting in conjunction with the Alaska Department of Fish and Game's external review of their sablefish assessment program, tentatively scheduled for February 2002.

3. TSC recommends that the committee explore with the various agencies the potential for a coordinated collection and cataloguing of tissue samples for genetics studies of critical groundfish species. The program would lead to a tissue sample bank. Access to the samples could be controlled by a representative advisory panel. Rick Stanley will communicate with the participating agencies to assess support for and feasibility of the concept.

4. The TSC would like to express its appreciation to Mr. Rick Stanley (DFO) and Dr. Jack Tagart (WDFW) for their many years of service as members of the Yellowtail Rockfish Working Group. This working group has been successful in facilitating a bi-national collaboration of research efforts, and an exchange of information that has been of great utility to the Canadian and United States yellowtail rockfish stock assessments used in their respective nations for fisheries management. In addition TSC would like to thank Tom Jagielo (WDFW) for his years of excellent service on the Lingcod Working Group. At this time, the TSC recommends that t he Yellowtail Rockfish Working Group and the Lingcod Working Group should be disbanded, since they have fulfilled the objectives for which they were formed.

5. The TSC recommends that, as working groups are constituted, they shall be initiated with a written Terms of Reference. The Terms of Reference will specify objectives for the purpose of clarifying the intended purpose of the working group and will also facilitate an annual review of working group activities.

6. Groundfish researchers increasingly seek to incorporate physical and biological oceanography information as components of stock assessments and other investigations. Some scientists have expressed frustration at the difficulty of finding and assembling this information. The TSC recommends that we begin to index pertinent oceanographic data sources, along with the names and contact information of the institutions or individuals who have developed or are currently managing the data sources.

TSC recommended:

1. Dr. Michael Schirripa lead the project.
2. TSC members provide Dr. Schirripa with data sources and contact information for pertinent information that their staff has found useful.
3. Dr. Schirripa develop an index of these data sources and contacts and post it to the TSC website.

B. TSC to Parent Committee

1. The TSC notes that the combined Canadian/U.S. harvest of hake continues to exceed the adopted coast wide yield option and recommends to the Parent Committee that the bilateral negotiations be encouraged to arrive at a solution. Further, Canadian and U.S. managers have adopted divergent yield options for trans-boundary stocks including yellowtail rockfish and lingcod. The TSC asks that the Parent Committee recommend that the Canadian and U.S. managers develop a process to discuss yield options to prevent over harvest of trans-boundary stocks.

2. The Canadian groundfish catch databases are now organized so they can provide catch data summaries to the PacFIN system. The TSC recommends that the PacFIN project solicit Fisheries and Oceans Canada for groundfish catch summaries for BC waters. The information to be incorporated will include all data back to those years that are missing from the database. Annually the Canadian and U.S. catch data will be combined and available for the TSC annual report.

C. TSC to CARE

1. The TSC recognizes substantial time is required to complete self-assessments through inter-agency age-structure exchanges. These assessments provide valuable information to our processes. The TSC encouraged CARE to complete these exchanges in a timely manner.

XI. Appointment of 2002/2003 TSC Chair

Cyreis was reappointed Chair; the TSC thanks her for her outstanding work.

XII. Schedule and Location of 2002

The next TSC meeting will be held within a two-day period beginning at 9 a.m., May 7 and 8 in Point Lobos or Santa Cruz, California.

XIII. Adjournment

The meeting was adjourned at 11:00 AM, 10 May, 2001.

Agency Reports

CANADA

British Columbia Groundfish Fisheries And Their Investigations in 2000

April 2001

Prepared for the 42nd Annual Meeting of the Technical Sub-committee of the Canada-United States Groundfish Committee May 8-11, 2001. Newport, Oregon, U.S.A.

by

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K. L. Yamanaka

Fisheries and Oceans Canada
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Pacific Biological Station
Nanaimo, British Columbia
V9R 5K6

REVIEW OF AGENCY GROUNDFISH RESEARCH, STOCK ASSESSMENT AND MANAGEMENT

A. Agency overview

Fisheries and Oceans Canada (FOC), Science Branch, operates three 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 North Vancouver, B.C., respectively. Dr. Laura Richards is currently the Acting RDS. The Division Heads in Science Branch reporting to Dr. Richards are:

Stock Assessment Division (STAD)	Mr. Ted Perry (Director)
Marine Environment and Habitat Science	Dr. J. Pringle (Director)
Ocean Science and Productivity	Mr. R. Brown (Director)
Aquaculture	Dr. D. Noakes (Director)

Groundfish research and stock assessments are conducted primarily in two sections of the Stock Assessment Division, Fish Population Dynamics (Mr. Sandy McFarlane, Head) and Assessment Methods (Mr. Jeff Fargo, Head). The Assessment Methods Section includes the Fish Ageing Lab. There are plans to merge the two groundfish sections in 2001.

Management of groundfish resources is the responsibility of the Pacific Region Groundfish Coordinator (Ms. Marilyn Joyce) within the Fisheries Management Branch in Vancouver, B.C.. Fishery Managers receive advice from STAD through the Pacific Scientific Advice Review Committee (PSARC, formerly the Pacific Stock Assessment Review Committee). The Chair of PSARC (Dr. Max Stocker) advises the Regional Management Committees on stock status and biological consequences of fisheries management actions and works in consultation with the Canadian Stock Assessment Secretariat (CSAS) in Ottawa. Research documents can be viewed on the CSAS website: http://www.pac.dfo-mpo.gc.ca/sci/psarc/ResDocs/res_docs.htm.

B. Multispecies or Ecosystem studies

An Ecosystem Approach to Fisheries Management in Hecate
(Website: http://www-sci.pac.dfo-mpo.gc.ca/sa-hecate/default.htm)

A three-year research project will be initiated in 2001 and will involve fishery scientists, oceanographers and geologists from government institutes and universities. The objectives are to expand the knowledge of the major factors affecting the productivity of commercial marine fisheries in the Hecate Strait region by investigating the relative influences of fishing, and environmental and biological processes on the population dynamics and distribution of marine fish species; and to develop new stock assessment

techniques that incorporate ecosystem considerations that can be introduced into the mainstream advisory process.

The spatial and temporal distribution of the key marine populations and their habitats will be described using data from bottom trawl research surveys, commercial fisheries, physical oceanographic surveys, surficial geology, and bathymetry. New biological surveys designed to cover areas and species inaccessible to trawling will be designed and tested. Available data on diets of the main species will be analyzed to determine trophic relationships and new collections will be made to fill in knowledge gaps.

Ecosystem models will be developed to investigate the relative importance of fishing, environmental forcing and biological interactions in affecting changes in the marine fish communities in the Hecate Strait area. These models will be used to integrate the information assembled in the descriptive studies described above. The ecosystem model parameters and structure will be calibrated by comparison of model predictions and time series of catch, fishing effort, and research survey indices. These calibrated models will be use to investigate alternative management policies for the Hecate Strait fisheries.

C. By species

1. Pacific cod

i. Research programs

None

ii. Stock assessment

A new assessment of Pacific cod in areas 5CD (Hecate Strait, Dixon Entrance) was conducted in November 2000. Current stock biomass was determined to be extremely low and recent exploitation rates were well above target. As a result, the annual TAC was reduced from 1000t to 200t. This is expected to allow small amounts of by-catch in fisheries directed at other species. In addition, a winter closure was introduced for the entire Hecate Strait area during January 1 - April 15 in 2001 and for 2002. A new assessment of Pacific cod in areas 3CD (West Coast Vancouver Island) is planned for November 2001.

2a. Rockfish - offshore

Slope Rockfish

i. Research programs

Six biological samples of longspine thornyhead were obtained from a W. E. Ricker tanner crab survey trip in area 5AB off the central British Columbia coast between Aug 26, 2000 and Aug 30, 2000. From the six samples, 105 males and 113 females were measured. Between the sexes, mean lengths (males = 237mm, females = 231mm) and mean weights (males = 171g, females = 156g) were similar (Starr and Haigh 2000).

In 2001, the Canadian Groundfish Research and Conservation Society (CGRCS), in collaboration with Fisheries and Oceans Canada (FOC), plans to implement a bottom trawl survey (see Starr and Schwarz 2000). Briefly, the proposed survey will sample three species most suited to bottom trawl surveys: Pacific ocean perch, shortspine thornyheads, and longspine thornyheads. Depth strata identified for these three species are 101-400 m, 401-800 m, and 801-1200 m, respectively. Stratification by latitude will depend on management requirements. The first year of the survey will most likely be limited to longspine thornyheads off the west coast of Vancouver Island. Commercial vessels will be used with the assistance of FOC technical staff. Tows within each stratum will be allocated randomly. Each research tow will be standardized as much as possible (tow speed, distance and direction towed, net characteristics including cod-end mesh size, door-spread and headline height). Monitoring of the time the net is in contact with the sea floor is strongly suggested.

ii. Stock assessment

Three stock assessment documents were presented in 2000: (i) a methods paper on estimating stock biomass from tow-by-tow data, (ii) a stock assessment of longspine thornyheads off the west coast of Vancouver Island, and (iii) a feasibility study of using bottom trawl surveys for three slope groundfish species.

The paper "Estimating stock biomass from tow-by-tow data for Pacific Groundfish" (Schnute and Haigh 2000) describes a systematic approach to biomass estimation, complete with a bootstrap method for assessing variance. The authors have focussed on a rigorous description of the method and give straightforward examples of its application. Tows give estimates of biomass density, stratified by depth. Bathymetry, locations of fish capture, and possible other data give estimates of habitat area. Multiplying the estimated depth-stratified densities by the estimated depth-stratified areas give an estimated biomass. The authors illustrate the methods by applying them to both research and commercial data, realizing that these two sources differ in many respects (random designs vs. targeting/avoidance patterns, seasonal surveys vs. year-round fishing, tens of tows vs. thousands, etc.). Biomass estimates by quarter from commercial data (1994-2000) are presented for Pacific ocean perch, rougheye rockfish, shortspine thornyheads, longspine thornyheads, rock sole and English sole. Annual biomass estimates from research survey data (1984-2000) are presented for rock sole and English sole. In comparisons of biomass estimates for the sole species between the commercial fishery and research surveys, there is general agreement. However, biomass estimates of commercially targeted species derived from commercial data are higher than those calculated from survey data. In contrast, biomass estimates of commercially avoided species are

no different between the fishery and the survey (i.e., catch rates are both random).

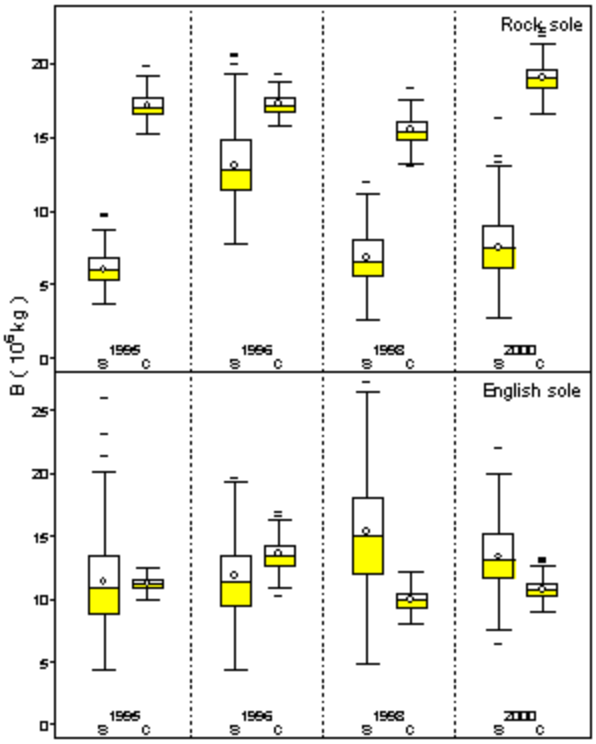

Fig. 1. Comparison of bootstrapped biomass distributions for rock and English soles from Hecate Strait research surveys in June (S) and commercial tows in the 2nd quarter (C). A circle in each boxplot indicates the corresponding biomass estimate.

The paper "Assessment of the Canadian longspine thornyhead (*Sebastolobus altivelis*) for 2000" (Starr and Haigh 2000) presents a detailed compilation and analysis of the available data for longspine thornyheads found in west coast Canadian waters. This analysis was prompted by concerns over the rapid development of a new bottom trawl fishery directed at this species since 1996. An analysis of the available length frequency data from the commercial fishery shows that these distributions have been stationary over the four years of the fishery. Relative abundance indices estimated from CPUE data using general linear modeling methods show a 16% decline in biomass over the four-year history of the fishery. Population modeling using a dynamic age-structured model fitted to the estimated relative biomass indices and the annual observations of length structure in the commercial fishery estimate that the population has declined between 10 and 30% over the four years of the fishery. These estimates are unreliable due to the lack of a validated growth function and uncertain estimates for natural mortality. This report recommends the development of an independent biomass survey for this species and further research on growth rates. The report also hypothesizes that this species may have very wide stock boundaries due to its extended pelagic larval phase (18-20 months) and the consequent opportunity for wide dispersal by prevailing ocean currents.

The paper "Feasibility of a bottom trawl survey for three slope groundfish species in Canadian waters" (Starr and Schwarz 2000) explores whether sufficiently precise biomass estimates (for Pacific ocean perch, shortspine thornyheads and longspine thornyheads) can be obtained at a reasonable cost. The objectives of such a survey are to generate comparable indices of population size over time that can be used as inputs into population assessment models for each of the three species. The feasibility analysis calculates the variability in catch per hour, for each species, from commercial catch and effort data. From this analysis, the authors determine the amount of stratification by depth and the number of tows required in each stratum to achieve a target level of precision. Of the three target species, commercial catch rates for longspine thornyheads appear to be the least variable and hence require the fewest tows to monitor the population. Shortspine thornyheads catch rates are of intermediate variability and Pacific ocean perch rates are highly variable. Pacific ocean perch have a spatial distribution distinct from the two thornyhead species and can be monitored independently of these two species. The two thornyhead species are spatially commingled, with shortspines having a more shallow distribution than the longspines. The final size and aerial extent of the survey will be dependent on the target precision level at which each species is monitored. These decisions are largely management-based or require additional stock boundary research. Several alternative options for number of strata and suggested levels of precision are presented, ranging from under 150 tows to nearly 400 tows for the entire survey, with estimated relative costs varying from CA$275,000 to nearly CA$800,000. An additional issue is that the performance of the nets while towing must be monitored electronically to ensure comparability both within and between surveys as it is likely that net efficiency will improve over time.

Shelf rockfish

i. Research Programs

The shelf rockfish program initiated a study of yellowtail rockfish (*Sebastes flavidus*) genetics during 2000. We collected samples from the central and southern portions of the B. C. coast and initiated analysis. Depending on funding in 2001, these data will be combined with samples provided by the Washington Department of Fish and Wildlife to provide insight into stock boundaries for yellowtail rockfish. The project should be completed in early 2002 for input into a Canadian yellowtail rockfish assessment scheduled for 2002 and a U. S. assessment scheduled for 2003.

ii. Stock assessment

Canadian shelf rockfish stock assessment activities concentrated on silvergray rockfish (*S. brevispinis*) in 2000 (Stanley and Kronlund 2001). The document summarized the available information on the stock status of silvergray rockfish (*Sebastes brevispinis*) in British Columbia waters and provided yield recommendations for the 2001/2002 fishing

year. It also summarized biological and historical fishery information so that future researchers will be able to use this document as the starting point for their assessment work on silvergray rockfish.

The available biological data were analyzed to provide recommended harvests. It provided harvest recommendations for silvergray rockfish based on three alternative harvest strategies (F=0.5*M, F=0.75*M and F=1.0*M). These estimates are not directly comparable to the previous low-risk and high- risk yield options. The F=0.75*M and F=1.0*M estimates are attempts to estimate a midpoint harvest option as opposed to a "bracketing" of possible harvests.

The best estimate of M is 0.06. Data for each of four stocks, corresponding to PMFC Areas 3CD, 5AB, 5CD and 5E, were examined using catch-at-age analysis. Each stock analysis examined three general cases, where Case 1 examined the impacts of tuning with commercial CPUE and/or survey estimates; Case 2 fitted proportion-at-age data only, with variable recruitment and; Case 3, which was similar to Case 2 but forced recruitment to be constant to mimic simple catch curve analysis.

For Area 3CD, quota recommendations are based on the model tuned to a U.S. triennial survey, which surveyed part of the area. The three recommended harvest levels were 152, 228, and 296t, corresponding to three target levels of F. Previous documents provided a "low-risk" and "high-risk" range of 150-425t. Quota recommendations for the remaining stocks 5AB, 5CD and 5E are based on Case 2 model runs, which fit ageing data, allow variable recruitment but lack a survey tuning index. The recommended options for 5AB were 214, 319 and 422 t, as compared with the previous range of 350-700t. For 5CD, the recommended options were 146, 217, and 288t as compared with a previous range of 125-400t and for 5E the recommended options were 137, 204, and 270t as compared with the previous range of 175-300t.

In general, while the assessments indicated modestly rising populations in most stocks, the harvest recommendations were approximately equal to previous recommendations. In retrospect, previous recommendations appeared slightly higher than optimal. A full assessment of widow *(S. entomelas*) and yellowtail rockfish (*S. flavidus*) is planned for the 2002 PSARC cycle.

2b. Rockfish - inshore

i. Research programs.

A two-week research cruise to Bowie Seamount (53^{o}20' N 135^{o} 40' W), a proposed FOC Marine Protected Area, and Gwaii Haanas (52^{o}03' and 52^{o}12' N, 131^{o}13' and 131^{o}27' W), a Parks and Heritage Canada's National Marine Conservation Area, was completed in August 2000. The purpose of this cruise was to develop non-intrusive *in*

situ visual methods to estimate abundance of yelloweye rockfish. Using the DELTA submersible, habitat specific rockfish densities were estimated and will be used to extrapolate biomass over the seamount (24 – 300 m) based on multibeam sonar habitat interpretations. Visual rockfish abundance estimates will also be compared with traditional fishing indices (CPUE) collected during the cruise by a chartered commercial longline vessel. The relationship between abundance and CPUE may be used to investigate rockfish abundance based on CPUE from commercial logbook data. Oceanographic sampling was also conducted on the cruise to characterize the ocean environment at Bowie Seamount and Gwaii Haanas. The Haida Eddy, originates along the coast of the Queen Charlotte Islands (Gwaii Haanas) and moves westward, away from the coast. During the cruise, the Haida Eddy was stationary alongside Bowie Seamount. The Haida Eddy and may provide a transport mechanism for pelagic larvae derived from the coast and recruited to Bowie Seamount. Rockfish from the longline survey were sampled for size, sex, maturity, ageing structures, DNA and tissues for pathology.

Sample collections are underway for microsatellite DNA population analyses of quillback rockfish (*Sebastes maliger*). The new Species at Risk Act has highlighted concern over inshore rockfish in the Strait of Georgia. Baseline data collections will be established for the Strait of Georgia and other areas coastwide that have recently been closed to groundfish fishing.

The directed hook and line rockfish logbook database is expanding to include the directed dogfish and lingcod hook and line logbook data (new requirement for 2001) and work is continuing to integrate logbook, dockside monitoring and onboard observer data. Rockfish logbooks were updated for the 2001 fishery with improvements to the description of fishing gear.

ii. Stock assessment

No assessment was conducted for 2000.

iii. Management and Regulations

The hook and line rockfish fishery is managed by limited entry licensing with fishing region designations (area licensing), regional catch quotas, fishing seasons, trip limits, fishing period limits and directed species fishery options. The logbook and dockside monitoring programs are continuing. The directed 2001 rockfish hook and line fishery quotas will remain unchanged from 1999.

A combination halibut and rockfish fishing option piloted in 2000 will continue in 2001. This option allocates an annual rockfish quota under a ZN license to a halibut fishers L license, which then allows halibut fishers to retain rockfish (ZN license) above the bycatch allowance provided by their L license.

Area closures instituted for the directed hook and line rockfish fishery in 1999 now include the directed halibut, lingcod and dogfish hook and line fisheries. The Strait of Georgia (4B) is also closed to groundfish trawling. Consultation with the recreational sector coastwide and the trawl sector in areas outside the Strait of Georgia on area closures to conserve inshore rockfish is continuing.

Onboard observers were deployed on hook and line vessels in 2000. However, a target of 10% coverage was not achieved. A similar onboard observer program will continue in 2001 to evaluate incidental catch and discards in each fishery.

3. Sablefish

i. Research programs

In 2000, cost-recovered funding was allocated to cover salaries, contracts and purchases for research projects that were approved by the Sablefish Finance Committee and the Science Branch of FOC. The committee consists of industry (Canadian Sablefish Association) and FOC representatives whose mandate is to ensure that research is conducted in a cost-effective manner. Secondarily, the industry representatives have provided input regarding the direction of the proposed research.

Trap Survey

A fall longline trap charter for sampling was conducted between October 9 and November 13, 2000 aboard the chartered fishing vessel Pacific Viking, under the direction of Mr. Mike Smith and Ms. Margo Elfert. This survey has been conducted annually since 1986. The purpose of the survey was to collect biological data from discrete depths at standard index sites along the coast and to conduct tagging. These data are used to monitor changes in age, growth and abundance (based on tagging release/recoveries) and are the major inputs for annual assessments. A total of 131 sets were made, 22,908 fish were tagged, 4,042 otoliths collected for ageing and 560 tagged fish were recovered. Results will be incorporated into the next assessment. Research being conducted during 2001 includes repeating the fall trap survey.

ii. Stock assessment

A major assessment of sablefish was completed during 2000. The population modeling and tagging analysis components were conducted by Vivian Haist and Ray Hilborn under a private contract with the Canadian Sablefish Association (Haist and Hilborn 2001). The results of the assessment work were provided in the full assessment submitted to the Groundfish Sub-committee of the Pacific Scientific Advice Committe (PSARC).

The principal data source on trends in abundance was the tagging program, and, in particular, the percentage of tags returned in the year following tagging. Coastwide, this percentage remained steady at 9-11% from 1991 to 1997, rose to 19% in 1998, and decreased to 8% in 1999. Three methods, all based on the tag release-recapture data, were used to estimate stock abundance. The methods differed in the degree that biological and fishery structure was incorporated in the estimation process, and in the choice of tagging data subsets used in the analyses. Different tagging data subsets were chosen to minimize potential bias in the alternative estimation methods. All three methods indicated that B.C. sablefish decreased in abundance from the early 1990's through 1997, followed by a substantial increase in 1999. These trends were consistent with those observed in commercial fishery CPUE and survey CPUE indices, except that the fishery and survey indices did not show significant increases in 1999. The fishery CPUE is not adjusted for the effect of escape-rings, used in the commercial fishery in 1999, and was not expected to reflect abundance trends.

Stochastic stock projections were conducted for the 2000 to 2002 period at three levels of harvest (3800 t, 4000 t, 4500 t). The expectation, at all harvest levels, is an increase in abundance for both stocks. Assuming an above average recruitment for 2000 increases the probability that the stocks will increase between 1999 and 2002. An above-average recruitment, about to become vulnerable to the fishery, is supported by survey data from Hecate Strait Inlets.
The Groundfish PSARC Subcommittee accepted the sablefish assessment subject to revision. The Subcommittee recommended that given the possibility for a distinct Southern B.C. stock and a single northern B.C./Alaska stock, that stock structure be reviewed to determine practical management units. A major assessment is planned for 2001.

4. Flatfish

i. Research programs

A groundfish trawl survey was conducted in Hecate Strait in 2000. The objective of the survey was to obtain data on the distribution of groundfish species in this region. Biological samples were collected for arrowtooth flounder, Dover sole, English sole, flathead sole, Petrale sole, rex sole, rock sole, Pacific cod, lingcod, copper rockfish, yellowtail rockfish, quillback rockfish, and canary rockfish.

ii. Stock assessment

Full assessments were prepared for rock sole and English sole stocks in Hecate Strait. Biomass and recruitment have declined steadily since the mid 1990's. Both species are below the average level of abundance for the last thirty years. Equilibrium calculations were used to define fishing mortality reference points. Fishing reference points of $F_{0.1}$,

F=M and F=0.75*M* were used to recommend a sustainable yield range to managers. An analysis of the population dynamics of rock sole in the north Pacific was jointly prepared by Fargo (FOC) and Wilderbuer (NMFS). There were significant differences in the growth and natural mortality rates between the Bering Sea and Hecate Strait stocks. The growth rate for the Bering Sea stocks was slower than for the Hecate Strait stock. The time to maturity was longer and the natural mortality rate was lower for the Bering Sea stocks compared to the Hecate Strait stocks as well. Target fishing mortality reference points also differed among stocks. The Hecate Strait stocks sustained a higher exploitation rate than the stocks in the Bering Sea. There was strong evidence of a Ricker stock recruitment relationship for both stocks. The highest production for the Hecate Strait stocks occurred at a spawning biomass at 37% of the maximum observed while it occurred at 31% of the maximum observed for the Bering Sea stocks.

iii. Management

Flatfish in British Columbia were managed using inter-transferable vessel quotas for the 2000 fishery. Estimates of 'kept' catch and 'discards' were recorded by species and location by on-board observers in 2000. These data were analyzed in 2000 to provide a measure of the change in selectivity for rock sole and English sole in Hecate Strait due to a change in codend mesh size. The change in mesh size reduced the capture of juveniles in the trawl fishery by more than 50% by weight.

5. Pacific hake

i. Research programs

Strait of Georgia

Synoptic fishing surveys of hake abundance, distribution and biology were conducted during April and August. Hake were widely distributed throughout the Strait of Georgia and associated mainland inlets. Interference from plankton appears to preclude using late spring and summer surveys to estimate abundance using 38Khz hull-mounted, split-beam sounders. While population numbers of hake appear to be stable, the population biomass is declining, a result of declining size-at-age of age 3+ hake. The reason for the decline is not clear although there are correlative links to environmental change. Cruises conducted during April and August included coincident examination of the distribution and abundance of zooplankton, which may begin to shed some light on the linkages. Surveys, which will focus on studying hake biology, are scheduled for March of 2001 and 2002.

Offshore

The monitoring of catch, estimation of species composition, and biological sampling in the Vancouver INPFC Area fishery was continued through extensive offshore observer

and shore-side monitoring programs. We collected synoptic biological samples of hake throughout the Canadian zone during August 2000 using the CCGS WE RICKER.

During 2000 there were major changes in the hake distribution and availability of hake to fishers. Changes in distribution were not unexpected but the degree of change was much greater than expected. Most notably, hake were absent from traditional grounds off southern Vancouver Island with only approximately 15,000t captured of a 90,300t quota. Some hake were found off the west coast of the Queen Charlotte Islands. They were also captured and in Queen Charlotte Sound where the Joint Venture fishery operated for the last month of the season. The fish were deep and scattered making them difficult to fish by smaller Canadian catcher boats that do not have sufficient horsepower to be effective. The U.S. fishery experienced similar problems in the first half of the season but then the fish eventually appeared on the U.S. continental shelf and became vulnerable to the fishing gear.

We do not believe this is a stock collapse but rather a change in distribution resulting from changes to climate/ocean conditions. While there is some interannual variability in the timing of the arrival of hake and the absolute abundance in the Canadian zone, the rather dramatic changes in 2000 have not previously been observed during the period of intensive study of this stock by U.S. and Canadian researchers that began in 1977. Furthermore, historical landings indicate no evidence of the event as far back as 1966. During most of the 1990's, a large proportion of the stock moved into the Canadian zone. In 1998, at the time of the last triennial survey, 50% of the 1.2 million t stock was present in the Canadian zone. In 1999, there was also high abundance in the Canadian zone. The sudden disappearance in 2000 is not consistent with a gradual fishing down of the stock.

During 2001 we are continuing to examine the factors that may have led to this change. A winter 2001 survey is planned to examine the winter spawning distribution and the triennial survey is planned for July/August 2001. Both surveys are supported by Canada and the United States. The triennial should provide an absolute estimate of the current size of the hake stock.

ii. Stock assessment

Strait of Georgia

No assessment was conducted in 2000.

Offshore

U.S. scientists conducted an update during 2000. The addition of current catch-at-age data confirmed the appropriateness of the 2001 projections, which were presented in the last major assessment conducted in 1998. American and Canadian managers adopted yield options for 2001, based on the 1998 assessment. A major Can./U.S. assessment is

planned for the winter of 2001/2002 that will include information from the 2001 triennial survey.

6. Dogfish

i. Research programs

Processing and analysis of dogfish tag recoveries was continued. The purpose of this experiment is to assess long-term movements, in particular the rate of exchange between the Strait of Georgia and offshore stocks.

ii. Stock assessment

A major assessment of dogfish has not been conducted for ten years although catches have been monitored. Landings, in particular hook and line, have increased in recent years although current harvests levels are below the optimal yield in both areas.

7. Lingcod

i. Research programs

Collaborative genetics research into stock membership for lingcod throughout area 4B (Strait of Georgia) and areas 3C/D will be continued through 2001 and 2002. A genetic baseline will be developed for lingcod to be eventually applied to identifying stock membership throughout British Columbia.

Aging methodology for lingcod was re-examined. The collection of juveniles (< 3 years of age) in 2000 will be augmented by samples in 2001. Measurements for the first and second annular distances will be made and used for upgrading the ageing methodology.

ii. Stock assessment

Offshore

A stock assessment for offshore lingcod was produced for PSARC in November 2000. Ongoing biological data collection from the commercial trawl fishery will be continued throughout the year. In 2001, a catch-age analysis for 3C and for 5A/B will be presented at PSARC.

Inshore

A stock assessment for inshore lingcod was included in the document presented at PSARC in November 2000. A nest density survey was conducted in the spawning sea-

son of 2001. This will augment abundance indices from creel surveys and information from a nest density survey conducted by the Vancouver Aquarium.

8. Walleye pollock

i. Research programs

Monitoring of catches and collection of biological samples were conducted during 2000 for pollock stocks in northern Hecate Strait/Dixon Entrance, Queen Charlotte Strait, the southwest coast Vancouver Island and the Strait of Georgia.

ii. Stock assessment

No assessment work was conducted on walleye pollock during 2000.

9. Other

Pelagics – Sardine and Mackerel

i. Research programs

Monitoring of sardine and mackerel stocks continued in 2000. Surveys to examine their distribution in Canadian waters were conducted in July, August and October. Biological data were collected during the sardine fishery, all research trawling operations, and bycatch in groundfish and salmon fisheries.

ii. Stock Assessment

PSARC currently uses the annual stock abundance for sardine estimated by US agencies. The U.S. uses a "modified" integrated stock assessment model called Catch At Age Analysis of Sardine – Two Area Model (CANSAR – TAM). The modification of the model is used to account for sardine stocks migrating northward along the Pacific coast outside of the assessment area. The CANSAR – TAM incorporates egg production and spawning habits of this species. The 1999 biomass estimates for age 1+ fish and older was 1.5 million t. Historical and recent accounts suggest that sardines are particularly abundant off BC when the northern population biomass exceeds 1 million tonnes, with the actual percent migration varying from year to year in response to changes in ocean conditions, food supply and stock size (average 10%). The U.S. is currently harvesting the northern stock at a rate of 5 to 15% and precautionary management dictates that the Canadian fishery harvest the percent of this stock that migrates to BC waters at a similar rate (5 – 15% of approximately 10% of the total biomass estimate).

iii. Management

In 1997, a three-year pilot fishery was implemented. Seven experimental licenses of 80t each were issued. In 1999, the individual license quota was increased to 160t. Using the 1999 US biomass estimates (1.5 million metric tonnes) estimated migration rate to British Columbia of 10%, and an extremely precautionary harvest rate (approximately 1%), a quota of 1,600 tons was issued for the BC Coast for the 2000 fishery season. This included a 200t allocation to the Pacific Coast Sardine and Mackerel Harvesters Association to help offset the costs associated with development of the fishery. In 1999 the Association's quota was not entirely caught and resulted in an underage of 116 tons. This underage was permitted to be carried over to the next season (2000) for one year only. This translated into a year 2000 quota of 1,716 tons, equally divided among the 7 licensees.

D. Other related studies

1. Statistics and Sampling

Principal Statistics and Sampling activities in 200 included the ongoing population of the overall biological database (GFBio). This database represents about 4,000,000 specimens. Data entry activities 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. Approximately 25% 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 about 1,000 length/sex/age samples and 2,000 length/sex samples in 2000. Hook-and-line and sablefish trap landings have 100% dockside validation. Observer coverage in the hook-and-line fishery was initiated in 2000. The target of 10% was not quite achieved. The port sampling unit field-tested a new hand-held data logging unit in 2000. This model will replace the previous non-DOS based system. The data recording program of the new system can be adapted in the field.

APPENDIX 1. REVIEW OF CANADIAN GROUNDFISH FISHERIES

1. Commercial fisheries

All catch figures for 2000 are preliminary. Canadian domestic trawl landings of groundfish (excluding halibut) in 2000 were 43,748 t, a decrease of 61% below the 1999 catch. The main cause for the reduction in landings was the decrease in landings of Pacific hake. The major species in the trawl landings were Pacific hake (17%), Pacific ocean perch (14%), turbot (10%), yellowtail rockfish (9%), dover sole (7%), yellowmouth rockfish (5%) and widow rockfish (5%).

Canadian landings of groundfish caught by gear other than trawl in 2000 totalled 13,458t. Sablefish landings by trap and longline gear accounted for 3,403 t, 79% by trap gear and 21% by longline gear. Landings of species other than sablefish by longline, handline and troll gear accounted for 9,947t (60% dogfish, 23% rockfish and 14% lingcod). Catches incidental to other gear types, including shrimp trawl, crab traps, seines and gillnets, totalled 108t (79% rockfish and 13 % dogfish).

2. Recreational fisheries

Each year, Fisheries Branch (FOC) conducts creel surveys of the recreational angling fishery in the Strait of Georgia. Principal target species are chinook and coho salmon. In 2000, these surveys covered the months of April to September, with some additional, limited coverage during the months of October to December. Provisional estimates of 2000 catches, landings and discards, for this 9-month period were 50,890 fish for lingcod, 96,821 fish for all rockfish species, 32,348 fish for flatfish species, 47,428 fish for dogfish, 2,429 fish for halibut and 22,248 fish other species, including greenling, cabezon, herring and ratfish.

3. Joint-venture fisheries

In 2000, 34 Canadian catcher vessels delivered Pacific hake and incidental species to six processing vessels in co-operative fishing arrangements. This fishery usually takes place off the southwest coast of Vancouver Island (Area 3C) but in 2000 the fishery extended northward to include areas 5A, 5B, 5D and 5E. A total of 15,060t of Pacific hake was processed by 6 Polish vessels. The quotas and catches are outlined below:

Joint-venture fisheries quotas and catches

Nation	Species	Quota (t)	Catch (t)
Poland	Hake	38,594	15,060
	Pollock	incidental	143
	Pacific ocean perch	incidental	50
	Rockfish	incidental	284
	Other	incidental	88

4. Foreign fisheries

There were no national fisheries for Pacific hake off British Columbia in 2000. However, three of the Polish processing vessels involved in the joint-venture fishery occasionally fished directly (supplemental fishing) when the Canadian catcher vessels could not supply sufficient quantities of Pacific hake. The fishing occurred in areas 3C, 3D, 5B and 5E. This supplemental catch is considered to be the national catch.

Nation	Species	Catch (t)
Poland	Hake	960
	Pollock	-
	Pacific ocean perch	2
	Rockfish	32
	Other	3

APPENDIX 2. GROUNDFISH RELATED REPORTS PUBLISHED BY THE STOCK ASSESSMENT DIVISION DURING THE PERIOD JANUARY 1, 2000 TO DECEMBER 31, 2000 ARE LISTED BELOW:

Primary Publications

Beamish, R.J., G.A. McFarlane, and J.R. King. 2000. Fisheries Climatology: Understanding the Interannual and Decadal scale processes that regulate British Columbia fish populations naturally. P 94 – 139. In: Parsons, J. and P. Harrison [eds.] Fisheries Oceanography: A Science for the New Millennium. Blackwell Scientific. 347p.

Beamish, R.J., D. McCaughran, J.R. King, R.M. Sweeting, and G.A. McFarlane. 2000. Estimating the relative abundance of juvenile coho salmon in the Strait of Georgia using surface trawls. North Am. J. Fish. Mgmt. 20. p. 369–375.

Beamish, R.J. and G.A. McFarlane. 2000. Reevaluation of the interpretation of annuli from otoliths of a long-lived fish, *Anaplopoma fimbria*. Fisheries Res. 46 (1-3): 105–111.

Beamish, R.J., D.J. Noakes, G.A. McFarlane, W. Pinnix, R. Sweeting, and J.R. King. 2000. Trends in coho marine survival in relation to the regime concept. Fish. Oceanogr. 9: 114–119.

Fargo, J. and T. Wilderbuer. 2000. Population Dynamics of rock sole (*Lepidopsetta bilineata*) in the North Pacific. Journal of Sea Research 44: 123-144.

Fargo, J. and A. R. Kronlund. 2000. Variations in growth for Hecate Strait English sole (*Parophrys vetulus*) with implications for stock assessment. Journal of Sea Research 44: 45-61.

King, J.R., G.A. McFarlane, and R.J. Beamish. 2000. Decadal scale patterns in the relative year class success of sablefish (*Anaplopoma fimbria*). Fish. Oceanogr. 9: 62–70.

McFarlane, G.A., and A. Geffen. 2000. Otoliths in studies of populations (editorial). Fish. Res. 46: 189–190.

McFarlane, G.A. J.R. King and R.J. Beamish. 2000. Have there been recent changes in climate? Ask the fish. Prog. Oceanog. 47: 147–169.

Stanley, R D., R. Kieser, K. Cooke, A. M. Surry, and B. Mose. 2000. Estimation of a widow rockfish (*Sebastes entomelas*) shoal off British Columbia, Canada as a joint exercise between stock assessment staff and the fishing industry. Int. Jour. Mar. Sci. 57: 1035-1049.

Swain, D.P., Poirier, G.A., and Sinclair, A.F. 2000. Effect of water temperature on catchability of Atlantic cod (*Gadus morhua*) to the bottom-trawl survey in the southern Gulf of St Lawrence. ICES J. Mar. Sci. 57 56-68.

Swain, D.P., and Sinclair, A.F. 2000. Pelagic fishes and the cod recruitment dilemma in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 57 1321-1325.

Other Publications

Fargo, J., A. R. Kronlund and J. T. Schnute. 2000. Flatfish stock assessments for the west coast of Canada for 2000 and recommended yield options for 2001. Canadian Stock Assessment Secretariat Research Document 2000/166.

Haist, V. and R. Hilborn. 2000. Sablefish stock assessment for 2000 and recommended yield options for 2001. Can. St. Assess. Sec. Res. Doc. 2000/157 74 p.

King, J. R. and A.M. Surry. 2000. Lingcod stock assessment and recommended yield options for 2001. Can. St. Assess. Sec. Res. Doc. 2000/164. 50 p.

Schnute, J. T. and R. Haigh. Stock biomass estimates from tow-by-tow data for Pacific Groundfish. Can. Stock Assess. Sec. Res. Doc. 2000/155, 32 p.

Sinclair, A. 2000. Assessment of Pacific cod in Hecate Strait, Nov. 2000. Canadian Stock Assessment Secretariat research Document 2000/170.

Stanley, R. D. and A. R. Kronlund. 2000. Silvergrey rockfish (Sebastes brevispinis) assessments for 2000 and recommended yield options for 2001 and 2002 Canadian Stock Assessment Secretariat research Document 2000/xxx.

Starr, P.J. and R. Haigh. 2000. Assessment of the Canadian longspine thornyhead (*Sebastolobus altivelis*) for 2000. Can. Stock Assess. Sec. Res. Doc. 2000/154, 66 p.

Starr, P.J. and C. Schwarz. 2000. Feasibility of a bottom trawl survey for three slope groundfish species in Canadian waters. Can. Stock Assess. Sec. Res. Doc. 2000/16, 42 p.

Swain, D.P., Sinclair, A.F., Chouinard, G.A., and Drinkwater, K.F. 2000. Ecosystem effects on pre-recruit survival of cod in the southern Gulf of St. Lawrence. Canadian Stock Assessment Secretariat Research Document 2000/147.

Wyeth, M. R., R. D. Stanley, R. Kieser, and K. Cooke. 2000. Use and calibration of a quantitative acoustic system on a commercial fishing vessel. Can. Tech. Rep. Fish. Aquat. Sci. 2324.

APPENDIX 3. STOCK ASSESSMENT DIVISION GROUNDFISH STAFF IN 2000

W. Andrews	Sablefish and hake
K. Charles	Fish Ageing
K. Cooke	Population hydroacoustics estimation
G. Kronkite	Acoustic development methods
J. Fargo	Stock assessment and biology, flatfish
C. Fort	Herring assessment
D. Gillespie	Fish Ageing
J. Groot	Fish Ageing
R. Haigh	Statistical analysis, exploratory data analysis
L. Hamer	Herring data base management
S. Hardy	Groundfish Port sampling
G. Jewsbury	Sablefish and hake
T. Johansson	Statistics/sampling
R. Kieser	Population hydroacoustics estimation
J. King	Lingcod assess, Sablefish climate studies
B. Krishka	Slope rockfish
G. Kronkite	Acoustic development methods
R. Kronlund	Analytical programs
D. Little	Fish Ageing
G. A. McFarlane	Marine Fish stock assessment, population dynamics and biology, fish/ocean interaction
S. E. MacLellan	Fish Ageing
W. Mitton	Sablefish, hake, dogfish and pollock
T. Mulligan	Acoustic development methods
S. Nahannah	Fish Ageing
K. Rutherford	Statistics/sampling
M. Saunders	Groundfish stock assessment and biology
J. Schnute	Multispecies stock assessment, mathematical analysis
J. Schweigert	Herring stock assessment and stock identification
R. Stanley	Shelf rockfish stock assessment biology, sampling studies
S. Sviatko	Groundfish port sampling
M. Surry	Lingcod
R. Tanasichuk	Hake/herring/euphausiid interactions
N. Venables	Groundfish port sampling
L. Yamanaka	Inshore rockfish stock assessment and biology

Alaska Fisheries Science Center
of the
National Marine Fisheries Service

2001 Agency Report
to the
Technical Subcommittee
of the
Canada-US Groundfish Committee

May 2001

Compiled by
Mark Wilkins, Tom Wilderbuer, and David Clausen

VIII. REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENTS, AND MANAGEMENT IN 2000

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 . Lists or organization charts of groundfish staff of these three units are included as Appendices II, III, and IV.

RACE DIVISION

In 2000 the primary activity of the Resource Assessment and Conservation Engineering (RACE) Division continued to be fishery-independent stock assessments of important groundfish species of the northeast Pacific Ocean and Bering Sea. The RACE Division changed over from a triennial to a biennial rotation of survey area emphasis in Alaskan waters in 1999. We will be surveying the Gulf of Alaska continental shelf and slope during odd years and the Aleutian Islands shelf and Bering Sea continental slope in even years. The crab and groundfish resources of the eastern Bering Sea shelf will continue to be surveyed annually. The Division will also continue the West Coast continental shelf and slope bottom trawl survey series and the echo integration/trawl survey for Pacific hake through 2001. Following this year's surveys, the AFSC will hand over full responsibility for West Coast surveys to the NWFSC.

Three major bottom trawl surveys of groundfish resources were conducted in 2000 by RACE researchers on the eastern Bering Sea shelf, in the Aleutian Islands region, and along the eastern Bering Sea continental slope. The Midwater Assessment and Conservation Engineering (MACE) Program conducted comprehensive acoustic/trawl surveys of pollock abundance in the Bogoslof Island area and the southeastern Bering Sea shelf in February-March 2000, in Shelikof Strait in March 2000, and on the eastern Bering Sea shelf in June-August 2000. RACE and REFM scientists also conducted a feasibility study in August 2000 in an area east of Kodiak Island to evaluate whether the area was suitable for future studies on the interactions between commercial fishing, pollock, and Steller sea lions. The Recruitment Processes task conduct-

ed several Fisheries-Oceanography Coordinated Investigations (FOCI) cruises during the spring and summer of 2000, investigating the interaction between the environment and the spawning products of Gulf of Alaska and eastern Bering Sea pollock.

Dr. Art Kendall, manager of the Fisheries-Oceanography Coordinated Investigations (FOCI) program, retired at the end of 2000. Art was instrumental in developing a program with considerable expertise and worldwide reputation in the field of ichthyoplankton and larval fish research. Jennifer Lanksbury joined the FOCI program in 2002.

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, and Status of Stocks and Multispecies Assessment. Scientists at AFSC assist in preparation of stock assessment documents for groundfish in the three management regions (Bering Sea/Aleutian Islands, Gulf of Alaska, and Washington- Oregon-California), 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.

NMFS - AFSC - 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 2001, the groundfish program began an additional new project to study the interaction between Steller sea lions and prey/predators in Alaska. Presently, the Groundfish Program is staffed by 14 scientists. Three personnel changes occurred in the Groundfish Program during

2000/2001: longtime staff member Ken Krieger retired, Mitch Lorenz from ABL's Habitat Program transferred into the Program, and Pat Malecha was hired to work on fishing effects studies.

In 2000 field research, ABL's Groundfish Program, in cooperation with the AFSC's RACE Division, conducted the annual NMFS sablefish longline survey in Alaska. Other field work by ABL included 1) a manned submersible study of deepwater coral beds off southeastern Alaska to identify Habitat Areas of Particular Concern (HAPC); 2) a SCUBA diving study of growth rates of a shallow water coral species to help determine effects of fishing on corals of Alaska; 3) continued juvenile sablefish studies, including tagging of juveniles and a laboratory young-of-the-year sablefish growth study; 4) an ongoing genetics and plankton study to identify rockfish larvae to species; 5) a sablefish longline hook spacing experiment; 6) electronic archival tagging of sablefish during the longline survey; 7) a continuing habitat study of rockfish in nearshore areas of southeastern Alaska; and 8) development of a benthic sled to house video cameras for observing seafloor habitat. Field work on the Steller sea lion/prey interaction study also began in early 2001.

Ongoing analytic activities involved management of ABL's sablefish tag database and preparation of three annual status of stocks documents for Alaska groundfish: sablefish, slope rockfish, and pelagic shelf rockfish. Other analytic activities during the past year were: 1) a study of the use of echosounder signals to stratify trawl surveys for Pacific ocean perch and thereby improve survey precision; 2) an analysis of tag reporting rates in the Alaska sablefish fishery; 3) establishment of a sablefish logbook database and computation of longline fishery catch rates; and 4) an examination of past trawl survey data in Alaska to identify locations of coral abundance that may be affected by fishing activities. In addition, several of the staff spent considerable time helping prepare the Programmatic Supplemental Environmental Impact Statement (SEIS) for the Bering Sea/Aleutian Islands and Gulf of Alaska Groundfish Fishery Management Plans. The purpose of this extensive document was to provide an updated discussion and analysis of the environmental impacts of the groundfish fishery 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 May 23- July 20, 2000. A total of 372 stations were sampled covering over 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 survey for the eighth consecutive year.

Preliminary biomass estimates for major roundfish species indicated a significant increase over 1999 for walleye pollock and a continuing downward trend for Pacific cod. Most flatfish species showed increases in abundance from the previous year. Like 1999, the survey was started approximately 2 weeks earlier than in recent years due to an earlier opening of the walleye pollock "B" season. Bottom water temperatures in 2000 were much closer to the long term mean (long term = 2.43, 2000 = 2.16) than in the record cold year of 1999. As a result, the distributions of walleye pollock and Pacific cod were once again spread across the shelf.

However, as happened last year, a high incidence of the lack of new eggs in red king crab (*Paralithodes camtschaticus*) was found, suggesting a delay in molting. As a result, after the completion of the standard survey, the primary area of red king crab abundance was resurveyed and a normal condition was found.

Twenty additional stations were sampled in the inshore waters of Bristol Bay to examine the feasibility of adding standard stations to improve the assessment of yellowfin sole. Yellowfin sole are spawning inshore during the time we conduct the survey and it is hoped that expanding the area sampled will yield better estimates.

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

Aleutian Islands Biennial Groundfish Assessment Survey - RACE

The seventh comprehensive bottom trawl survey of Aleutian Island region groundfish resources was conducted from 17 May through 25 July, 2000 by the RACE Division. Previous surveys were conducted more or less triennially in 1980, 1983, 1986, 1991, 1994, and 1997. Future surveys will be conducted biennially.

Survey sampling was conducted aboard two chartered commercial trawlers using our standardized Poly Nor'Eastern bottom trawls rigged with roller gear. Sampling operations began on the north side of the Aleutian Islands between Unimak Pass (165W) and the Islands of Four Mountains (170W) and extended westward throughout the remainder of the Aleutian Archipelago to Stalemate Bank (170E). The primary focus of this groundfish survey series is to build a standardized time series of data for use in assessing, describing, and monitoring the distribution, abundance, and biological condition of various

Aleutian groundfish stocks. Specific objectives of the 2000 survey included 1) defining the distribution and relative abundance of the principal groundfish and commercially important invertebrate species that inhabit the Aleutian region; 2) obtaining catch and effort data from which to estimate the absolute abundance of the principal groundfish species; 3) collecting data to define various species-specific biological parameters i.e., age, sex, size, growth rates, length-weight relationships, feeding habits, spawning condition, and taxonomy; and 4) collecting data and specimens requested by other researchers or institutions.

Time lost to bad weather and gear repair was generally minimal, but during periods of extreme tidal flow, heavy currents at specific stations sometimes caused work to be postponed. Sampling generally proceeded from east to west. Some preassigned stations were not sampled due to unsuitable bottom conditions; some untrawlable stations were replaced with preselected alternate locations, or a new location within the proper area-depth stratum. Successful tows were performed at 428 of 456 assigned assessment sites. Stations ranged in depth from 20 to 471 m. Sea surface temperatures and successful bathythermograph recordings were collected at 441 stations.

Biomass was estimated for the major groundfish species using the area-swept technique. Total biomass estimates indicate that Atka mackerel and Pacific ocean perch were, by far, the dominant species in the Aleutian region as a whole, but Atka mackerel was the predominant species in the Central regulatory area. Pacific ocean perch ranked second in overall total biomass in the region, but was the most abundant species in the western Aleutian area. Northern rockfish was fourth overall in total biomass following giant grenadiers. In the southern Bering Sea area walleye pollock was the most abundant species.

The results show a striking degree of variability among some of the biomass estimates across these years, especially for species with highly contagious distributions, such as Atka mackerel, Pacific ocean perch, and northern rockfish. In general, sampling in the rough, hard- bottom areas inhabited by Atka mackerel, giant grenadiers, and the rockfishes has improved over the past decade, largely due to the expertise of our charter vessel operators. Some variability might be due to differences in survey timing. This survey was approximately 3 weeks earlier than the 1994 and 1997 surveys, which were 7 weeks earlier than the 1991 survey.

In the Aleutian Islands region, 2000 was the coldest year yet detected during AFSC groundfish surveys. The warmest years tend to lag about a year behind El Niño events. The coldest years thus far detected have occurred within the same decade, 6 years apart. Generally, temperatures at shallower depths vary more than at depths greater than 300 m where they are within a range of about 0.5C or less. Perhaps the temperatures in 2000 are not as anomalous as they appear, but many individual fish were visibly thinner than during other surveys. Unfortunately, we have no data to compare for the intervening years.

Table 1. Biomass estimates (t) of major species captured during the 1991-2000 AFSC bottom trawl surveys of the Aleutian region.

Species	1991	1994	1997	2000
Atka mackerel	723,979	668,764	461,994	512,900
Pacific ocean perch	351,093	383,618	625,273	511,706
Giant grenadier	24,594	33,669	71,501	219,693
Northern rockfish	215,255	93,289	87,390	205,348
Pacific cod	189,190	184,109	83,416	136,075
Walleye pollock	180,088	117,198	158,912	128,015
Arrowtooth flounder	21,809	57,978	73,893	64,470
Pacific halibut	39,490	61,379	66,248	49,619
Northern rock sole	*37,326	*54,786	49,897	44,078
Shortraker rockfish	23,703	28,190	38,487	37,782
Kamchatka flounder	15,485	49,041	37,664	28,479
Rougheye rockfish	11,131	14,552	11,596	15,259

*** Grouped rock sole species in 1991 and 1994**

For further information, contact Harold Zenger, (206)526-4158.

Bering Sea Continental Slope Bottom Trawl Pilot Survey - RACE

The RACE Division's Groundfish Task completed a pilot bottom trawl survey of the groundfish and shellfish resources of the eastern Bering Sea continental slope (BSCS) aboard the chartered commercial trawler *Morning Star* between June 16 and July 20, 2000. The vessel worked along the continental slope of the eastern Bering Sea from Akutan Island toward the northwest, sampling predetermined stations at depths between 180 and 1,100 meters. The objectives of the investigation were somewhat exploratory in nature, to gain a familiarity with the area, habitats, and biota that will be sampled when we begin a new biennial bottom trawl survey series in 2002.

Another objective was to determine the type of trawl needed to sample this habitat appropriately. Since this region was reputed to be quite rugged, we needed to determine whether a rough-bottom sampling trawl, capable of sampling marginally trawlable bottom, was necessary. Using such gear often requires us to sacrifice some of our ability to collect smaller demersal fish and invertebrates that can escape under the larger ground gear. Therefore, last summer's work included a study comparing the ability of two different configurations of the RACE Division's Poly Nor'Eastern sampling trawl to sample all species and sizes of demersal fish and shellfish in this habitat. Two hauls were made at each station using trawls rigged with different types of ground gear.

• The "mudsweep" ground gear was constructed of 20-cm diameter solid rubber disks strung on 16-mm high tensile chain. (This is the standard gear used for the AFSC's continental slope bottom trawl surveys off Washington, Oregon, and California.)

• The "rockhopper" ground gear consisted of 46-cm diameter rockhopper disks separated by solid sections (approximately 35 cm long) of 25-cm diameter rubber disks.

We successfully completed paired trawl hauls at 56 of the 58 planned stations. Two stations in the deepest stratum were abandoned due to untrawlable bottom. Only four tows resulted in unsatisfactory performance (three due to torn nets and one due to the net "mudding down"). Mean path widths of the mudsweep and rockhopper trawls were 14.94 and 14.02 m, respectively, with corresponding mean net heights of 7.24 and 8.35 m.

Average catch rates of the mudsweep gear were higher than those of the rockhopper gear in all depth strata except the shallowest. Average catch rates in the shallowest stratum were strongly influenced by large catches of Pacific ocean perch, and the largest of those catches (>16 t) was made with the rockhopper net. With Pacific ocean perch excluded, the average catch rate of the mudsweep gear in the shallowest stratum exceeded that of the rockhopper gear by 46%. These preliminary results suggest that the mudsweep gear we currently use for the West Coast continental slope survey would sample the biota better and that the survey area can be adequately sampled without resorting to the rough-bottom rockhopper sampling trawl.

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

West Coast Trawl Survey of Upper Continental Slope Groundfish Resources - RACE

The RACE Division completed a four-week bottom trawl survey of the upper continental slope groundfish resources off Washington, Oregon, and California on November 9, 2000. The survey covered the upper continental slope habitat 183-1,280 m deep in the International North Pacific Fisheries Commission (INPFC) U.S. Vancouver, Columbia, Eureka, Monterey, and northern Conception statistical areas (U.S./Canada border-lat. 3430'N). Sampling for the survey began near the U.S./Canada border in Nitinat Canyon and progressed southward toward Point Conception. We successfully sampled 207 of 208 possible stations during the survey. Results from annual groundfish slope surveys are used by fishery managers to assess stock conditions and establish annual harvest guidelines for sablefish (*Anoplopoma fimbria*), Dover sole (*Microstomus pacificus*), and two species of thornyhead rockfish (*Sebastolobus alas-*

canus and *S. altivelis*). This was the twelfth survey in an ongoing series to monitor long-term trends in the distribution and abundance of WCUCS groundfish populations.

For more information, contact Bob Lauth, (206)526-4121.

Fisheries Behavioral Ecology Program - RACE

This research program focuses on understanding the role that behavior plays in regulating the growth, distribution, abundance and survival of economically and ecologically valuable fish species. Two major groups of laboratory studies are conducted. Bycatch research focuses on the potential for recovery of juvenile and adult walleye pollock, sablefish, lingcod and halibut that initially survive capture or are otherwise impacted by fishing gear. Behavioral ecology research focuses on larval, juvenile and adult stages of walleye pollock, sablefish and halibut and their responses to changing environmental conditions and how these influence distribution, growth and survival.

Bycatch studies are aimed at evaluating: 1) the potential for long-term survival following capture; 2) whether fish that survive capture suffer deficits in behavioral and physiological capabilities that may compromise their ability to feed successfully and avoid predation; 3) whether the capability of surviving and recovering from capture differs with age and species; 4) how environmental factors interact with stresses imposed by capture to influence survival and recovery of behavioral and physiological capabilities. Recent results have shown that in walleye pollock, sablefish and halibut, survival and recovery of orientation, recognition of species mates, feeding, predator evasion and baseline physiology after capture is dependent on gear type (towed net or longlining) and the types of interactions between fish and fishing gear. New research has shown that the fate of fish escaping from trawls is not well known and may represent a large and unspecified source of indirect fishing mortality. The light conditions in a net are important, with fish under dark conditions being unable to orient or swim, a condition that results in greater injury, behavioral deficits and mortality. Sensitivity to capture stress varies among ages and species, with walleye pollock being the most sensitive species, followed by sablefish, halibut and lingcod and younger fish being more sensitive than older fish, a result that shows that generalizations about bycatch stress, behavioral deficits and mortality among species is not possible. Elevated temperature plays a major role in the magnification of stress that is induced by capture. Exposure of sablefish, halibut or lingcod to temperatures ranging from 12 to16C after capture, a condition that is similar to thermocline conditions and deck conditions off the northwest coast of the U.S. and Canada during the summer, results in magnification of behavioral and physiological deficits as well as mortality. Clearly, management of fisheries stocks should consider the impact of seasonally elevated tempera-

ture on the increase in bycatch stress and mortality for all gear types.

Behavioral ecology studies on various stages of walleye pollock, sablefish and halibut include experimental analysis of feeding and growth, predator/prey interactions and social interactions (schooling and resource competition) in response to physical gradients of light, temperature, and mixing and temporal and spatial distribution of food, predator threat and social interactions. Results are assessed in conjunction with field studies to help improve sampling surveys, predict responses by fish to changes in their environment, help define critical habitat for economically and ecologically important species and ultimately, predict survival and recruitment potential.

For further information, contact Michael Davis, (541) 867-0256 .

Fisheries Resource Pathology Program - RACE

The Fisheries Resource Pathobiology sub-task continued its monitoring effort of potentially important diseases of juvenile walleye pollock, red (*Paralithodes camtschaticus*) and blue (*P. platypus*) king crab, four species of tanner crabs (*Chionoecetes bairdi, C. opilio, C. tanneri, and C. angulatus*), and Atka mackerel during the 2000 survey season. Juvenile walleye pollock (20 - 90 mm) were collected from the Bering Sea and will be microscopically examined to determine the prevalence and distribution of diseases that may lead to mortality prior to recruitment age. To determine the distribution and prevalence of Bitter Crab Syndrome caused by the parasitic dinoflagellate *Hematodinium sp.*, hemolymph smears were collected from *C. bairdi* and *C. opilio* from the Bering Sea shelf and from *C. tanneri* and *C. angulatus* from the Bering Sea slope. Ongoing studies of disease prevalence and distribution in red and blue king crab were continued during the 2000 survey season. Tissue samples were fixed and will be microscopically examined to determine disease affects on population abundance and distribution.

In 1999 and 2000, tumors were discovered in the body cavities of Atka mackerel found in the Aleutian Islands. Upon microscopic examination a protistan parasite, *Myxosporidia sp.*, was found to be associated with the affected tissues and tumor masses. We have not yet determined what, if any, role the parasite or tumors play in the survivability of Atka mackerel.

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

Age and Growth Task - REFM

The Age and Growth Program, of the REFM Division, serves as the Alaska Fisheries Science Center's ageing unit for groundfish species. The

program consists of a biometrician, age validation researcher, data manager/technician, and 9 age readers. Ages are usually determined from otoliths, but scales and/or finrays 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 miscellaneous sole and rockfish species.

Craig Kastelle recently completed a radiometric study with Joan Forsberg, of the IPHC, using young 5-7 year old halibut collected in 1960. The measurement of Pb-210 and Ra-226 in these old samples provides clues as to whether the assumption of no leakage of radon from otoliths is valid. This assumption is required when applying Pb-210/RA-226 radiometric ageing to fish otoliths. The results were not definitive due to the extremely low levels of radium present in the otoliths. However, a brief paper describing these results is being written for publication.

Still continuing is a study with the NMML to apply radiometric ageing to gray and bowhead whales. The laboratory work has been completed, and results will be analyzed and submitted for publication. Preliminary results suggest that the method may possibly be applicable to gray whales, but not bowhead whales. The problem appears to be excess lead found in the bullae of bowhead whales.

Nancy Roberson should soon complete her thesis concerning problems ageing Alaska Pacific cod. She has prepared thin sections that were used along with imaging equipment and Optimas software to measure otolith rings. Results from these measurements were used to help determine ageing criteria, and whether miss-ageing had occurred. Otoliths from tagged Pacific cod enabled the selection of a back calculation method and an indirect validation of ageing criteria. Although not answering all questions, this thesis should provide a basis for the return of Pacific cod to production ageing.

Jon Short and Chris Gburski are working on a study to use otolith shape analysis and other measurements as a tool to distinguish arctic cod from walleye pollock. At small fish sizes, walleye pollock can be extremely difficult to distinguish from arctic cod, and pollock otolith collections may be contaminated with other species. Otolith analysis can provide a good method of detecting collector error.

The Age and Growth Program recently hired Wes Shockley, (Univ. Of South Florida, B.S. (94), M.S. (97); both in zoology).

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

Resource Ecology and Ecosystem Modeling - REFM

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 2000, we collected samples during bottom trawl surveys of the Aleutian Islands and the eastern Bering Sea shelves and upper continental slopes. Observers collected stomach samples during fishery operations from the eastern Bering Sea. In total, 10,592 stomachs were collected from the eastern Bering Sea and 4,174 from the Aleutian Islands. Laboratory analysis was conducted on 5,429 fish stomachs from the Bering Sea, 2,864 from the Gulf of Alaska and Aleutian Islands, and 1,787 from the west coast regions.

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

Ecosystem modeling- Eastern and Western Bering Sea Shelves

A comparison, in collaboration with Russian researchers, of two mass-balance food web models of the 1980s eastern and western Bering Sea shelves, revealed structural differences which may arise through the difference in biogeography between the regions. The eastern Bering Sea ecoregion primarily consists of a wide continental shelf, while the western Bering Sea has an extremely narrow shelf in comparison with its slope area. As a result, the western Bering Sea possesses approximately twice the level of primary and secondary pelagic production per unit area, as higher production occurs over the slope rather than on the shelf. However, much of this extra energy is lost between lower and upper trophic levels in the western Bering Sea, due to the differences in supported fish communities in the two regions. The eastern Bering Sea possesses a larger per-unit-area biomass of most higher trophic level fish guilds.

In both systems, primary production follows two distinct pathways to higher trophic levels: (1) the pelagic pathway, through pelagic zooplankton, forage fish, and cephalopods and (2) the benthic pathway, through benthic zoo-

plankton, infauna, epifauna, and small flatfish. The transfer of energy through pelagic pathways is proportionately similar in both systems. However, the flow of energy through the benthic pathways differs substantially, especially between trophic levels 3 and 4.

In the eastern Bering Sea, a complex community of small flatfish species, especially yellowfin sole, rock sole, flathead sole, and Alaska plaice, provides a major energy conduit between benthic invertebrates and higher trophic levels. These small flatfish may, as a guild, represent a keystone component of the ecosystem on the eastern Bering Sea shelf. This community is considerably smaller in the western Bering Sea, where an extremely high density of epifauna, such as brittlestars and sea urchins, consume a large proportion of benthic material without passing it up the food chain. On higher trophic levels (4+), Pacific cod seems to be a keystone predator in both ecosystems. The determination of keystone species and points in the food web of at which top-down and bottom-up control occurs is being explored further through sensitivity analysis of the two food webs.

Additionally, this work brought together data and aided in evaluating data quality, and served as a backdrop for comparing different methods for estimating food consumption in groundfish species. Sensitivity analyses point to the importance of analyzing food habits and growth rates of fish over their entire life history when measuring their impact on ecosystem dynamics. A next, important step in this work is to improve the quantification of highly migratory animals, especially marine mammals, in the two models.

Environmental Impact Analysis

A comprehensive analysis of the impacts of the Alaskan groundfish fisheries on the environment was performed. Members of the REEM program provided background information on groundfish food habits and benthic habitat. Ecosystem-level impacts of alternative fishery management regimes were also evaluated. A draft of the full analysis is available on the web at http://www.fakr.noaa.gov/sustainablefisheries/seis/default.htm .

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

2. Stock Assessment

Status of Stocks and Multispecies Assessment Task - REFM

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

support for the evaluation of potential impacts of proposed fishery management measures.

During the past year, stock assessment documents were prepared by the Task 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 Steller 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 climactic 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 regional management councils 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 2000, no foreign vessels were allowed to catch or process fish in the U.S. EEZ along the west coast and Alaska. The Observer Program trained and deployed 878 observers to vessels fishing off Alaska, and the Washington-Oregon-California coast. The Program was 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 were provided to the Alaska and Northwest Regional Offices to assist in management decisions regarding the catches of groundfish and prohibited species. Data were also collected regarding the operations of the groundfish fishery.

Observer Program Review

An extensive, independent review of the Observer Program began in late 1999. The review was carried out by Marine Resources Assessment Group (MRAG) Americas, Inc. MRAG is an independent consulting firm which provides professional advice and services for the management of marine fisheries throughout the world. The purpose of this review was to provide recommendations for changes in Program operations and organization which might improve the Program's ability to meet its mission and goals. Their final report along with a response from the AFSC was made available to the North Pacific Fishery Management Council at its meeting in September 2000.

Two key recommendations in the MRAG report involved the reestablishment of Program goals and objectives and the development of a contractual relationship between NMFS and the observer provider companies. Reestablishing goals and objectives will be an important first step in guiding and defining the role and future direction of the Observer Program. The development of a contractual relationship between NMFS and the observer companies is an initiative toward the elimination of any real or perceived conflicts of interest between the observer companies and the fishing fleet they service. As a first step, the Observer Program is proposing the development of a pilot contract using the American Fisheries Act (AFA) catcher processor and mothership fleet. Under this arrangement, the AFA fleet would be required to seek their observer coverage from the observer company that holds that contract with NMFS. The contract is envisioned as a "no-cost" arrangement where the observer company receives payment for their services directly from the AFA fleet and must abide by the performance standards of the contract in order to retain their exclusive rights to provide observers to the AFA fleet. This contractual arrangement will place the NMFS Observer Program in the role of "client"

in the eyes of the observer company and will significantly reduce any perceived or actual conflict of interest between the AFA fleet and the current observer companies that service that fleet.

In addition to the MRAG review, the Observer Program was also reexamined this year along with all other NMFS observer programs, through the annual NMFS management control review (MCR) process. The newly established, National Observer Program Advisory Team (NOPAT) was actively involved in this endeavor. NOPAT is made up of representatives from all NMFS regional offices, science centers and observer programs and is coordinated through the National Observer Program office of NMFS. The AFSC's Observer Program contribution to the MCR report was completed in late September and the entire national MCR report was made available the following month.

Observer Program "Cadre" Takes Shape

New office space in Anchorage was designed, constructed and leased in the Federal building annex during 2000, to house ten new Observer Program employees. These new employees along with the existing two positions in Anchorage will make up the Observer Program "Cadre." The cadre is an inherently flexible unit of employees that can be deployed as needed to ports throughout Alaska. They help to increase the Observer Program's presence in the field and allow for more "front line" communication between NMFS, observers and the fishing industry. Todd Loomis, the Anchorage field office manager, was selected to lead the Cadre. The first five employees to join the Cadre were hired in December.

2nd Biennial Us-Canada Fisheries Observer Program Workshop

Several AFSC Observer Program staff participated in the 2nd biennial US-Canada Fisheries Observer Program Workshop in St. John's Newfoundland from June 26-29, 2000. The first workshop was hosted by the AFSC in 1998 and was developed to bring together some of the key organizations responsible for the design, management and delivery of at sea fisheries observer programs in the U.S. and Canada. The second such biennial workshop was expanded in scope to include greater representation from the fishing industry and observers. Two currently active and highly experienced North Pacific groundfish observers attended the workshop. The workshop's objectives were as follows:

- To facilitate discussions of the role of observer programs as management, compliance and scientific programs, within the broader context of alternative fisheries monitoring systems.
- To address some of the key issues, related to the delivery of observer programs, from the perspective of governments, service providers, the fishing industry, and observers.

- To explore the current applications, limitations and future uses of scientific data collection from observer programs.

CDQ and AFA Fisheries

Implementation of an expanded Community Development Quota (CDQ) program and implementation of provisions of the recently enacted American Fisheries Act (AFA) continued during 2000. The CDQ program was developed for the purpose of allocating fishery resources to eligible Western Alaska communities to provide the means for starting or supporting commercial fishery activities that would result in ongoing, regionally based, commercial fishery or related businesses. CDQ was initiated in 1992 with pollock and expanded to include fixed gear halibut and sablefish in 1995. In 1998, it was further expanded to include multiple species of groundfish and crab (MSCDQ). In 1999, NMFS was responsible for monitoring the groundfish (including pollock and sablefish) and halibut CDQs and the State of Alaska was responsible for monitoring the crab CDQs. This division of responsibility continued into 2000.

The AFA, enacted by Congress in late 1998, made changes to the pollock fishery in the Bering Sea and Aleutian Islands. These changes included reallocation of fish among industry segments, provided for the formation of fishing cooperatives, and increased observer coverage levels on some components of the fleet. The offshore component of the fleet organized a fishing cooperative in 2000 and received increased, mandatory observer coverage. Also during 2000, the Observer Program was involved in implementation of aspects of the AFA related to shoreside pollock. The shoreside component proved to be more complex then offshore and involved NMFS regulatory actions and a changing role for the observer.

MSCDQ and AFA catch accounting for offshore processors is based entirely on data collected by observers and, unlike the open access fisheries, where observer data is used to manage a fleet wide quota, industry participants in the MSCDQ and AFA fisheries require individual accounting of fish harvested in each haul or set. This change in expectations placed on observers, their data, and the Observer Program in general, has required much Observer Program staff effort in the development of special selection criteria and training requirements for observers, development of new sampling strategies and regulations to enhance the observer's working environment, and changes to the data collection and data management software systems.

For further information or if you have questions about the North Pacific Groundfish Observer Program please contact Dr. Daniel Ito, (206) 526-4194.

Socioeconomic Assessment Program - REFM

During 2000, the Socioeconomic Assessments Program was actively

involved in preparing the Draft Programmatic Supplemental Environmental Impact Statement for the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) groundfish fisheries. This included analyzing the economic effects of the alternatives and developing a mathematical optimization model that includes equality and inequality constraints to solve for the catch and bycatch of each species. The constraints included the catch and bycatch quotas by fishery for each alternative and year as well as the historical species composition of catch and bycatch in the various groundfish fisheries. Fisheries were defined by area, gear and target species.

Other activities included the following: (1) efforts to improve the basic economic data that are available to assess the economic performance of the BSAI and GOA groundfish fisheries and to evaluate the economic effects of alternative fishery regulations; (2) the economic analysis of sea lion protection measures in the pollock, Pacific cod and Atka mackerel fisheries; (3) preparing a qualitative assessment of excess fishing capacity in federally managed commercial fisheries off Alaska; (4) providing assistance in the preparation of the NMFS National Fishing Capacity Task Force report on defining and measuring fishing capacity; (5) providing assistance in the preparation of the NMFS guideline for the economic analysis of fishery management actions; and (6) assisting with the economic analysis of guideline harvest level (GHL) and individual fishing quota (IFQ) alternatives for the Alaska charter boat halibut fishery.

In addition papers were prepared on the following topics: (1) measuring fishing capacity; (2) cost-earnings survey design issues; (3) the use of random utility models in commercial fishing; (4) non-market valuation; (5) recreational fishery attributes, participation rates and regional economic impacts; (6) modeling the economic effects of marine protected areas (MPA); (7) location choice theory; and (8) common property institutions in the Alaska groundfish fisheries.

For further information contact Dr. Joe Terry (206) 526-4253.

C. By species, by agency

1.Pacific cod

b. Stock Assessment

BERING SEA/ALEUTIANS

The present assessment updates last year's assessment, incorporating new catch and survey information. This year's EBS bottom trawl survey resulted in a biomass estimate of 528,000 t, a 9% decrease from last year's estimate and the lowest observed value for the survey. The Aleutian Islands were surveyed in 2000; the biomass increased 63% from 1997. Estimates of abundance

are higher for the 2000 assessment compared to the 1999 assessment. For example, estimated 2001 spawning biomass for the BSAI stock is 369,000 t, up about 10% from last years projection of harvest at the F_{ABC} level for 2001. Since reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, Pacific cod qualify for management under tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 389,000 t, 0.29, and 0.35, respectively. Fishing at a rate of 0.29 is projected to result in a 2001 spawning biomass of 369,000 t, and solves the equation for the maximum permissible value of F_{ABC} under tier 3. Because projected biomass for 2001 is less than $B_{40\%}$, Pacific cod qualify for management under sub-tier "b" of tier 3. Fishing at an instantaneous rate of 0.29 is projected to result in a 2001 catch of 214,000 t, which is the maximum permissible ABC under Amendment 56. However, the assessment author recommended setting the 2001 ABC at 188,000 t, 12% below the maximum permissible level. The recommendation was based on a risk-averse optimization procedure which considers uncertainty in the estimates of the survey catchability coefficient and the natural mortality rate in the computation of an $F_{40\%}$ harvest level. The Bayesian meta-analysis which has formed the basis for a risk-averse ABC recommendation in each of the last four years was not performed for the present assessment. Instead, the ratio between last years recommended F_{ABC} and $F_{40\%}$ (0.87) resulting from the Bayesian meta-analysis was assumed to apply this year as well.

The Plan Team of the NPFMC indicated that a 12% reduction from the maximum permissible ABC is justified not only on the basis of these decision-theoretic concerns, but also because estimated spawning biomass from the model has declined continuously since 1988 and also because four of the last five year classes recruited to the population (assessed at age 3) appear to have been well below the long-term average. A 2001 catch of 188,000 t would represent a decrease of 2% over the 2000 ABC of 193,000 t, the same direction as the 9% decrease in the trawl survey biomass estimate. Spawning biomass projected for 2001 is 38% of its unfished level. Spawning biomass is projected to decline through 2004. ABC reaches a minimum of 150,000 t in 2003. A 2001 catch of 188,000 t corresponds to a fishing mortality rate of 0.28, below the value of 0.29 which constitutes the upper limit on F_{ABC} under tier 3b.

The overfishing level was also determined from the tier 3b formula, where fishing at a rate of 0.32 gives a 2001 catch of 248,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

GULF OF ALASKA

Only size composition and total catch data from the 1999 and January-August 2000 commercial fisheries (federal and state) were incorporated into the 2000 Pacific cod assessment model. The Bayesian meta-analysis that has formed the basis for a risk-averse ABC recommendation in each of the last four years,

was not performed. Instead, the ratio between last year's recommended F_{ABC} and $F_{40\%}$ (0.87) was assumed to apply this year as well.

The estimated 2001 spawning biomass for the GOA stock is 93,800 mt, down about 15% from last year's estimate for 2000 and down about 7% from last year's F_{ABC} projection for 2001. The estimated 2001 total age 3+ biomass for the GOA stock is 526,000 mt, down about 7% from last year's estimate for 2000 and down about 5% from last years $F_{40\%}$ projection for 2001. While the population is still projected to decrease, it is still above the estimated $B_{40\%}$ level.

The recommended 2001 ABC for the GOA stock of 67,800 mt was obtained by applying the ratio of 0.87 to the updated model fit. This is down about 11% from last year's recommendation for 2000 and down about 5% from last year's F_{ABC} projection for 2001. The estimated 2001 OFL for the GOA stock is 91,200 t, down about 11% from last year's estimate for 2000.

Apportioning the ABC between regulatory areas in proportion to the biomass estimates from the most recent trawl survey, results in the following: Western-36% , Central-57%, and Eastern-7%, which would result in 24,400 mt, 38,650 mt, and 4,750 mt, respectively.

For further information, contact Dr. Grant Thompson at (206) 526-4232.

3. Shelf Rockfish

a. Research

Distribution and Habitat of Rockfish in Nearshore Waters of Southeast Alaska

Scientists in the ABL Habitat Program continued to assess the distribution, habitat, and behavior of rockfish in nearshore waters of Southeast (SE) Alaska. Sampling methods included use of a beach seine to capture fish in shallow (<10 m deep), vegetated habitats (e.g., eelgrass meadows, understory kelps) and a remotely operated vehicle (ROV) to record *in situ* observations of rockfish in deeper water (10-90 m) habitats such as vertical bedrock walls and complex bottoms of boulders or broken rock. To date, 123 seine hauls and 208 ROV dives have been completed at 37 sites throughout SE Alaska. Of the over 30 species of rockfish known to occur in Alaska, 16 species were captured or observed in nearshore waters of SE Alaska. Shallow, vegetated habitats were frequented by juvenile black, brown, copper, dusky, and quillback rockfish. Tagging studies showed that juvenile (age >1) copper rockfish moved into shallow, vegetated habitats in early summer and remained there for up to four months. Young- of-the-year rockfish appeared in nearshore, vegetated habitats in August. Most (>75%) observations of rockfish with the ROV were over complex bottoms of boulder and rock or in vertical bedrock wall habitats. Few rockfish were observed over soft bottoms with no relief. Rockfish observed with the

ROV included black, canary, china, copper, dusky, harlequin, Puget Sound, quillback, rosethorn, silvergray, tiger, yelloweye, and yellowtail rockfish. Median depth of observation was <30 m for black, copper, dusky, and yellowtail rockfish and >30 m for all other species. Size of fish observed ranged from 10 to 60 cm; fish size was positively correlated (P <0.036) with depth for dusky, quillback, and yelloweye rockfish. Species often observed alone were China (67%), copper (46%), quillback (46%), and rosethorn (43%) rockfish. Most (>70%) observations of harlequin, Puget Sound, silvergray, tiger, and yelloweye rockfish were in mixed species assemblages. When first observed, the behavior of most rockfish species was swimming or hovering. Notable exceptions were China, harlequin, rosethorn, and tiger rockfish; 33-57% were resting on bottom or in a hole or crevice. Studies in 2001 will focus on identifying seasonal patterns in abundance and factors (e.g., temperature, salinity) that may influence rockfish distribution in nearshore waters of SE Alaska.

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

b. Stock Assessment

GULF OF ALASKA

Pelagic Shelf Rockfish

The pelagic shelf rockfish assemblage is comprised of three species 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.

Similar to previous years, ABC for the assemblage in 2001 is calculated using biomass estimates based on trawl survey data. Gulfwide exploitable biomass, 66,443 mt, is based on the average of the biomasses estimated for the assemblage in the three most recent trawl surveys of this region (those in 1993, 1996, and 1999). Almost all this biomass comes from dusky rockfish. Applying an F=M strategy to this biomass, in which the annual exploitation rate is set equal to the estimated rate of natural mortality for dusky rockfish (0.09), yields a Gulfwide ABC of 5,980 mt for 2001.

Work is presently in progress on applying an age-structured model for the first time to assess stock condition of light dusky rockfish. This model is

expected to be used in this year's assessment to help determine a recommended ABC for light dusky rockfish in 2002.

For more information, contact David Clausen at (907) 789-6049 or Jon Heifetz at (907) 789- 6054.

4. Slope Rockfish

a. Research

GULF OF ALASKA

Stratifying by Echosounder Signal to Improve Trawl Survey Precision for Pacific Ocean Perch

In 1998 color sonar signals were recorded on paper during individual trawl hauls conducted in a study of rockfish, *Sebastes* spp., survey methods by the Auke Bay Laboratory. Visual sonar categorization criteria were developed on a subset of the data based on signal patterns and shapes and color. Blind tests on a subset of 38 of these hauls were then conducted by individual scientists. Between scientist agreement of high and low categories varied from 76-87% The trawl catch rates in the test subset were divided into 14 low catch rates and 24 high catch rates. High and low sonar categorizations corresponded with high and low catch rates 66- 78% of the time Data were collected again in 1999 and categorized using the same criteria. Onboard scientists agreed with categorizations done by a shoreside scientist on 65% of 49 categorizations. The trawl catch rates in the 1999 study were divided into high and low catch rates and the scientists' sonar categorizations corresponded with catch rates on 59% and 61% of the hauls for the shoreside and onboard scientists, respectively. The vessel captains were asked to rate the sonar signals and 61% of their categorizations corresponded with the catch rates. Variance estimates that would result from simple double sampling (Cochran 1977) using the sounder categorizations as strata definitions were predicted using the observed within-category variances at various levels of first stage (sonar) sampling. Sonar samples are considerably less expensive in time and cost than trawl sampling and if 10 times as many sonar samples are taken to stratify the trawl samples, variance improved 18-37% compared to simple random sampling, depending on the data set and the categorizer. If trawl hauls were allocated optimally, the improvement increased from 44-60% over simple random trawl hauls. To match the variance obtained by double sampling with sonar primary sampling, the number of random trawl hauls would have to be increased 1.8-2.5 fold depending on data set and categorizer.

For more information, contact Jeff Fujioka at (907) 789-6026.

Species Identification of Rockfish Larvae and Other Larval Rockfish Studies

Rockfish (*Sebastes* spp.) larvae and early post-larvae present most vexing problems in marine ecology. As a group they are abundant in the spring and early summer zooplankton, where they may have important trophic roles. Single plankton samples may have six species of rockfish and within a small sampling area eight and possibly more species may be present in the plankton. As many as 27 species have been tentatively identified from a single 10-day cruise in the eastern Gulf of Alaska. Although easily identified to genus, specific identification using morphology and pigmentation patterns is very difficult. ABL scientists, in cooperation with Dr. Anthony Gharrett and Andrew Gray of the University of Alaska Fairbanks, are attempting to resolve some of the problems using genetic techniques. In this study, pigmentation patterns of larval and post-larval rockfish have been compared with genetic identifications. Early attempts to use allozymes to identify species of rockfish larvae were inconclusive. In 1996, we showed that an alternative genetic technique, recombinant mitochondrial DNA (mtDNA), can be used to identify single larvae at much smaller and earlier stages than allozyme technology. Subsequently, 14 of 33 rockfish species known to occur in the inside waters of southeastern Alaska have been identified in plankton samples from this area.

Because several of the species found in this study as preflexion larvae have identical or nearly identical pigment patterns, it now appears that pigment patterns will be useful only to identify subgeneric groups or species complexes. Therefore, this research suggests that genetic examination of individual rockfish larvae may be necessary to obtain a positive identification to species. Clearly, genetic identification of every rockfish larva in a large plankton sampling program is impractical due to cost and manpower constraints. To reduce the cost and time of genetic analysis, we tested a refinement of our field plankton sampling technique during an August 2000 cruise of the NOAA vessel *John N. Cobb*. Using an 80-cell block instead of individual vials, all rockfish larvae were separated from the samples. If proven practical, this may allow us to statistically estimate species composition of rockfish larvae in a sampling area.

During this same cruise we tried to capture larger postflexion rockfish larvae. A surface- towed small Isaacs-Kidd midwater trawl caught a few 15-30 mm rockfish juveniles. Best success was when the net was deliberately towed in or through drifting kelp. This lends support (but not poof) to the hypothesis that rockfish aggregate about drifting seaweed or seek a structured bottom habitat at a very early stage. Unfortunately, because drifting seaweed was very sparse during the cruise we were not able to adequately test the hypothesis.

For more information, contact Bruce Wing at (907) 789-6043.

b. Stock Assessment

BERING SEA AND ALEUTIAN ISLANDS

Rockfish

The POP complex consists of true POP (*Sebastes alutus*) and four other red rockfish species (northern rockfish, rougheye rockfish, sharpchin rockfish, and shortraker rockfish). Prior to 1991, the complex was managed as a unit in each of the two management areas. Since 1991, however, the North Pacific Fisheries Management Council has managed *S. alutus* separately from the other species in both areas, and has also split out rougheye and shortraker in the Aleutians. This was done to avoid excessive catches of the less abundant members of the complex, particularly shortraker and rougheye. Beginning in 1996, the ABC and TAC for true POP have been subdivided within the AI area, based on an average of the biomass estimates from the two most recent trawl surveys: Eastern subarea 25%, Central subarea 25%, and Western subarea 50%.

True POP, Eastern Bering Sea

The most recent assessment incorporates new catch information into the stock assessment model and indicates that the total biomass of POP in the eastern Bering Sea is 50,000 t, nearly the same level as the past fifteen years. Since reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock it therefore qualifies for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 21,500 t, 0.049, and 0.058, respectively. Projected spawning biomass for 2001 is 18,100 t, placing POP in the EBS in sub-tier "b" of Tier 3. The maximum F_{ABC} value allowed under Tier 3b is computed as follows:

$$F_{ABC} \quad F_{40\%} \times (B_{2001} / B_{40\%} - 0.05)/(1-0.05) = 0.049 \times (18{,}100/21{,}500 - 0.05)/0.95 = 0.040$$

Projected harvesting at a fishing mortality rate of 0.040 gives a 2001 catch of 1,730 t (last year's ABC was set using a higher fishing mortality rate, 0.054, in part because last year's $B_{40\%}$ estimate of 26,200 t was higher than this year's estimate of 21,500 t).

The OFL fishing mortality rate is computed under Tier 3b as follows:

$$F_{OFL} = F_{35\%} \times (B_{2001} / B_{40\%} - 0.05)/(1-0.05) = 0.058 \times (18{,}100/21{,}500 - 0.05)/0.95 = 0.048$$

Projected harvesting at a fishing mortality rate of 0.048 gives a 2001 catch of

2,040 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

True POP, Aleutians

The present assessment incorporates updated catch information and age composition data into the stock assessment model and indicates that the total biomass of POP in the Aleutian Islands region is 233,000 t, about the same level of abundance estimated for the past 11 years after rebuilding from low levels in the late 1970s. Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{30\%}$ exist for this stock, which qualifies it for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 89,100 t, 0.062, and 0.073, respectively. Projected spawning biomass for 2001 is 84,900 t, placing true POP in the Aleutians in sub-tier "b" of Tier 3. The maximum F_{ABC} value allowed under Tier 3b is computed as follows:

$$F_{ABC} \quad F_{40\%} \times (B_{2001} / B_{40\%} - 0.05)/(1-0.05) = 0.062 \times (84{,}900/89{,}100 - 0.05)/0.95 = 0.059$$

Projected harvesting at a fishing mortality rate of 0.059 gives a 2001 catch of 10,200 t. The ABC is apportioned among AI subareas based on survey distribution as follows: Western AI = 46.5%, Central AI = 25.1% , and Eastern = 28.4%, corresponding to 4,749 t (W), 2,563 t (C), and 2,900 t (E).

The OFL fishing mortality rate is computed under Tier 3b as follows:

$$F_{OFL} = F_{35\%} \times (B_{2001} / B_{40\%} - 0.05)/(1-0.05) = 0.073 \times (84{,}900/89{,}100 - 0.05)/0.95 = 0.069$$

Projected harvesting at a fishing mortality rate of 0.069 gives a 2001 catch of 11,800 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Other Red Rockfish, Aleutian Islands and Eastern Bering Sea

The Groundfish Plan Team of the NPFMC recommended that separate chapters be prepared for *S. alutus* and the combined "other red rockfish"to improve the clarity of the assessment and facilitate better understanding of the methodology used and the results obtained. It was also recommended that the assessment authors examine the possibility of specifying area- specific OFLs, ABCs, and TACs for the shortraker/rougheye complex and a combined-area OFL, ABC, and TAC for the northern/sharpchin complex, as well as including catch and survey data by individual species to determine if differential harvest rates exist.

Through 2000, the other red rockfish complex was split out into northern/sharpchin and rougheye/shortraker groups in the AI, and a combined

other red rockfish group for the eastern Bering Sea. The assessment authors provided an assessment for these species groups, by incorporating recent catch data and the 2000 AI survey results.

For 2001, the complex was broken out to separate species for management. The was done for conservation reasons, because when managed as a species complex, there is a risk that one stock would be fished disproportional to its abundance, resulting in overfishing of that stock. This is especially true when one species has a higher value to the fishery that the other species. This has happened in the other red rockfish complex, and a recent appendix to the assessment showed that on a species basis, catches have sometimes exceeded what OFL would have been. This occurred for rougheye rockfish in the AI in 1997, and northern rockfish in the Bering Sea in 2000. Establishing ABCs on a species by species basis would help prevent overfishing.

There are further economic and management issues to be addressed by splitting out the other red rockfish category since the low abundance of rockfish in the EBS would be very constraining to the fleet. The low OFL calculated for the 2001 EBS other red rockfish complex (180 mt) could greatly impact the 2001 fisheries. The 2000 catch was 228 mt even though it was on bycatch status all year. Other target fisheries could be shut down, or prohibited to retention, to prevent the OFL from being exceeded.

For each species the F_{ABC} was set at the maximum value allowable under Tier 5, which is 75% of M. Accepted values for M are: rougheye rockfish—0.025, shortraker rockfish—0.030, and northern rockfish—0.060. Multiplying these rates by the best estimates of species-specific biomass gives the following 2001 ABC's:

Northern Rockfish (BSAI)	6,760 mt
Rougheye Rockfish (BSAI)	262 mt
Shortraker Rockfish (BSAI	766 mt

Note that sharpchin rockfish are at the extent of their range in the BSAI, and are not common. Therefore, no specifications for this species are recommended.

There is some risk associated with establishing area-wide ABCs if there are truly separate stocks of shortraker and rougheye rockfish in the AI and EBS. For rougheye rockfish, there has been some genetic samples collected in the EBS, but most of the research to date has been done in the Gulf of Alaska. To address this concern, the TACs for these species are apportioned among BS and AI areas. Apportionments of the full ABC based on average (1991-2000) survey biomass are:

	BS	AI
Northern	19 mt (0.3%)	6,741 mt (99.7%)
Rougheye	32 mt (10.9%)	230 mt (89.1%)
Shortraker	84 mt (11.0%)	682 mt (89.0%)

The overfishing level (OFL) was determined from the Tier 5 formula,

where setting $F_{OFL}=M$ for each species gives 2001 OFLs:

Northern Rockfish (BSAI) 9,020 mt
Rougheye Rockfish (BSAI) 349 mt
Shortraker Rockfish (BSAI)1,020 mt

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

GULF OF ALASKA

Slope rockfish are defined as those species of *Sebastes* that, as adults, inhabit waters of the continental slope and outer continental shelf, generally in depths greater than 150-200 m. Twenty-one species of rockfish are classified into the slope assemblage, the most abundant of which are Pacific ocean perch, and northern, rougheye, redstripe, sharpchin, shortraker, silvergray, and harlequin rockfish. Until recently, the stock abundance of slope rockfish, especially Pacific ocean perch, was considered to be quite depressed compared to its former abundance in the early 1960's. The most recent trawl surveys of the Gulf of Alaska in 1996 and 1999 showed a substantial increase in biomass of Pacific ocean perch. This increase followed another large increase in biomass seen in 1993, and suggests that current abundance of Pacific ocean perch is much improved in comparison with its formerly depressed condition. Age structured models are applied to Pacific ocean perch and northern rockfish. This is the first year that an age structured model has been applied to northern rockfish. Based on these models, the best estimate of exploitable biomass for Pacific ocean perch in the Gulf of Alaska is now 211,190 mt, similar to last year's estimate of 200,310 mt, and the exploitable biomass for northern rockfish is 93,850 mt. Exploitable biomass for all other species in the assemblage is estimated from the average values in the 1993, 1996 and 1999 trawl surveys, and totals 173,400 mt.

To prevent possible over-exploitation of the more desirable species, the slope rockfish assemblage is divided into four subgroups: Pacific ocean perch, shortraker/rougheye rockfish, northern rockfish, and other slope rockfish. Separate ABC's are assigned to each subgroup. Pacific ocean perch and northern rockfish are presently managed using an $F_{40\%}$ strategy adjusted for relative spawning biomass. The other subgroups are managed under an $F=M$ strategy, in which the annual exploitation rate is set equal to or less than the rate of natural mortality. The 2001 ABCs are as follows: Pacific ocean perch, 13,510 mt; shortraker/rougheye rockfish, 1,730 mt; northern rockfish, 4,880 mt, and other slope rockfish, 4,900 mt.

For more information, contact Jonathan Heifetz at (907) 789-6054, James Ianelli at (206) 526- 6510, or David Clausen at (907) 789-6049.

Rockfish Age-Structured Modeling Workshop

A rockfish (*Sebastes* spp.) modeling workshop was held at the ABL February 20-22, 2001. The workshop was attended by stock assessment scientists from NMFS REFM Division in Seattle and from ABL. The goal of the workshop was to implement a common model framework for a number of different rockfish populations managed by NMFS. A simple age-structured model (with allowance for size composition data) was agreed upon as a base model and constructed with AD Model Builder Software. The base model was applied to the following Gulf of Alaska stocks: Pacific ocean perch (POP), northern rockfish, dusky rockfish, and rougheye rockfish. Additionally, the model was applied to the Aleutian Islands and Eastern Bering Sea POP stock and may be applied to the POP stock off the coast of Washington and Oregon. Since each stock has particular differences in fishery, survey, and biology, features were added to the base model to account for additional data types and special fishery characteristics. The base models will be tuned by individual stock assessment scientists to their particular stocks and the patterns of information will be compared among these stocks for the specific common model. The base model will also be evaluated for sensitivity to assumptions for the different stocks. Results will be summarized in a NOAA technical publication.

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

West Coast

Pacific Ocean Perch

Pacific ocean perch catches are characterized by large removals during the mid-1960s by foreign vessels. The domestic fishery proceeded with subsequent moderate removals of between 1,000-2,000 tons per year since 1976. Catches have been further reduced by management measures to about 700 tons since 1995. In 1999 the catch was estimated at slightly higher than 500 tons and for 2000, the catches are estimated at slightly less than 300 tons.

Previous assessments were done in 1992 and 1995 and involved extensive analyses of diverse data types using an age structured model (the stock synthesis program). In 1998, and in this assessment, a similar model structure was implemented. The new data presented in this assessment include updated catches, a revised length-at-age transition matrix, updated commercial length frequency data, and the 1998 NMFS triennial-trawl survey estimate of biomass and age structure. There were a number of changes in model structure from that used in the 1998 assessment. A non-informative prior was placed on steepness and a very diffuse prior was placed on the trawl survey catchability estimates reflecting the lack of relevant auxiliary information. Also the population

was not assumed to be at equilibrium at the start of the fishery and it was assumed that the stock size at the beginning of the fishery (1956) was consistent with the variability that might be expected based on observed recruitment variability.

As in past assessments, the estimates of current stock status are uncertain and conditional on assumptions about the data and the model. The 1998 survey age composition data provides the first information of year class strengths observed in the 1990s (age composition was not determined for the 1995 survey) and there is evidence of three "strong" year classes. These values are not well determined, but show some promise of improved stock status. The most recent assessment evaluated a wide range of models to present a clearer depiction of the model structure and how the data are providing insight on stock condition. This involved running three distinct types of models. These were simply 1) an age-structured production model (with no recruitment stochasticity), 2) an age-structured model with no underlying estimate of productivity, and 3) an age-structured production model with recruitment stochasticity. The 3 models (and variants) were evaluated with respect to implications regarding trawl survey catchabilities. These catchabilities are shown to be negatively correlated with productivity estimates. The sensitivity of model results to assumptions about prior distributions on stock-recruitment parameters were also evaluated. A number of sources of uncertainty complicate the scientific interpretation of the results in this assessment. The authors attempted to develop a model that encompasses greater realism in this uncertainty. For example, uncertainty was allowed in natural mortality, total catch (by weight) estimates, the spawning biomass and recruitment relationship, and in the survey catchability coefficients. For sensitivity analyses, other plausible alternatives suggest that the overall uncertainty may be greater than that predicted by a single model specification.

It is likely that the current management plan (i.e., bycatch only) is not conducive to accurate estimates of removals from the fishery. The assessment relies heavily on the accuracy of removals from the fishery. Accurate estimates of landings and unaccounted fishing mortality (e.g., discard mortality) are crucial to the assessment of the fishery and the subsequent derivation of management reference points. Underestimation of removals, associated with lack of trends in the survey indices, is likely to lead to an overly pessimistic assessment of the fishery.

The recruitment pattern for POP is similar to many rockfish species. Recent decades have provided rather poor year-classes compared to the 1950s and 1960s. This assessment is the first to have new information on POP recruitment in the 1990s. POP otolith samples from the 1995 NMFS survey had not been aged for the previous assessment. Given limited resources to age samples, only the 1998 survey otoliths were read for age determinations.

The exploitation status of POP continues to be set to bycatch only, since West Coast POP are at the southern limit of their geographical range, while the

overall species condition has improved in other areas more central to their range (e.g., in the Canadian EEZ and in the Gulf of Alaska). Management actions of setting harvest guidelines to bycatch only (ABC=0) implemented over the past several years has not yet resulted in observable stock increases based on available data.

Forecasts for the next three years under an F_{MSY} policy and for $F_{50\%}$ harvest rates are very similar and are as follows:

Year	$F_{50\%}$	F_{MSY}
2001	831	834
2002	877	880
2003	918	921

Findings suggest that there is some probability (~15%) that the current stock level is below 50% of the target (B_{MSY}) stock size. Based on these results, we recommend harvests should remain at minimal levels until substantive stock increases are observed.

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

6. 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 1987-2000. 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. The eastern Bering Sea, Aleutian Islands region, and Gulf of Alaska were sampled during the cooperative longline survey, but the AFSC longline survey sampled only the Gulf of Alaska until 1996, when biennial sampling of the Aleutian Islands region and eastern Bering Sea was added. The Aleutian Islands region was sampled in 2000. In 2000, 73 stations were sampled in the Gulf of Alaska and 14 stations were sampled in the Aleutian Islands from 1 June to 5 September. Sixteen kilometers of groundline were set each day, containing 7,200 hooks baited with squid. The survey vessel was the chartered fishing vessel *Alaskan Leader*. Sablefish was the most frequently caught species, followed by giant grenadiers, Pacific cod, arrowtooth flounder, and Pacific halibut. A

total of 76,351 sablefish, with an estimated total round weight of 255,919 kg (564,301 lb), was taken during the survey.

A total of 3,092 sablefish, 492 shortspine thornyhead, and 37 Greenland turbot were tagged and released during the survey. Length-weight data and otoliths were collected from 2,079 sablefish.

Killer whales preying on sablefish and Greenland turbot caught on the gear were observed at one Aleutian Islands station and one Gulf of Alaska station, and may have affected catch rates at these stations.

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

Sablefish Longline Hook Spacing Experiment

In addition to the sablefish longline survey, a longline hook spacing experiment also was conducted from the chartered fishing vessel *Alaskan Leader* near Yakutat on 25-26 July 2000. The purpose of the experiment was to test an assumption on how to interpret longline fishery catch rates. The fishery catch per skate is assumed to be an index of relative abundance. For example, a 10% difference in catch rate reflects a 10% difference in relative abundance. This assumption would be wrong if increasing the hook spacing increased the fishing power of each hook. Most (about 70%) sablefish longline fishermen currently use 1 meter hook spacing, but this spacing differs among vessels and may change with time. In the hook-spacing experiment, circle hooks (size 13/0) baited with squid were used. Four hook spacings were tested: 0.5, 1, 2, and 4 m. Six sets were completed. Each set contained all hook spacings. For this experiment and earlier hook spacing experiments conducted in 1986 and 1999, catch rate per hook increased as hook spacing increased to an asymptote at 4-m spacing.

Catch per hook for 1-m spacing, the most common spacing currently used in the fishery, was about half that for the 4-m spacing. These results imply that analysis of fishery catch rates should be standardized by longline set to account for differences in hook spacing. These data are being used to improve an equation for standardizing catch rate differences associated with hook spacing. We are now computing standardized fishery catch rates annually which are included in the sablefish stock assessment.

For more information, contact Chris Lunsford (970) 789-6008 or Michael Sigler at (907) 789- 6037.

Sablefish Logbook Database Near Completion

A sablefish logbook program was initiated by ABL in 1999 to collect

detailed fishery information to better understand fishery characteristics and improve the sablefish assessment in Alaska. Vessel logbooks are required from sablefish longline vessels over 60 feet in length. Voluntary logbooks are also submitted by vessels less than 60 feet and are included in the data set when available. The individual logbook sheets are designed to collect catch and effort information for all sablefish sets made by a vessel. With this information, catch rates for the fishery can be computed and compared to catch rates from the NMFS longline survey. The 1999 and 2000 sablefish logbooks have been received and key punched and logbook sheets for 2001 are currently being collected. The logbook database is expected to be operational by summer 2001.

Preliminary work on fishery catch rates was conducted in 1999 using data collected by the domestic observer program. The analysis of catch rate trends is an important step in incorporating both survey and fishery data into the management process. More extensive analysis of fishery data is warranted because some fishermen are concerned that their catch rates have remained strong in some areas despite declines in longline survey catch rates. Using data from the sablefish logbook program and the domestic observer program, fishery catch rates were computed and included in the 2000 sablefish assessment model.

For more information, contact Chris Lunsford (970) 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 2000. Recoveries total 725 for the year so far, which is about the same as in 1998 and 1999. Over 18% of the fish recovered in 2000 had been at liberty for over 15 years. The two fish at liberty the longest (27.5 years) were both tagged in Chatham Strait in 1973. One was recovered in Chatham Strait and one off the coast of Vancouver Island. Tagging continued on the 2000 sablefish longline survey, with 3,092 sablefish tagged and released.

A total of 660 recoveries from a joint NMFS/ADFG study conducted in Clarence Strait from 1979 to 1983 were obtained from ADFG and entered into the database. Database releases, including adults and juveniles, now total 303,514. There are 23,360 recoveries to date.

An additional 930 sablefish were tagged and released on three seamounts in July during the longline survey vessel transit from the Western to Eastern Gulf of Alaska. Seamount tagging began last year to determine whether fish which travel to the seamounts ever return to the slope. Six tags from 1999 seamount releases were recovered on the slope in 2000, verifying that seamount to slope migration does occur. Also in 2000, seven tagged fish were recovered on the same seamounts where they were released; to date no seamount-tagged

fish have been recovered on a different seamount. Seamount tagging will continue in 2001.

Seamount sablefish populations share several characteristics quite different from slope sablefish. Only older fish are found on the seamounts, and males outnumber females as much as 12 to 1 in samples taken so far. Otoliths from 1999 samples processed by Delsa Anderl of the REFM Age and Growth Task in Seattle were extremely difficult to read due to the unusually compressed growth pattern. The average age in the seamount sample was far older and fish size at age was smaller than longline survey samples.

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

Estimation of Tag-reporting Rates for Sablefish

ABL scientists recently completed a study in which they estimated tag-reporting rates for the sablefish fishery in Federally-managed waters of Alaska during 1980–1998. To estimate these rates, tag returns in the fishery were compared to tag returns from sablefish longline surveys that have been conducted in Alaska where all tag recoveries were assumed to be reported. When pooled over geographic areas or years, estimates of reporting rates were reasonably precise with coefficients of variation (CVs) usually less than 25%. Reporting rates were highest in the central (0.384) and eastern (0.315) Gulf of Alaska, intermediate in the western Gulf of Alaska (0.269) and lowest in the Aleutians (0.174) and eastern Bering Sea (0.169). Rates pooled over all areas increased from lows of 0.102-0.248 in 1980-1982 to a peak of 0.465 in 1985 before declining to 0.199 in 1986 and 0.157 in 1987. The reporting rate increased gradually and fluctuated between 0.376 and 0.483 since 1995. The increase in reporting in 1995 was coincidental with the implementation of the Individual Fishing Quota (IFQ) system. The linear increase in reporting rates during 1986-1998 was significant. Factors that may have influenced the reporting rate were the number of tags available for recovery, the length of the commercial season, the presence of scientific observers on commercial vessels, and the tag reward program. Pooled over all years and areas the tag-reporting rate has been 0.273 with a CV of 4.2%.

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

Archival Sablefish Tags

During the 1998 and 2000 sablefish longline surveys, a combined total of about 330 sablefish were surgically implanted with an electronic archival tag. Two fish were tagged and released at each station from the eastern Aleutian Islands throughout the Gulf of Alaska to Dixon Entrance. The archival tag con-

tains 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, twenty tags have been recovered. A $500 reward per tag is being offered to fishermen for the recovery of these tags. Plans are to release an additional number of sablefish with implants of archival tags during the 2001 longline survey.

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). All twenty fish exhibited random movement, eighteen fish exhibited diel vertical movement, and six fish exhibited reverse diel vertical movement. Random movement was the most commonly observed behavior, occurring 87% of the time. Diel vertical movement occurred 11% of the time and reverse diel movement occurred 2% of the time. During random movement, individual fish traveled a wide depth range, sometimes several hundred meters during 1-2 days. Vertical migration occurred in bouts with vertical migration frequently occurring for periods of several days or weeks, preceded and followed by months with no vertical migration. This plasticity in movement pattern presumably represents prey-switching. Vertical migration occurred throughout the year and no obvious seasonal pattern was apparent. The shallow depth of the diel vertical movement range typically was 250 meters, the approximate depth of the continental shelf break in the Gulf of Alaska, where invertebrates and small fish concentrate; sablefish may vertically migrate to this depth to feed at night.

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

Juvenile Sablefish Studies

Juvenile sablefish studies have been conducted by ABL in Alaska since 1984 and were continued in 2000. A total of 744 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 June 2000. This cruise has been conducted annually since 1985, and relatively large numbers of juvenile sablefish have been found in this small bay each year except for 1999. This is the only known location in Alaska where juvenile sablefish have been consistently found. A young-of-the-year (YOY) sablefish study, which started in 1995, was conducted again in 2000 using the survey vessel *Alaskan Leader* opportunistically during the sablefish longline survey. A small-mesh surface gillnet was fished at night at offshore locations in the Gulf of Alaska to capture YOY sablefish. Mean lengths of YOY sablefish caught in the gillnets during these surveys have ranged from 10 to 19

cm. In the 2000 survey, 27 surface gillnet sets were completed which yielded a low number of YOY sablefish (only 138 total) relative to most previous years. Both the juvenile tagging and YOY sablefish studies will be continued in 2001.

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

Young-of-the-Year Sablefish Age and Growth in the Gulf of Alaska

Ageing of juvenile sablefish from their sagitta otoliths has been completed by ABL for fish collected in the Gulf of Alaska from 1995-99. Age determinations were used to calculate growth rates which showed that some relationship may exist between year class strength, estimated from age-structured modeling of adult sablefish, and growth of young-of-the-year (YOY) sablefish. Juvenile sablefish age determination methods and results from 1995-1999 were presented at the Western Groundfish Conference, April 24-28, 2000 in Sitka, Alaska.

Experiments were conducted to validate and verify the daily periodicity of otolith increment deposition in YOY sablefish. The validity of daily increment formation was tested by chemically marking the otoliths of YOY sablefish held in captivity at ABL. Approximately 30 YOY sablefish were captured along the continental shelf by NMFS staff and returned alive to ABL on June 1, 2000. The fish were maintained in sea water tanks at ABL for up to 104 days. The water temperature was elevated and held at a constant 13 degrees C and the photo period was lengthened and held at a constant 16 hours of light per day. The fish were split into three groups of roughly equal size. The otoliths of the fish in each group were marked twice by immersing the live fish in seawater with elevated levels of $SrCl_2$. For each group, the strontium immersions were separated by a period of approximately 15 days. The first group was marked twice in June, the second was marked twice in July and the third was marked twice in August. The fish from each group were sacrificed approximately 15 days after the second strontium immersion. The otoliths of marked fish are being processed into thin sections and the strontium markers will be detected with electron scanning microscopy by staff at the University of Alaska Fairbanks. For each processed otolith, the number of micro-increments (alternating light and dark bands visible under a transmitted light compound microscope) between detected strontium bands will be counted and compared to the number of days between $SrCl_2$ immersions.

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

Young-of-the-Year Sablefish Abundance, Growth, and Diet in the Gulf of Alaska

ABL scientists synthesized basic life history information on young-of-the-year sablefish abundance, growth, and diet to determine whether forecasting year class abundance based on young of the year surveys was practical. Surface gillnet surveys were conducted annually from 1995 to 1999 along the seaward edge of the continental shelf of Alaska (see section above on "Juvenile Sablefish Studies"). Sablefish made up about one-third of the catch and were caught mostly in the central and eastern Gulf of Alaska. Growth averaged 1.2 mm d^{-1}. The mean date the first otolith increment formed, April 30, implied an average spawning date of March 30. Diet was mainly euphausiids. Growth rate tended to be higher in years when gillnet catches were higher, but no relationship was apparent between diet and gillnet catches. Data for the synthesis was drawn from work conducted in recent years by NMFS staff from ABL and from the AFSC in Seattle. Much of this work was presented at the Western Groundfish Conference, April 24-28, 2000 in Sitka, Alaska. The results are detailed in a manuscript accepted for publication by the Alaska Fishery Research Bulletin.

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

b. Stock Assessment

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

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

The longline survey abundance index decreased 10% in numbers and 8% in weight from 1999 to 2000. These decreases follow increases from 1998 to 1999 in the survey abundance index of 10% in numbers and 5% in weight and in the fishery abundance index of 7% in weight, so that relative abundance in 2000 is similar to 1998. Fishery abundance data for 2000 were not analyzed because the fishery was still open at the time the assessment was completed. Exploitable and spawning biomass are projected to increase 3% and 4%, respectively, from 2000 to 2001. Alaska sablefish abundance now appears low and stable. This confirms the conclusion from last year's assessment that the abundance trend has changed from low and slowly decreasing to low and stable. Abundance is projected to continue to increase slowly; the size of the increase depends on the actual strength of the above-average 1997 and 1998 year classes.

A simple Bayesian analysis was completed by examining the effect of uncertainty in natural mortality and survey catchability on parameter estimation. A decision analysis was completed using the posterior probability from the Bayesian analysis to determine what catch levels likely will decrease abundance. The decision analysis indicates that a yield of 16,800 mt will maintain spawning biomass. The maximum permissible yield from an adjusted $F_{40\%}$ strategy is 16,900 mt, which was the 2001 ABC accepted by the North Pacific Fishery Management Council for the combined stock, similar to the 2000 ABC of 17,300 mt (2% decrease).

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

7. Flatfish

b. Stock assessments

BERING SEA

Yellowfin sole

Two abundance estimators (trawl survey and age structure model) indicate that the yellowfin sole resource increased slowly during the 1970s and early 1980s to a peak during the mid-1980s and that the resource has remained abundant and stable since that time. This trend is consistent with the fact that yellowfin sole is a slow-growing species which has been lightly exploited while experiencing average to strong recruitment during the past 18 years.

The present assessment includes incorporation of new catch and survey information. This year's EBS bottom trawl survey resulted in a biomass estimate of 1,580,000 t, an increase of 21% from last year's survey, but still a 32% decline from 1998. The sharp decrease in 1999 was attributed in part to cold water which might have decreased availability. However, both the 1999 and 2000 trawl survey lower estimates may be due to the survey being performed earlier, when a significant portion of the stock is still at the spawning grounds in shallow water. Extra tows were done outside the normal trawling area (in shallow waters) and concentrations of yellowfin sole were encountered. An AI trawl survey was also performed and caught yellowfin sole in only two tows, of less than 20 kg each. The biomass estimate for the AI is not included in the model due to the relatively low catch. Model results estimated the yellowfin sole total biomass at over 2.3 million t and is projected to increase further in the near future when the strong 1991 year class maximizes its cohort biomass.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, and therefore qualifies for management under Tier 3 of the BSAI Groundfish FMP. The

updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 502,000 t, 0.11, and 0.13, respectively. Given that the projected 2001 spawning biomass of 742,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2001 were calculated under sub-tier "a" of Tier 3. F_{ABC} was set at the $F_{40\%}$ (=0.11) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2001 ABC of 176,000 t.

The Plan Team's OFL was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.13 gives a 2001 OFL of 209,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Rock sole

The present assessment includes use of year-specific weight-at-age schedules, and incorporation of new catch and survey information. The 2000 EBS bottom trawl survey resulted in a biomass estimate of 2,130,000 t, a 26% increase relative to last year's estimate, and very similar to the 1998 trawl survey estimate. An Aleutian Island trawl survey was also performed and resulted in a biomass estimate of 46,000 t, which represents only 2% of the BS/AI rock sole combined biomass estimate from the trawl surveys. The biomass estimate for the AI is not included in the model due to the low relative catch. The stock assessment model indicates a high and abundant population estimated at 1.94 million t in 2001, a decline of 28% from the peak estimate of 2.7 million t in 1995. The decline is due to lower than average recruitment during the 1990s, however the stock is very lightly exploited.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, and that this stock therefore qualified for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 285,000 t, 0.16, and 0.19, respectively. Given that the projected 2001 spawning biomass of 676,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2001 were calculated under sub-tier "a" of Tier 3. F_{ABC} was set at the $F_{40\%}$ (=0.16) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2001 ABC of 230,000 t.

The overfishing level was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.19 gives a 2001 OFL of 273,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Flathead sole

The present assessment is a straightforward update of last year's assessment, incorporating new catch and survey information into the length-based assessment model. This year's EBS bottom trawl survey resulted in a biomass estimate of 399,000 t, a 1% increase relative to last year's estimate. Model results indicate that the flathead sole population peaked at 874,000 t in 1992 and has

since declined 29% to 618,000 t in 2000 due to a lack of recruitment during the 1990s. Exploitation remains light.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, and therefore is qualified for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 134,000 t, 0.30, and 0.38, respectively. Given that the projected 2001 spawning biomass of 268,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2001 were calculated under sub-tier "a" of Tier 3. F_{ABC} was set at the $F_{40\%}$ (=0.30) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2001 ABC of 84,000 t.

The overfishing level was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.38 gives a 2001 OFL of 102,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Other flatfish

Beginning with the 1995 fishing season, flathead sole were removed from the "other flatfish" complex, leaving Alaska plaice as the dominant member of the complex. The complex has remained at a stable, and presumably high, level of abundance throughout the modern history of the EBS survey time series (i.e., since 1982, when the present survey net configuration was adopted). The present assessment includes an update of catch and trawl survey information to the age-structured model used to estimate Alaska plaice abundance. The stock assessment model indicates that the Alaska plaice population biomass peaked in 1984 at 1.3 million t and has since declined an estimated 34% to 865,000 t in 2000 due to reduced levels of observed recruitment.

This year's EBS bottom trawl survey resulted in biomass estimates of 501,470 t for Alaska plaice and 80,000 t for the remaining species in the "other flatfish" complex. The other "other flatfish" are Dover sole (1%), rex sole (21%), longhead dab (17%), Sakhalin sole (<1%), starry flounder (58%), butter sole (2%) and English sole (<1%). This represents a decrease of 19% in Alaska plaice and an increase of 15% of "other flatfish" relative to last year's estimates. Last year, plaice increased and "others" decreased.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock complex, and therefore it qualifies for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 111,000 t (Alaska plaice only), 0.29, and 0.36, respectively. Given that the projected 2001 spawning biomass (Alaska plaice only) of 217,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2001 were calculated under sub-tier "a" of Tier 3. Because 85% of the "other flatfish" category is Alaska plaice and the assessment author calculates plaice separately, the ABC and OFL for Alaska plaice were determined separately from the other species. For Alaska plaice, F_{ABC} was set at the $F_{40\%}$ level (=0.29), which is the maximum allowable

under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2001 ABC of 122,000 t for Alaska plaice. For the remaining species in the flatfish complex, F_{ABC} was also set at the $F_{40\%}$ level (=0.30), which is the maximum allowable under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2001 ABC of 18,000 t for "other" non-plaice flatfish.

Greenland turbot

A stock assessment was not completed for Greenland turbot in 2000. The following is summary from last year. The 1999 EBS bottom trawl survey resulted in a biomass estimate of 19,797 t, a 30% decrease relative to the previous year's estimate. Conditions do not appear to have changed substantively over the past several years. For example, the abundance of Greenland turbot from the Eastern Bering Sea trawl survey has found only spotty quantities with very few small fish that were common in the late 1970s and early 1980s. The majority of the catch has shifted to longline gear in recent years. The assessment model analysis was similar to last year but with a slightly higher estimated overall abundance. This is attributed this to a slightly improved fit to the longline survey data trend. The target stock size ($B_{40\%}$, female spawning biomass) is estimated at about 81,200 t while the projected year 2000 spawning biomass is about 150,800 t. Given the continued downward abundance trend and no sign of recruitment to the shelf are, it is recommended that the ABC be set to 25% of the maximum F_{ABC} value.

Last year, the SSC determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{30\%}$ existed for this stock, and that this stock therefore qualified for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ (which replaces $F_{30\%}$ under Amendment 56) from the present assessment are 81,300 t, 0.26, and 0.32, respectively. Projected spawning biomass for 2000 is above $B_{40\%}$, placing Greenland turbot in sub-tier "a" of Tier 3. The ratio of 1999 spawning biomass to $B_{40\%}$ has changed dramatically since last year's assessment: In last year's assessment, the ratio was 79%, whereas in the present assessment, the ratio is 203%. The main reason for this change is that the recruitments used to estimate $B_{40\%}$ in last year's assessment included year classes spawned prior to the regime shift of 1977, whereas the recruitments used to estimate $B_{40\%}$ in the present assessment include only year classes spawned during the current environmental regime. The maximum permissible value of F_{ABC} under Tier 3a is 0.26. A fishing mortality rate of 0.26 translates into a 2000 catch of 34,700 t, which would be the maximum permissible ABC under Amendment 56. The Plan Team concurred with the authors' recommendation to set the 2000 ABC at a value substantially less than the maximum permissible, using $F_{ABC} = 0.25 \times max\ F_{ABC}$, which results in a 2000 ABC of 9,300 t. A 2000 ABC well below the maximum permissible value is warranted for the following reasons: 1) estimated age 1+ biomass has trended downward continually since

1972; 2) the 7 most recent age 1 recruitments constitute 7 of the lowest 8 values in the entire time series; and 3) if the maximum permissible ABC of 34,700 t were actually caught, this would constitute the highest catch since 1983, even though spawning biomass in 2000 is projected to be less than half of what it was in 1983.

The OFL fishing mortality rate is computed under Tier 3a, $F_{OFL} = F_{35\%} =$ 0.32, and translates into a 2000 OFL of 42,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Arrowtooth flounder

The arrowtooth flounder stock assessment utilizes a length-based stock assessment model and is updated for the 2000 assessment with the incorporation of new catch and survey information. This year's EBS bottom trawl survey resulted in a biomass estimate of 340,000 t, a 29% increase relative to last year's estimate and similar to the 1998 trawl survey. The 2000 AI trawl survey resulted in a biomass estimate of 93,500 t, which represents 22% of the BS/AI arrowtooth flounder combined biomass estimate from the trawl surveys. Model results indicate that the population total biomass peaked in 1994 at 914,00 t and has since declined 18% to 750,000 t in 2000. Recruitment since 1992 is estimated to be below the long-term average.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, therefore qualifies for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 183,000 t, 0.23 and 0.28, respectively. Given that the projected 2001 spawning biomass of 458,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2001 were calculated under sub-tier "a" of Tier 3. F_{ABC} was set at the $F_{40\%}$ (=0.23) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2000 ABC of 117,000 t.

The OFL fishing mortality rate is computed under Tier 3a, $F_{OFL} = F_{35\%} =$ 0.29, and translates into a 2000 OFL of 141,500 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The effort in the fishery increased this year due to a developing market in Japan for arrowtooth flounder, though still a low exploitation rate (< 0.02).

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

GULF OF ALASKA

Arrowtooth flounder

EXPLOITABLE

YEAR	ABC	BIOMASS	CATCH[1]
1999	217,110	2,126,714	16,062
2000	145,360	1,571,670	24,056
2001	148,150	1,586,530	

1/ Catch through October 28, 2000.

The 2001 exploitable biomass of 1,586,530 mt is based on abundance estimates derived from an age-structured model developed with AD Model Builder software. Similar to the previous assessment, the model accommodated a higher proportion of females in the larger size intervals of both survey and fishery data by giving males a higher mortality rate than females. Exploitable biomass in 2001 is estimated to be greater than $B_{40\%}$ and ABC was determined to be 148,150 mt based on Tier 3a calculations ($F_{40\%}$ = 0.134). The ABC was apportioned among regulatory areas in proportion to biomass distributions in the 1999 trawl survey. The resulting ABCs are:

WESTERN	CENTRAL	WYAK	EYAK/SEO	TOTAL
16,480	99,590	24,220	7,860	148,150

Using Tier 3a criteria, the overfishing level based on $F_{35\%}$ = 0.159 is estimated at 173,550 mt.

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

10. Walleye pollock

a. Research

BERING SEA

Acoustic/Trawl Surveys - Southeastern Bering Sea Shelf and Bogoslof Island Area

The Mace Program completed EIT surveys of walleye pollock on the southeastern Bering Sea shelf and in the Aleutian Basin near Bogoslof Island aboard the NOAA ship *Miller Freeman* between February 27 and March 13, 2000. Survey design consisted of two series of parallel transects. On the Bering Sea shelf, east-west transects were spaced 12.5 nmi apart, and in the Bogoslof Island area, 10, 5, or 2.5 nmi-spaced transects (depending on fish density) were oriented north-south. The Bogoslof survey began in the east at about 166 W and proceeded westward to about 170 15 W, covering 2000 nmi of trackline. On the

southeastern Bering Sea shelf, pollock were observed from near the start of the first transect to near the end of the eighth. On the first several transects, pollock formed dense, near-bottom, aggregations between 95-100 m bottom depths that often extended for several miles. Dense pollock schools were found adjacent to Unimak Island beginning at about 50 m bottom depth; some continued westward to >150 m bottom depths. Fork lengths (FL) of pollock from 8 trawl hauls ranged between 30 and 73 cm and averaged 44 cm. Smaller pollock were encountered in the final shelf-area trawl haul that targeted isolated, dense, schools over bottom depths of around 160 m. Most males and females were pre-spawning (74% and 48%, respectively), although 43% of the females had small ovaries and were categorized as developing. Preliminary analyses estimate pollock biomass in this portion of the Bering Sea shelf to be about 0.816 million metric tons.

In the Bogoslof Island area, pollock were observed in the first two miles of the first transect in relatively shallow water. Farther to the west, pollock aggregations were sparse. Very few pollock were observed between transects 168-169 W. Much of the remainder of the cruise was spent surveying and trawling between 169-170 W, north of Samalga Pass, and east of the Islands of Four Mountains, where relatively large pollock spawning aggregations were observed. Pollock fork lengths ranged from 31-68 cm. On average, fish were largest in the Samalga Pass area. Percent female ranged from 35-79, with more females caught overall. The vast majority of fish were prespawning (95% and 94% among males and females, respectively). Average GSI among prespawning females was 0.17, similar to previous years' average Bogoslof GSIs. Numbers and biomass for the Bogoslof area in 2000 appeared to be somewhat lower than observed in 1998 and 1999. Preliminary analyses estimate pollock biomass in the Bogoslof area to be 0.321 million metric tons.

Acoustic/Trawl Surveys - Eastern Bering Sea Shelf

Between June 8 and August 3, 2000,the MACE program conducted an EIT survey of walleye pollock aboard the NOAA ship *Miller Freeman* on the eastern Bering Sea shelf from Port Moller, Alaska, to the U.S./Russia convention line. Principal objectives of the research cruise were 1) to collect echo integration and trawl data to estimate pollock abundance and distribution and 2) to collect pollock target strength information to validate the relationship between pollock length and target strength – a measure of acoustic reflectivity. Survey design comprised north-south transects spaced 20 nmi apart. Acoustic data were collected continuously between sunrise and sunset; pollock target strength data and Methot trawl samples for age-0 pollock were collected at night.

Preliminary cruise results show that pollock were present on all but the second transect of the survey. East of the Pribilof Islands, the highest pollock concentrations were observed along transects north of Unimak Island. Pollock

abundance was lower between Unimak and the Pribilofs. West of the Pribilof Islands, pollock increased and peaked in abundance in an area southwest of St. Matthew Island. In the far west, pollock were heavily concentrated in a few spots along the U.S./ Russia border. On many transects pollock were distributed somewhat farther north in summer 2000 than in 1999, particularly west of the Pribilofs. Biological data and specimens were collected from 115 midwater, 9 bottom, 4 Marinovich, and 47 Methot trawls. Among pollock sampled in midwater and bottom trawls, lengths ranged from 10 cm to 82 cm. East of 170 W, pollock modal length was 44 cm; west of 170 W, pollock modal lengths were 12, 21, and 33 cm. The majority of pollock (51% of sexes combined) were observed to be in a developing maturity stage, with fewer numbers of post-spawners (28%) and immatures (20%). Estimated pollock abundance for the total survey area between the surface and 3 m off-bottom was 3.05 million tons and 7.6 billion fish. About 13% (0.39 million t) was in Steller sea lion critical habitat (CH) management area, 16% (0.50 million t) was east of 170 outside CH, and 71% (2.16 million t) was west of 170 W.

One of several additional research projects conducted during the cruise involved mounting an underwater video camera on the midwater trawl to observe pollock behavior in front of the codend as part of ongoing research on fish behavior in relation to trawl gear.

Acoustic/Trawl Surveys - Shelikof Strait

The Mace Program completed an EIT survey of walleye pollock within the Shelikof Strait area between Chirikof Island and Cape Chiniak between March 15 and March 28, 2000 aboard the NOAA ship *Miller Freeman*. Two survey passes were conducted in the Shelikof Strait area. For the first pass, parallel transects were spaced 13.9 km apart except on the western side of Shelikof Strait, where transect spacing was reduced to 6.9 km. All transects were spaced 6.9 km apart for the second pass. Most of the mature pollock were distributed along the western side of the Strait, with the greatest densities occurring from Cape Kekurnoi to Cape Nuskhak; a similar pattern of distribution has been observed in previous years. Echo sign was less dense but more broadly distributed along transect lines from Chirikof Island to Cape Kekurnoi. Fish were most abundant within 50-150 m of the bottom. The size distributions of pollock from hauls within the Strait generally exhibited dominant modes around 10-14 cm, 20-24 cm, 30-36 cm, and 43-57 cm FL. Seventy percent of the females greater than 34 cm FL were mature, with 67% in a pre-spawning condition, 1% spawning, and 2% spent. The mean GSI of 0.14 obtained from pre- spawning females was lower than the mean GSI of 0.18, 0.19, and 0.17 obtained during the 1996-98 surveys, respectively. Pollock from the 1999 year class (mode 10-14 cm FL) formed a strong, well-defined midwater layer (150-200 m depth) from about Chirikof Island to Sitkinak Strait and off Cape Kekurnoi. Video recordings of

pollock behavior within the midwater trawl were collected during the Shelikof Strait survey and will be used to evaluate sampling gear performance.

Feasibility Study for Future Fishery-Pollock-Steller Sea Lion Investigation

A feasibility study was conducted off the east side of Kodiak Island between August 8 and August 20, 2000 aboard the NOAA ship *Miller Freeman* as a collaborative effort between RACE and REFM scientists from the AFSC. The purpose of the work was to evaluate the suitability of this location for conducting a multi-year summertime field experiment to evaluate the effect of commercial fishing activity on the availability of walleye pollock to Steller sea lions (*Eumetopias jubatus*).

Principal objectives for the feasibility study were to: 1) use standard EIT survey methodologies to describe the abundance and distribution patterns of walleye pollock within Barnabas and Chiniak gullies; 2) determine whether acoustic back-scattering from non-targeted species would prohibit meeting the 1st objective; and 3) determine the spatio-temporal variability in pollock abundance and distribution patterns within and between the two gullies over the duration of the study. The researchers plan to use this information to assess the proposed experimental design for the more comprehensive field work which will occur in subsequent years and which requires that the gullies serve as treatment and control sites where commercial fishing would be allowed in one location and prohibited in another.

The EIT survey operations included the collection of 38- and 120-kHz acoustic data, as well as net catch data from 38 midwater and 7 bottom trawls. These data were collected along a series of uniformly-spaced (i.e., 3 nmi) parallel transects during the 2-week survey. Two complete survey passes were conducted in both Barnabas and Chiniak gullies.

Preliminary survey results indicated that it was possible to use EIT survey methods to assess the summer distribution of pollock within the study area. Substantial back-scattering was attributed to "adult" pollock as well as "small fishes" which included age-0 pollock, age-1 pollock, and capelin (*Mallotus villosus*). It was difficult, however, to determine the relative contribution of capelin and age-0 pollock to the "small fishes" backscattering. Additional analyses of the data are in progress to quantify the spatio-temporal distribution patterns and abundance of pollock and capelin. Interpretation of these results will provide information to determine whether these two submarine gullies off of the east side of Kodiak Island are appropriate sites for conducting a more comprehensive field experiment during the next summer.

For more information, please contact Dr. William Karp, (206) 526-4164.

b. Stock assessments

GULF OF ALASKA

The age-structured assessment model and three population biomass surveys indicate that the Gulf of Alaska pollock stock has declined from the high levels observed in the early 1980s to the lowest level estimated since 1969. Poor recruitment for the four consecutive year-classes 1990-93 and then again in 1996 and 1997 have caused the stock decline. Total 2+ biomass is estimated at 706,000 t in 2000 and the projected exploitable biomass for age-3+ pollock in 2001 is 699,000 mt. Projected spawning biomass in 2001 for the Western, Central and West Yakutat areas is 202,800 mt, which is below the $B_{40\%}$ value of 247,000 mt and places Gulf pollock in Tier 3b. In addition, the stock is projected to decline further in 2002. The assessment author recommended the 2001 ABC set at 99,350 mt for the Western, Central, and West Yakutat areas. This harvest rate corresponds to an $F_{40\%\ adjusted} = 0.28$. As in the previous assessment, the guideline harvest level (1,420 mt) for the state-managed pollock fishery in Prince William Sound (PWS) was deducted from the GOA ABC prior to area apportionment of the 2001 GOA ABC.

The 2001 ABC is apportioned according to the mean distribution of the exploitable population biomass in the four most recent bottom trawl surveys. Using just the 1999 trawl survey distributions was not selected because of high variability observed in the 1999 trawl survey distributions. This resulted in the apportionments listed below. In the Western and Central areas, the ABC is further apportioned among four reporting areas in the A and B seasons and among three reporting areas in the C and D seasons. The West Yakutat ABC is not seasonally apportioned. OFL for Western, Central, and West Yakutat pollock in 2001 is defined as $F_{35\%adjusted} = 117{,}750$ mt.

Pollock in the Southeast Outside and East Yakutat areas fall into a Tier 5 assessment. Under this approach, 2001 ABC is 6,460 mt, based on exploitable biomass of 28,710 mt as derived from CPUE data during the 1999 Gulf trawl survey and a natural mortality estimate of 0.30. The OFL is 8,610 mt. The assessment authors noted that pollock catch in the pooled Southeast Outside and East Yakutat areas never exceeded 100 mt during 1991-2000.

Area Apportionment of Western, Central, and West Yakutat ABC

Area	Shumagin	Chirikof	Kodiak	Shelikof	West Yakutat	SE	Total
ABC (mt)	35,240	14,260	26,650	20,680	2,520	6,460	105,810

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

EASTERN BERING SEA

The recent stock assessment for the 2001 fishing season features new data from the 2000 fishery and bottom trawl and echo-integration trawl surveys. The 2000 bottom trawl survey biomass estimate of 5,140,000 t is an increase of 44% relative to the 1999 estimate and follows a 61% increase from 1998 to 1999. The 2000 echo-integration trawl survey estimated a biomass of 3,005,000 t, a decrease of 7% relative to the 1999 estimate and following an increase of 27% from the 1997 estimate, the last year an echo-integration trawl survey was conducted in this region. Ten alternative models were examined in the assessment, all of which follow the statistical age-structured approach that was used to set the 2000 ABC. All but one of these ten models estimate 2000 age 3+ biomass to fall between 10,200,000 t and 11,200,000 t (the other model gives a value of 6,900,000 t).

Of the ten models presented, Model 1 was chosen as the model of choice on which to base the 2001 ABC recommendation. The model assumes a Ricker stock-recruitment relationship and uses the commercial fishery selectivity pattern from 1999 to make projections of future catch and stock size. This model is most similar to the model used last year to recommend the 2000 ABC, except that the selectivity estimates are based only on estimates from 1999 since the establishment of cooperatives and new regulations may be best reflected in the most recent year of fishery data. In addition this year's model runs all include the fishery CPUE data from 1965-1976.

The predicted strength of the 1996 year class is larger than observed for the 2000 bottom trawl and EIT surveys. This discrepancy likely is due to the model fit to the substantial increase in trawl survey biomass estimate by increasing the strength of the 1996 year class, inconsistent with the time-series of age composition information. Some contradiction apparently exists between the observed biomass estimate and the observed age compositions. However this inconsistency does not appear to lead to substantial bias in the abundance estimates.

Abundance estimates from 1993 to 1999 increased sharply in this year's assessment. For example the estimate of 1999 age 3+ biomass is 7,513,000 t for last year's assessment and 10,772,000 t for this year's assessment, a 43% increase. The change in estimated abundance is the main reason the Tier 3b recommendation for 2001 is substantially larger than the Tier 3b recommendation for 2000. The change in estimated abundance appears reasonable. From 1998-1999 survey biomass increased 61% and from 1999-2000 increased 44%. The model provided a poor fit to the increased abundance estimates from 1998-1999 in previous assessments, but after two year's of consecutive increases, the model provides a good fit to the increasing trend.

Last year, the SSC 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 qualified for management under Tier 1. The senior assess-

ment author continues to feel that the Tier 1 reference points are reliably estimated given the structure of the model. The updated estimates of B_{MSY} and the harmonic and arithmetic means for F_{MSY} from the present assessment are 2,125,000 t, 0.71, and 1.18, respectively, compared to 1,790,000 t, 0.50, and 0.80, respectively, from last year's assessment. Projected spawning biomass for 2001 is 2,761,000 t (at time of spawning, fishing at F_{MSY}), placing EBS walleye pollock in sub-tier "a" of Tier 1. The maximum permissible value of F_{MSY} under Tier 1a is 0.71, the harmonic mean of the probability density function for F_{MSY}. A fishing mortality rate of 0.71 translates into a 2001 catch of 2,125,000 t, which would be the maximum permissible ABC under Tier 1a (compared to 1,200,000 t in last year's assessment). Last year the senior assessment author recommended setting ABC at a lower value, specifically, the maximum permissible level that would be allowed under Tier 3. The Tier 3 reference points $B_{40\%}$ and $F_{40\%}$ are estimated at values of 2,426,000 t and 0.49, respectively, similar to 2,340,000 t and 0.48 from last year's assessment. The projected spawning biomass for 2001, 3,066,000 t (at time of spawning, fishing at $F_{40\%}$), is above $B_{40\%}$, so the maximum permissible value of F_{ABC} that would be allowed under Tier 3 is not adjusted downward. The 2001 catch associated with a fishing mortality rate of 0.49 is 1,842,000 t, a 13% reduction from the maximum permissible level under Tier 1.

The ABC recommendation for 2001 is 1,842,000 t. Although this ABC is a 62% increase from the 1,139,000 t ABC approved for 2000, the increase was recommended for the following reasons:

1) The model to estimate abundance and the method to recommend 2001 ABC are the same as those used for the 1999 and 2000 ABC values.

2) Abundance has substantially increased and so a substantial increase in ABC appears reasonable. A broad distribution of ages in the population are average strength or better, not only the strong 1996 year class. The catch will come from multiple year classes, not a single predominant year class as occurred for some harvests in the past. Spawning biomass is projected to stay above 35% of unfished biomass if harvesting in future years continues based on an $F_{40\%}$ policy, except for a slight dip below $B_{35\%}$ in 2003. Even if biomass equals the lower confidence bound for abundance of 5,000,000 t, a 1,840,000 t catch would result in an exploitation rate of about 30%, which the senior assessment author says is considered a reasonable maximum exploitation rate for gadid stocks.

3) Increased pollock abundance potentially provides additional prey to pollock predators. Even with the increased ABC, additional pollock is likely to be available as prey compared to three years ago when pollock abundance was substantially less. In addition other measures are in place to provide pollock as prey to higher trophic levels.

The OFL fishing mortality rate under Tier 3a is approximately 0.80, corresponding to $F_{35\%}$. A fishing mortality rate of 0.80 translates into a 2001 OFL of 2,359,000 t. The EBS walleye pollock stock is not overfished nor approaching an overfished condition.

ALEUTIANS

The 2000 bottom trawl survey of the Aleutians Islands region resulted in a biomass estimate of 106,000 t, an increase of 13% relative to the 1997 estimate. The 1997 estimate previously was 106,000 t, but was revised this year to 94,000 t due to discrepancies found in strata definitions. The 1997 stock assessment concluded that the model which had been used to recommend ABC for 1997 was no longer reliable due to the confounding effect of immigration from other areas, and the SSC determined that Aleutian pollock qualified for management under Tier 5. The recommended 1998, 1999, and 2000 ABC was 23,800 t, computed as the product of the 1997 survey biomass estimate and 75% of the natural mortality rate (0.3). The recommended 1998, 1999, and 2000 OFL was 31,700 t, computed as the product of the 1997 survey biomass estimate and the natural mortality rate. The 2000 survey biomass estimate is considered the best available estimate of biomass in 2000, which keeps 2001 ABC and OFL at the 2000 levels. 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 2000 hydroacoustic survey of the Bogoslof region resulted in a biomass estimate of 301,000 t. Last year Bogoslof pollock were placed in Tier 5. This designation places Bogoslof pollock in the same classification as Aleutian pollock, a stock which generally has about the same quality of assessment information. The 2001 recommendation of ABC and OFL are based on the hydroacoustic survey estimate for the entire spawning aggregation (301,000 t), rather than the biomass observed in Area 518 alone. Because the hydroacoustic survey is attempting to measure the biomass of a discrete spawning aggregation, it was deemed appropriate to use the entire biomass estimate rather than the proportion of the estimate that happened to reside in Area 518 at the precise time of the survey. In SAFE reports previous to last year, ABC calculations were made by projecting the hydroacoustic biomass estimate forward to account for natural mortality, but not growth or recruitment. In contrast, growth and recruitment have been assumed to balance natural mortality for all other BSAI stocks lacking an age- or length-structured assessment model. The Ground Plan Team recommended that the assumptions of zero growth and zero recruitment be discontinued for Bogoslof pollock, and recommended instead that projected biomass be set equal to the most recent survey biomass estimate. The recommendation for the maximum permissible 2001 ABC is 45,200 t (= 301,000 t × M × 0.75), and for 2001 OFL is 60,200 t (= 301,000 t × M). 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.

13. Other Species - Atka mackerel

a. Research

Identification and Characterization of Atka Mackerel Reproductive Habitat

The basic biology of Atka mackerel has been poorly studied despite its commercial value and importance as a key forage species for the endangered Steller sea lion and other marine piscivores. After locating an Atka mackerel nesting site in the central Aleutian Islands in 1999, AFSC scientists returned there in July and August 2000 to investigate the spawning and associated habitat. The primary objective for last summer's cruise was to estimate and more fully describe the spawning area near Finch Cove, Seguam Island. The F/V Morning Star served as a support platform for near shore dive and underwater camera work. Thirty four man dives and numerous drop camera sets were made in the near shore areas surrounding Seguam and Amlia islands. We obtained extensive video footage documenting the habitat in which Atka mackerel spawn, and recording the distinct behavior patterns associated with courtship, spawning, and nest guarding.

Three in situ time-lapse camera deployments, 34 man dives, and numerous drop camera sets were made in the nearshore areas surrounding Seguam and Amlia islands. On the last time- lapse deployment, the camera was aimed at a nest and a male was videotaped in the act of courtship and spawning with several different females. A current meter was placed alongside the time-lapse camera to see how nesting behavior varied with the tidal cycle. Current speeds ranged from 0 to 7.94 cm/s and water temperature 4.7 to 5.7C over a 24 h period. During an earlier AFSC cruise in June 2000, another time-lapse camera deployment was made at Finch Cove, in the general vicinity where nests were observed the previous year, to determine when males moved nearshore for spawning. The camera was retrieved in early August and the video footage revealed that males did not utilize that particular area for nesting during the three-month period.

A drop video camera was used to survey coastal areas of Amlia and Seguam Islands for other nesting habitat and to delineate the nesting site boundaries at Finch Cove. A new nesting site was observed at East Cape on the north side of Amlia Island. The Finch Cove nesting site extended coastwise just south of the cove (where the first time-lapse camera was placed) to Wharf Point on the south side. The Finch Cove terminus of the nesting site appeared to be less exposed to tidal current, which may have made it less favorable. A pronounced southerly swell became noticeable at Wharf Point terminus and may have been what limited the southern extent of the nesting area. The shallowest nest observed was 14m and the deepest was 32 m. Neither nests or rocky habitat extended beyond the 32 m contour where the bottom changed to moderately sloping sand. To determine if nest density varied over depth, diver transects

were done at three depth zones: 14-17 m, 18-25 m, and 26-32 m. Embryo masses were collected across all depths to determine developmental stages of embryos and to determine average batch size so that embryo density for the entire Finch Cove spawning site could be estimated.

For more information, contact Bob Lauth, (206)526-4121.

D. Other Related Studies

Research on "Habitat Areas of Particular Concern"

A survey of a potential Habitat Area of Particular Concern (HAPC) was carried out by ABL in late May 2000. A manned submersible was used to run transects at the site about 20 km W of Cape Ommaney, Baranof Is., southeastern Alaska during a series of 7 dives. The submersible was tracked at 1 min intervals from the support vessel using DGPS and an ultra- short baseline acoustic tracking system. Continuous images of the sea floor were obtained using an externally-mounted video camera fitted with a laser scaling device. The audio tracks on the videotapes were used to note time when the transects began and ended, water depth, estimated current velocity, substrate, megahabitat and microhabitat characteristics, lateral water visibility, faunal assemblages, behavior and associations of individual species within those assemblages, presence of derelict fishing gear along transects, and any damage to epifaunal invertebrates.

The potential HAPC site measures approximately 400 x 600 m with maximum vertical relief of 55 m, and water depths range between 201 and 256 m. The area studied is likely a ridge projecting southeastward from the 200 m isobath on the continental shelf, and may be part of a series of such features. The substrate is primarily bedrock and large boulders, most likely composed of mudstone, and provides abundant cover in the form of caves and interstices of various sizes. The epifaunal community is rich and diverse, much more so than the surrounding low-relief sand-gravel habitat. Largest epifauna were gorgonian red tree coral colonies and several species of sponge. These organisms were not randomly distributed at the study site. Numerous species of fish, particularly adult and sub-adult rockfish, were present in relatively large numbers and were often associated with gorgonian coral colonies and several species of sponge. Derelict longline gear was commonly observed, as were dead and damaged red tree coral colonies.

The submersible depth and location data were used to produce a precise bathymetric chart of the site by Nautical Solutions Inc., of Annapolis, MD. Data recorded in real time on the submersible system's event log, as well as data recorded on the video and audio tapes, are being used in conjunction with computer software provided by Maptech, Inc., of Andover MA, to produce chart overlays depicting locations of particular habitat features and associated biota.

For more information, contact Linc Freese at (907) 789-6045.

Effects of Fishing on Sea Floor Habitat

Coral in Alaska: Distribution, Abundance, and Species Associations

To help identify fishery management actions that minimize the adverse impacts of fishing activities on corals in Alaska, scientists at ABL analyzed the distribution and abundance of corals based on trawl survey data in the AFSC RACEBASE database collected during 1975-1998. The species of groundfish associated with coral were also examined. Soft corals, primarily *Gersemia* sp., were the most frequently encountered corals in the Bering Sea. In the Aleutian Islands gorgonian corals, primarily in the genera *Callogorgia, Primnoa*, *Paragorgia*, *Fanellia* (=*Callogorgia*), *Thouarella,* and *Arthrogorgia* were the most common corals. In the Gulf of Alaska, gorgonian corals, primarily in the genera *Callogorgia* and *Primnoa*, and cup corals, primarily AScleractinia unidentified@, occurred most frequently. The Aleutian Islands area appears to have the highest abundance and diversity of corals. Some fish groups are associated with particular types of coral. Rockfish (*Sebastes* spp. and *Sebastolobus alascanus*) and Atka mackerel (*Pleurogrammus monopterygius*) were the most common fish captured with gorgonian, cup, and hydro corals, whereas flatfish and gadids were the most common fish captured with soft corals.

For more information, contact 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 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. In 1999-2000, scientists from the ABL began a study to examine growth and recruitment of *Calcigorgia spiculifera*, a shallow- water Alaskan gorgonian, in an effort to 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 five colonies were tagged at 2 sites in southeastern Alaska in July 1999. Thirty two (91%) of those colonies were found again when the sites were re-visited in July 2000. The three missing colonies had presumably detached from the seafloor. Growth measurements were possible for 16 colonies. 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}. Growth rates (mean = 5.81 mm yr^{-1}, std = 4.99) measured during this study were generally much lower than those reported for other gorgonians world-wide, 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 during the first year of this study, although preliminary, are noteworthy since 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. Future research priorities are to focus on growth of smaller colonies and to establish a third study site where colonies are more numerous and more variable in size (i.e., age).

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

Study of Alaskan Sponges

A recent study of the effects of mobile fishing gear on the benthos of the continental shelf in the eastern Gulf of Alaska has shown that several species of large erect sponge provide important components of structural habitat on the seafloor, and are particularly susceptible to removal or damage by commercial trawling activity. No sign of recovery from trawl damage was noted during a follow-up investigation conducted one year post-trawl. In contrast, experimental trawling carried out in warm, shallow water on the southeastern continental shelf of the U.S. has shown that sponge communities are quick to recover to pre-trawl abundances and that individual damaged sponges undergo rapid regeneration. Because the ability of benthic epifauna to recover from trawl damage may be a consideration in future Fishery Management Plans, ABL biologists will be conducting a study of several species of sponge in 2001. A small community of sponges was previously discovered at scuba diving depths in

Seymour Canal, Admiralty Island, southeastern Alaska. Several of the species present resembled those found in deeper waters on the continental shelf in the Gulf of Alaska.

The purpose of this study is to determine some basic life history parameters of shallow cold water sponges. Growth and regeneration is of particular interest. During annual observations we hope to collect additional information regarding large scale distribution, habitat associations, and recruitment. Plans for 2001 are to visit the site in Seymour Canal to: 1) roughly chart the distribution of the sponge community; 2) tag individual sponges; 3) take manual measurements of individual sponges; 4) video individual sponges so the growth can be measured; and 5) remove pieces of a known size from individual sponges to examine regenerative ability and to determine species through spicule analysis. During the cruise several additional sites will be examined for the presence of additional sponge communities. During future years we hope to deploy temperature probes, current meters and settling substrates at the site(s).

For additional information contact Linc Freese at (907) 789-6045.

Development of a Benthic Sled to Observe Seafloor Habitat

Fishing impact studies by ABL have depended on videos of the seafloor to quantify invertebrates and habitat. A manned submersible has been the primary method of collecting seafloor videos. As a method of supplementing video collected via submersible, a benthic sled was developed and tested in 1999 by ABL with assistance of the AFSC RACE Division. The sled was constructed and tested in waters near Kodiak using video equipment that was developed for attachment to bottom-trawls. The sled was tested at speeds of 1-3 knots and it traveled smoothly on the seafloor and produced video of the seafloor.

In 2000, ABL and RACE developed a system that allows video to be collected at a sled speed of 2-4 knots and then replayed at slower video speeds without a significant reduction in resolution. In April 2000, the new digital camera system was installed on the sled and tested aboard the NOAA research vessel *John N. Cobb*. During this cruise a variety of camera settings and lighting options were tested. The system was tested to 650 feet and survived encounters with boulders and crab pots. Results indicate that this relatively inexpensive system can be successfully used to observe and enumerate small benthic fauna and may be useful in future
studies of fishing gear impacts on the benthic habitat.

For additional information, contact Phil Rigby at (907) 789-6653.

Studies on Sea Lion/Groundfish Interactions:

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

The Auke Bay Laboratory 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 (free fatty acid analysis), 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 stable. In SE Alaska, the ABL is cooperating with the Alaska Department of Fish and Game, the University of Alaska, and the North Pacific Universities Marine Mammal Research Consortium. This study also is being coordinated with the existing University of Alaska study on Kodiak Island. Field work for the SE Alaska study began in March 2001.

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

Shark Predation of Steller Sea Lions

The Auke Bay Laboratory plans to expand research to test the hypothesis that sleeper sharks prey on Steller sea lions. Longlines will be used to capture sleeper sharks around Steller sea lion rookeries in the central Gulf of Alaska during times of pup vulnerability to determine if live Steller sea lions are prey for sleeper sharks. The diet of sleeper sharks will be investigated by collecting stomach content data (including microsatellite DNA-based identification of questionable prey items) and by fatty acid analysis of tissue samples. Also, the vertical distribution of sharks will be measured by tagging methods for comparison to the vertical distribution of Steller sea lions while at sea. Currently, 3

sleeper sharks are tagged with satellite pop-up tags (tagged in 2000 as part of an *Exxon Valdez* Oil Spill study), and tagging 9 additional sleeper sharks would strengthen the biological information on depth, activity, and movements. Field work is planned for August 2001 and March 2002.

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

Survey Gear Performance Research

Retrospective Evaluation of Bottom Trawl Survey Information

RACE Groundfish scientists have been continuing a retrospective analysis of suspiciously small or "zero" catches in our West Coast triennial bottom trawl surveys (1977-1998), especially in the early survey years of 1977, 1980, and 1983. Although there is no definitive proof, we suspect that many of these hauls were partly or entirely off-bottom, greatly reducing the catch rates of some important fish and invertebrates species. Supporting this theory is a strong trend in the data showing that the catch rates of benthic species have been increasing throughout the survey history. If an arbitrary threshold is imposed on the data, so that hauls with total CPUE values below 1.0 kg/ha (equivalent to about 4 kg total catch in a standard haul) are removed from the data set, biomass estimates increase substantially for several species of flatfish, especially in 1980. Numerous changes in our trawling methodology, including increased use of electronic trawl monitoring devices, have improved our ability to keep the trawl on-bottom in the more recent surveys.

For more information, contact Mark Zimmermann, (206)526-4119.

GIS Resources

The principal GIS software products used at the Alaska Fisheries Science Center (AFSC) are ArcInfo and ArcView. A GIS coordinator acquires and maintains base data, provides consulting and technical support to users, and educates users on GIS technology. Most fisheries data is maintained in separate relational databases. GIS data includes coastlines, bathymetry, zones (e.g., by catch, EEZ, critical habitat), biological data (e.g., marine sightings), and physical data such as ice, temperature, and currents. GIS is used to produce an atlas of ichthyoplankton, define critical habitat, plan research cruises, analyze results of animal movement, make maps for journal articles, create bathymetry from soundings, and show the distribution and quantity of fish. GIS is used because "A picture is worth a thousand words", GIS saves time, and some things can only be done with a GIS.

In addition to establishing core GIS data, institutional framework and GIS educational opportunities are being developed. Metadata is being developed so users have a better idea of the accuracy of the data and its appropriate use. Metadata also informs users of what data needs citations, and how to cite the data. A fall weekly GIS seminar was presented and recorded. These recordings were placed into RealPlayer format and made available to users for viewing. A GIS users group meets every other month. At the last meeting a technical representative from ESRI presented highlights from the new software release and showed users some tricks and tips to using the current software.

APPENDIX I - Alaska Fisheries Science Center Groundfish Publications in 2000

(AFSC authors are in bold text)

BAILEY, K. M.
2000. Shifting control of recruitment of walleye pollock *Theragra chalcogramma* after a major climactic and ecosystem change. Mar. Ecol. Prog. Ser. 198:215-224.

BRODEUR, **R. D**.
2000. Habitat-specific distribution of Pacific ocean perch (*Sebastes alutus*) in Pribilof Canyon, Bering Sea. Cont. Shelf Res. 21:207-224.

BRODEUR, **R. D.**, **M. T. WILSON**, and L. CIANNELLI.
2000. Spatial and temporal variability in feeding and condition of age-0 walleye pollock (*Theragra chalcogramma*) in frontal regions of the Bering Sea. ICES J. Mar. Sci. 57:256-264.

BUCKEL, J. A., and **A. W. STONER**.
2000. Functional response and switching behavior of young-of-the-year piscivorous bluefish. J. Exp. Mar. Biol. Ecol. 245:25-41.

BUSBY, M. S., and **J. W. ORR.**
2000. A pelagic basslet *Howella sherborni* (family Acropomatidae) off of the Aleutian Islands. Alaska Fish. Res. Bull. 6(1):49-53.

BUSBY, M. S., A. C. MATARESE, and **K. L. MIER**.
2000. Annual, seasonal, and diel composition of larval and juvenile fishes collected by dip-net in Clam Bay, Puget Sound, Washington, from 1985 to 1995. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-111, 36 p.

CLAUSEN, D. M., and **J. HEIFETZ.**
2000. Pelagic shelf rockfish. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 295-314. North Pacific

Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

CSEPP, D., and **B. L. WING.**
2000. Northern range extensions and habitat observations for blackeye goby *Rhinogobiops nicholsii* and kelp perch *Brachyistius frenatus* in southeastern Alaska. Alaska Fish. Res. Bull. 6(2): 70-84.

DORN, M. W., A. B. HOLLOWED, E. BROWN, B. MEGREY, C. WILSON, and J. BLACKBURN.
2000. Walleye pollock. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 31-89. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

FARGO, J., and **T. K. WILDERBUER**.
2000. Population dynamics of rock sole (*Lepidopsetta bilineata*) in the north Pacific. J. Sea Res. 44:123-144.

FRITZ, L. W.
2000. Squid and other species. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 529-543. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

FRITZ, **L. W**.
2000. Steller sea lion-induced changes in the management of pollock and Atka mackerel fisheries in the North Pacific, 1998-2000, p. 26. *In* P. M. Mace (editor), Proceedings of the sixth NMFS national stock assessment workshop: Incorporating ecosystem considerations into stock assessments and management advice, What are the pros and cons of going beyond single species? U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

HARVEY, J. T., **T. R. LOUGHLIN**, **M. A. PEREZ**, and D. S. OXMAN.
2000. Relationship between fish size and otolith length for 63 species of fishes from the eastern North Pacific Ocean. U. S. Dep. Commer., NOAA Tech. Memo. NMFS 150, 36 p.

HEIFETZ, J., J. N. IANELLI, D. M. CLAUSEN, D. L. COURTNEY, and **J. T. FUJIOKA.**
2000. Slope rockfish. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 231-294. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

HIATT, T. and **J. TERRY.**

2000. Economic status of the groundfish fisheries off Alaska, 1999. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska and Bering Sea/Aleutian Island area. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501. 91 p.

HOFF, **G. R**. 2000. Biology and ecology of threaded sculpin, *Gymnocanthus pistilliger*, in the eastern Bering Sea. Fish Bull., U.S. 98:711-722.

HOFF, **G. R.**, **T. W. BUCKLEY**, J. C. DRAZEN, and K. M. DUNCAN.
2000. Biology and ecology of *Nezumia liolepis* and *N. stelgidolepis* from the west coast of North America. J. Fish Biol. 57:262-280.

HOLLAND, D. S.
2000. On direct and indirect management of fishing capacity. Mar. Resour. Econom. 14:263-267.

HOLLAND, D. S.
2000. A bioeconomic model of marine sanctuaries on Georges Bank. Can. J. Fish. Aquat. Sci. 57:1307-1319.

HOLLAND, **D. S**.
2000. Incorporating dynamics of fish and fisherman in models of marine protected areas on Georges Bank, p. 28. *In* P. M. Mace (editor), Proceedings of the sixth NMFS national stock assessment workshop: Incorporating ecosystem considerations into stock assessments and management advice, What are the pros and cons of going beyond single species? U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

HOLLOWED, **A. B.**, **J. N. IANELLI**, and **P. A. LIVINGSTON**.
2000. Including predation mortality in stock assessments: a case study for Gulf of Alaska walleye pollock. ICES J. Mar. Sci. 57:279-293.

HOLLOWED, A. B., N. BAX, R. BEAMISH, J. COLLIE, M. FOGARTY, **P. LIVINGSTON**, J. POPE, and J. C. RICE.
2000. Are multispecies models an improvement on single-species models for measuring fishing impacts on marine ecosystems? ICES J. Mar. Sci. 57:707-719.

IANELLI, J. N., L. FRITZ, T. HONKALEHTO, N. WILLIAMSON, AND **G. WALTERS.**
2000. Walleye pollock. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions, p. 39-130.

North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

JURADO-MOLINA, J., and **P. A. LIVINGSTON**.
2000. Climate forcing effects on trophically-linked groundfish populations: Implications for fisheries management, p. 29. *In* P. M. Mace (editor), Proceedings of the sixth NMFS national stock assessment workshop: Incorporating ecosystem considerations into stock assessments and management advice, What are the pros and cons of going beyond single species? U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

JURADO-MOLINA, J., and **P. A. LIVINGSTON**.
2000. Multispecies perspectives on the Bering Sea groundfish fishery management regime, p. 30. *In* P. M. Mace (editor), Proceedings of the sixth NMFS national stock assessment workshop: Incorporating ecosystem considerations into stock assessments and management advice, What are the pros and cons of going beyond single species? U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

KASTELLE, C. R., **D. K. KIMURA**, and S. R. JAY.
2000. Using Pb-210/Ra-226 disequilibrium to validate conventional ages in Scorpaenids (genera *Sebastes* and *Sebastolobus*). *In* 2nd International Symposium on Fish Otolith Research and Application, Bergen, Norway, 20-25 June 1998. Fish. Res. 46:299-312.

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2000. Using nonlinear functional relationship regression to fit fisheries models. Can. J. Fish. Aquat. Sci. 57:160-167.

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2000. Variation in groundfish predation on juvenile walleye pollock relative to hydrographic structure near the Pribilof Islands, Alaska. ICES J. Mar. Sci. 57:265-271.

LAUTH, R. R.
2000. The 1999 Pacific west coast upper continental slope trawl survey of groundfish resources off Washington, Oregon, and California: Estimates of distribution, abundance, and length composition. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-115, 287 p.

LIVINGSTON, **P. A**.
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Incorporating ecosystem considerations into stock assessments and management advice, What are the pros and cons of going beyond single species? U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

LIVINGSTON, P. A., (editor).
2000. Ecosystem considerations for 2001. In Stock assessment and fishery evaluation report for the groundfish resources of the EBS/AI and GOA. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501. 119 p.

LIVINGSTON, P. A., and J. JURADO-MOLINA.
2000. A multispecies virtual population analysis of the eastern Bering Sea. ICES J. Mar. Sci. 57:294-299.

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LIVINGSTON, **P. A**., **P. D. SPENCER, T. W. BUCKLEY**, and **A. GREIG**.
2000. The influence of spatial dynamics on predation mortality of Bering Sea walleye pollock, p. 35. *In* P. M. Mace (editor), Proceedings of the sixth NMFS national stock assessment workshop: Incorporating ecosystem considerations into stock assessments and management advice, What are the pros and cons of going beyond single species? U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

LOWE, S. A., and **L. W. FRITZ.**
2000. Assessment of Gulf of Alaska Atka mackerel. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 353-377. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

LOWE, S. A., and **L. W. FRITZ.**
2000. Assessment of Bering Sea/Aleutian Islands Atka mackerel. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 515-527. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

MANDERSON, J. P., B. A. PHELAN, **A. W. STONER**, and J. HILBERT.
2000. Predation by summer flounder (*Paralichthys dentatus* Linnaeus) on young-of-the-year winter flounder (*Pseudopleuronectes americanus* Walbaum): dietary patterns of the predator in the field and laboratory experiments testing prey selection and role of sediment and vegetation as winter flounder refugia. J. Exp. Mar. Biol. Ecol. 251:17-39.

McCONNAUGHEY, **R. A.**, and **K. R. SMITH**.
2000. Associations between flatfish abundance and surficial sediments in the eastern Bering Sea. Can. J. Fish. Aquat. Sci. 57:2410-2419.

McCONNAUGHEY, **R. A.**, **K. L. MIER**, and **C. B. DEW**.
2000. An examination of chronic trawling effects on soft-bottom benthos of the eastern Bering Sea. ICES J. Mar. Sci. 57:1377-1388.

MURPHY, **M. L.**, **S. W. JOHNSON**, **D. J. CSEPP**.
2000. A comparison of fish assemblages in eelgrass and adjacent subtidal habitats near Craig, Alaska. Alaska Fish. Res. Bull. 7:11-21.

NAPP, **J. M.**, **A. W. KENDALL**, **Jr.**, and J. D. SCHUMACHER.
2000. A synthesis of biological and physical processes affecting the feeding environment of larval walleye pollock (*Theragra chalcogramma*) in the eastern Bering Sea. Fish. Oceanogr., 9:147-162.

OLLA, B. L., M. W. DAVIS, and **C. ROSE.**
2000. Differences in orientation and swimming of walleye pollock, *Theragra chalcogramma*, in a trawl net under light and dark conditions: Concordance between field and laboratory observations. Fish. Res. 44:261-266.

O'REILLY, P. T., **M. F. CANINO, M. F.**, **K. M BAILEY,** and P. BENTZEN.
2000. Isolation of twenty low stutter di- and tetranucleotide microsatellites for population analyses of walleye pollock (*Theragra chalcogramma*) and other gadoids. J. Fish. Biol. 56: 1074- 1086.

ORR, J. W., and **A. C. MATARESE**.
2000. Revision of the genus *Lepidopsetta* Gill, 1862 (Teleostei: Pleuronectidae) based on larval and adult morphology, with a description of a new species from the North Pacific Ocean and Bering Sea. Fish. Bull., U.S. 98:539-582.

ORR, J. W., **M. A. BROWN**, and **D. C. BAKER**.
2000. Guide to rockfishes (Scorpaenidae) of the genera *Sebastes*, *Sebastolobus*, and *Adelosebastes* of the northeast Pacific Ocean, second edition. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-117, 47 p.

PARKER, S. J., S. A. BERKELEY, J. T. GOLDEN, D. R. GUNDERSON, **J. HEIFETZ,** M. A. HIXON, R. LARSON, B. M. LEAMAN, M. S. LOVE, J. A. MUSICK, V. M. O'CONNELL, S. RALSTON, H. J. WEEKS, and M. M. YOKLAVICH.

2000. Management of Pacific rockfish. Fisheries 25(3):22-30.

REUTER, R. F., and **P. D. SPENCER.**
2000. Other rockfish. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 503-513. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

RYER, **C. H.**, and **B. L. OLL**
2000. Avoidance of an approaching net by juvenile walleye pollock *Theragra chalcogramma* in the laboratory: the influence of light intensity. Fish. Res. 45:195-199.

SCHABETSBERGER, R., **R. D. BRODEUR**, L. CIANNELLI, **J. M. NAPP**, and G. L. SWARTZMAN.
2000. Diel vertical migration and interaction of zooplankton and juvenile wall-eye pollock (*Theragra chalcogramma*) at a frontal region near the Pribilof Islands, Bering Sea. ICES J. Mar. Sci. 57:1283-1295.

SHAW, F. R., M. E. WILKINS, K. L. WEINBERG, M. ZIMMERMAN, and **R. R. LAUTH**.
2000. The 1998 Pacific West Coast bottom trawl survey of groundfish resources: Estimates of distribution, abundance, and length and age composition. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-114, 138 p. + Appendices.

SHIMA, M., **A. B. HOLLOWED**, and G. R. VanBLARICOM.
2000. Response of pinniped populations to directed harvest, climate variability, and commercial fishery activity: a comparative analysis. Rev. Fish. Sci. 8:89-124.

SIGLER, M. F.
2000. Abundance estimation and capture of sablefish (*Anoplopoma fimbria*) by longline gear. Can. J. Fish. Aquat. Sci. 57:1270-1283.

SIGLER, M. F., J. T. FUJIOKA, and **S. A. LOWE.**
2000. Alaska sablefish assessment for 2001. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 169-230. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

SOGARD, S. M., and **B. L. OLLA.**

2000. Endurance of simulated winter conditions by age-0 walleye pollock: Effects of body size, water temperature and energy stores. J. Fish. Biol. 56:1-21.

SOGARD, **S. M.**, and **B. L. OLLA**.
2000. Effects of group membership and size distribution within a group on growth rates of juvenile sablefish *Anoplopoma fimbria*. Environ. Biol. Fishes 59:199-209.

SPENCER, P. D., D. H. ITO, and **J. N. IANELLI.**
2000. Pacific ocean perch. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 435-483. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

SPENCER, P. D., and **R. F. REUTER.**
2000. Other red rockfish. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 485-502. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

SPENCER, P. D., G. E. WALTERS, and **T. K. WILDERBUER.**
2000. Flathead sole. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 327-346. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

SPENCER, P. D., G. E. WALTERS, and **T. K. WILDERBUER.**
2000. Other flatfish. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 347-371. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

SPENCER, **P.**, and **T. WILDERBUER**.
2000. The bycatch and mixed species yield-per-recruit of flatfish fisheries on the eastern Bering Sea shelf, p. 46. *In* P. M. Mace (editor), Proceedings of the sixth NMFS national stock assessment workshop. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

SARUWATARI, T., I. OOHARA, **J. W. ORR,** MCDOWALL, R. M. and T. KOBAYASHI.
2000. Phylogeny of lower euteleosts reconstructed from mtDNA analysis. DNA Research 8: 96-101.

Simpson, A. J., **A. W. KENDALL, JR.,** and **J. W. ORR.**

2000. Translations of the original descriptions of *Sebastes* by Georges Cuvier. NMFS/Alaska Fisheries Science Center Processed Report 2000-09. 24 pp.

THOMPSON, **G. G**.
2000. Evaluation of single-species versus multi-species models in the context of managing for maximum sustainable yield, p. 47. *In* P. M. Mace (editor), Proceedings of the sixth NMFS national stock assessment workshop: Incorporating ecosystem considerations into stock assessments and management advice, What are the pros and cons of going beyond single species? U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SPO-46.

THOMPSON, G. G., and **M. W. DORN.**
2000. Pacific cod. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 189-212. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

THOMPSON, G. G., H. H. ZENGER, and **M. W. DORN.**
2000. Pacific cod. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 91-110. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

TURNOCK, B. J., T. K. WILDERBUER, AND **E. S. BROWN.**
2000. Flatfish. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 111-135. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

TURNOCK, B. J., T. K. WILDERBUER, AND **E. S. BROWN.**
2000. Arrowtooth flounder. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 137-167. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

WALTERS, **G. E.**, and **T. K. WILDERBUER**.
2000. Decreasing length at age in a rapidly expanding population of northern rock sole in the eastern Bering Sea and its effect on management advice. J. Sea Res. 44:17-26.

WESPESTAD, **V. G.**, **L. W. FRITZ**, **W. J. INGRAHAM**, and **B. A. MEGREY**.
2000. On relationships between cannibalism, climate variability, physical transport, and recruitment success of Bering Sea walleye pollock (*Theragra chalcogramma*). ICES J. Mar. Sci. 57:272-278.

WILDERBUER, T. K., and **D. NICHOL.**

2000. Yellowfin sole. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 213-254. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

WILDERBUER, T. K., and **T. M. SAMPLE.**
2000. Arrowtooth flounder. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 257-290. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

WILDERBUER, T. K., and **G. E. WALTERS.**
2000. Rock sole. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region, p. 291-326. North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, AK 99501.

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WILSON, **C. D.**, **M. A. GUTTORMSEN**, K. COOKE, M. W. SAUNDERS, and R. KIESER.
2000. Echo integration-trawl survey of Pacific hake, *Merluccius productus*, off the Pacific coast of the United States and Canada during July-August, 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-118, 103 p.

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2000. Occurrence of Pacific sardine, *Sardinops sagax*, off southeastern Alaska. Fish. Bull. 98:881-883.

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2000. Mobile fishing gear effects on benthic habitats: a bibliography. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-116, 163 p.

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2000. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990, 1993, and 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-112, 174 p. Abstract.

ZIMMERMANN, **M.**, K. H., KILBURNE, M. E. FIELD, J. V. GARDNER, C. JENKINS, R. G. CURRIE, J. V. BARRIE, and B. D. BORNHOLD.
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Alaska Fisheries Science Center Groundfish Publications and Publications in Press in 2001

(partial list as of April 2001)

ACKLEY, D., and **J. HEIFETZ**.
2001. Fishing practices under maximum retainable bycatch rates in Alaska's groundfish fisheries. Alaska Fish. Res. Bull. 8(1): (in press).

BRITT, L. L., and M. H. MARTIN.
2001. Data Report: 1999 Gulf of Alaska bottom trawl survey. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-121, 249 p.

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2001. The feeding habits of slope dwelling macrourid fishes in the eastern North Pacific. Deep- Sea Res. 48: 909-935.

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2001. Identification of rockfish (*Sebastes* spp.) by restriction site analysis of the mitochondrial ND-3/ND-4 and 12S/16S rRNA gene regions. Fish. Bull. 99: 49-62.

HEIFETZ, J., and **N. E. MALONEY.**
2001. Estimation of tag-reporting rates for sablefish in the northeast Pacific Ocean. Alaska Fish. Res. Bull. 8(1): (in press).

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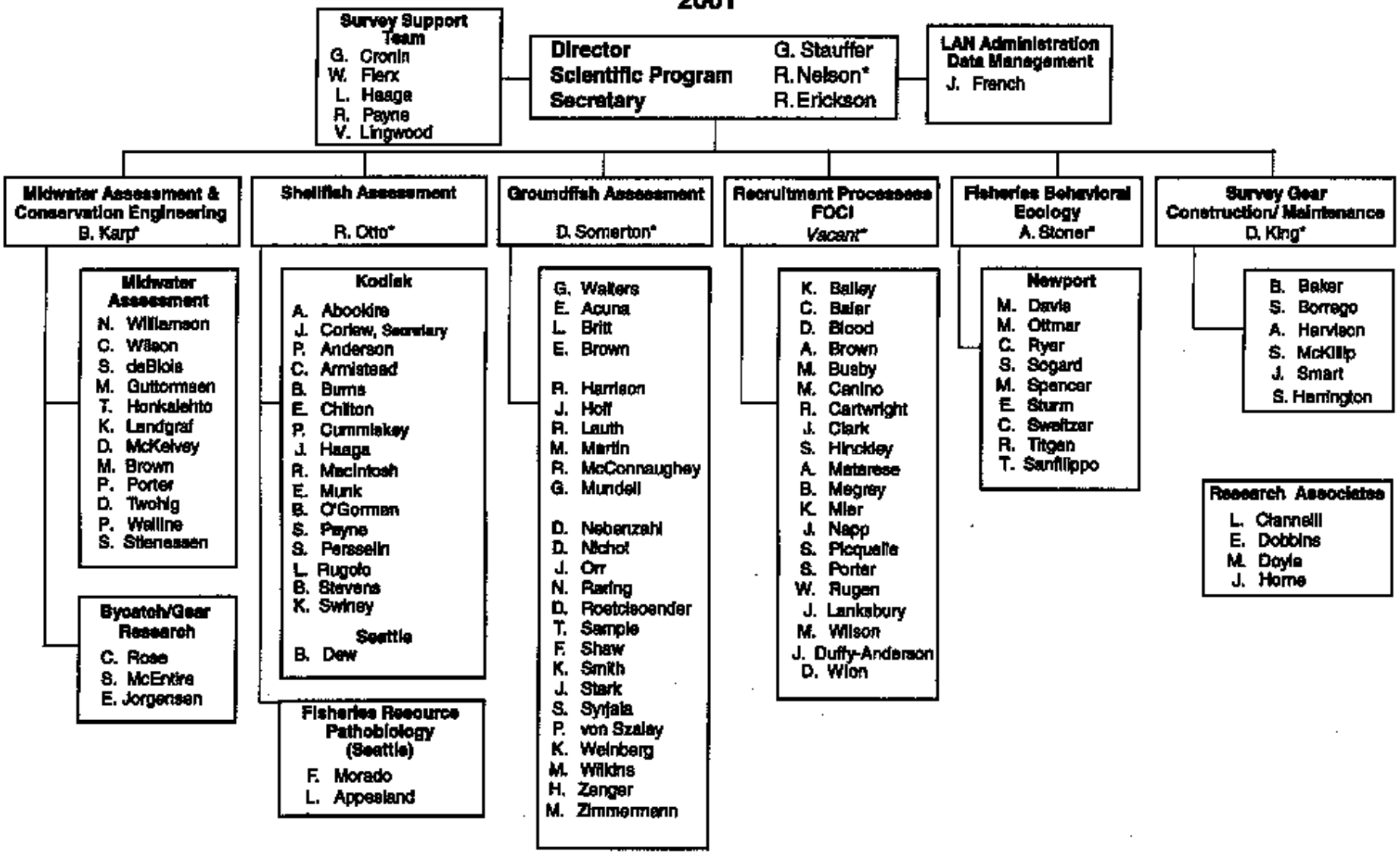
SIGLER, M. F., T. L. RUTECKI, D. L. COURTNEY, J. F. KARINEN, and **S.YANG.**
2001. Young-of-the-year sablefish abundance, growth, and diet. Alaska Fish. Res. Bull. 8(1): (in press).

VON SZALAY, P. G., and **E. BROWN.**
2001 A side-by-side trawl comparison experiment to determine fishing power differences and their applicability between NMFS and ADF&G trawl survey gear. Alaska Fish. Res. Bull. (in press).

VON SZALAY, P. G., and **R. A. McCONNAUGHEY.**
2001. The effect of slope and vessel speed on the performance of a single beam acoustic seabed classification system. Fisheries Research. (in press).

APPENDIX II.–RESOURCE ASSESSMENT AND CONSERVATION ENGINEERING DIVISION ORGANIZATION CHART 2001



* Program Manager

May 2001

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APPENDIX IV - Auke Bay Laboratory Groundfish Assessment Program Staff

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Dean Courtney	Rockfish, Stock Assessment, Sablefish Daily Growth
Linc Freese	Effects of Fishing, Sponge Life History
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Jon Heifetz	Rockfish, Sablefish, Stock Assessment, Effects of Fishing
John Karinen	Gulf of Alaska Groundfish
Mitch Lorenz	Essential Fish Habitat
Chris Lunsford	Rockfish, Sablefish, Stock Assessment, Longline Survey
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
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Scott Johnson	Essential Fish Habitat
Bruce Wing	Groundfish Early Life History

Northwest Fisheries Science Center
of the
National Marine Fisheries Service

2000 Agency Report to the Technical Subcommittee of the Canada_U.S. Groundfish Committee

May, 2001

Compiled by
Cyreis Schmitt

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. It has positioned itself to provide the best possible science, anticipate solutions to emerging fishery resource challenges, and develop strong constituent relationships. 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, 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 Subcommittee of the Canada_US Groundfish Committee. The FRAMD works in partnership with state and federal resource agencies, universities, and the groundfish industry to achieve a coordinated groundfish program for the West Coast.

The Division develops and provides scientific information necessary for managing West Coast marine fisheries, striving to provide useful, accurate, and reliable stock assessment data with which fishery managers can set ecologically safe and economically valuable harvest levels. It develops models for managing multispecies fisheries and designs programs to provide information on the extent and characteristics of bycatch in commercial fisheries as it looks at methods to reduce fisheries bycatch.

During 2000, West Coast groundfish research took on new urgency. Reduced harvest levels put in place for several highly valued and commercially important species meant economic disaster for segments of the fishing fleet and regional economies. In January, after a particularly sharp decline in allowable catches to rebuild depleted stocks, Commerce Secretary William M. Daley determined a commercial groundfish fishery failure, the first step in the process of securing funds from Congress to assist fishermen.

Research facilities in Newport on the Oregon coast are particularly important for groundfish research. The Newport location provides opportunities for the

FRAMD 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.

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 multidisciplinary 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 understanding 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 multidisciplinary 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

2.) Stock Assessment

Multispecies Analysis - One approach to improving assessments of data-poor species is to link their assessment to that of more data-rich species. The triennial bottom trawl survey is a primary source of information for several ground-

fish stock assessments, and each of these assessments produces an estimate of the catchability (Q) which relates the nominal biomass estimate from the survey to the assessment model's estimate of the biomass level available to the survey. This information on Q could be used to improve assessments for similar, but data-poor, species which occur in these surveys. In 2000, Dr. Russell Millar (University of Auckland, New Zealand) visited the NMFS-Northwest Fisheries Science Center and worked with Richard Methot to develop a Bayesian method for conducting simultaneous assessments of several species which share a common prior distribution on the potential value of Q. The method was applied to several species which have been previously assessed and a manuscript describing this work is in review.

For more information, please contact Dr. Richard Methot at or at (206) 860-3365.

Unassessed Species

Of the 82 species identified in the Pacific Council's groundfish fishery management plan, formal stock assessments are conducted on only about 20 of these species. Means are needed to evaluate the status of the large number of unassessed groundfish species. The first phase of the unassessed species project is to compile a database, and summarize the information on the basic life-history characteristics, geographic distribution, habitat requirements, and abundance. In the second phase the complied information will be used to evaluate potential methods for assessing stocks.

In 2000, a graduate student began developing a database for slope species, and we anticipate expanding to other species complexes in future years. Types of information to be incorporated into the database for each species will include geographic range; types of commercial and sport fisheries that are used to harvest them; essential habitat requirements; important life history characteristics, such as reproductive strategy and age structure; genetic information; survey information; historical trends in stock abundance; and the current status of the stock, if known.
For more information, please contact Cyreis Schmitt at (541) 867-0127 or cyreis.schmitt@noaa.gov.

C. By Species, by Agency

1.) Pacifc Cod

Puget Sound

b.) Stock Assessment

ESA Status Review - NWFSC scientists were part of a team of NMFS scientists that responded to a petition submitted in1999 to list 18 species of marine fish in Puget Sound under the Endangered Species Act (ESA). NMFS initiated status reviews of six of the these species, including Pacific cod, *Gadus macrocephalus*. The NMFS team formed a biological review team (BRT), composed of Federal scientists with expertise in one or more of these species, to conduct review the status of three gadid species: Pacific cod, Pacific hake, and walleye pollock. The status reviews summarized the biological and environmental information gathered in that process and the preliminary conclusions reached by the BRT. The two major components of the process were to identify one or more "distinct population segments" (DPSs) for each species, and to evaluate if the populations within those DPSs are undergoing severe declines in abundance or if substantial risks of extinction are facing these populations. The results of the BRT process for the gadid species were published in the Federal Register in November, 2000 and in a NOAA Technical Memorandum (see Appendix).

The majority opinion of the BRT was that there was good reason to believe that Pacific cod from Puget Sound are part of a DPS that is larger than Puget Sound and that this DPS extends northward to at least the Dixon Entrance, British Columbia. [RTF bookmark start: _1__9_][RTF bookmark end: _1__9_]However, the BRT concluded that there was insufficient information available to identify the exact northern boundary of the DPS that incorporates Puget Sound Pacific cod.

The BRT considered risks for three DPS scenarios: Georgia Basin, Puget Sound to Dixon Entrance, and Puget Sound through Southeast Alaska. The majority of the BRT concluded that Pacific cod encompassed by the latter two scenarios are not in danger of extinction or likely to become so in the foreseeable future. The BRT agreed that the Pacific cod in the Georgia Basin scenario are not presently in danger of extinction; however, the BRT was nearly equally divided on the question of whether Pacific cod in this population segment are likely to become endangered in the foreseeable future if present trends continue. The BRT identified several concerns that might affect the survival of Pacific cod: a) the apparent loss of the major known spawning locations in Puget Sound; b) the general synchronicity in declining trends in Pacific cod abundance from Puget Sound to Southeast Alaska; and c) the relatively little quantitative information or understanding about the effects of potential risk factors. Overall, the BRT was not certain which risk factors, either singly or in combination, may significantly contribute to the current low stock sizes of Pacific cod in Puget Sound.

For more infomation please contact Dr. Bruce McCain at or (541) 867-0346.

2.) Nearshore Rockfish

Puget Sound

b.) Stock Assessment

ESA Status Review - In response to a petition to list 18 species of marine fishes in Puget Sound under the Endangered Species Act (ESA), a NMFS Biological Review Team (BRT), including scientists with the NWFSC and other Federal scientists with expertise in one or more groundfish species, was formed and conducted the status review for copper, quillback and brown rockfish in Puget Sound. The status review for these rockfishes summarizes the biological and environmental information gathered in that process and the preliminary conclusions reached by the BRT. The BRT concluded that the Distinct Population Segments in Puget Sound for Copper, Quillback and Brown rockfish may be vulnerable (in the sense of the International Union for the Conservation of Nature) due to their life history and lack of resilience in populations. These conclusions were published in a Federal Register Notice on April 3, 2001 with a determination that listing of Puget Sound populations of these species under the Endangered Species Act is not warranted at this time.

Distinct Population Segments (DPS)s in Puget Sound were defined by the BRT through consideration of the available genetic information. However, the extent of DPSs for these species outside of Puget Sound are not clear and further investigation of the genetic separation of the DPSs is justified. Discussions among the BRT members indicated considerable concern about declines in abundance of the three species in the DPS, inadequate data to track current trends in abundance, the ease of overfishing rockfish in many of their preferred habitats in the DPS, and the possibility that contaminants may be adversely affecting productivity. However, declines in abundance appear to have decreased or stopped since 1995, the species were still widely distributed in the DPS in 1995, minimal estimates of abundance of each of the species approached or exceeded 100,000 fish in 1995, and there have not been any studies that show that productivity was actually impaired by contaminants. Because of its concerns, the BRT suggested continued monitoring of the populations, very conservative if any exploitation, and further investigation into possible impacts of contaminants.

For more information, please contact Dr. Bruce McCain at or (541) 867-0346.

West Coast

a.) Research

Nearshore Rockfish Research Proposal

Concerns about the health of nearshore rockfishes and their ecology coupled with a partnership between NOAA, and the Coastal States Organization prompted the development of a region-scale research plan for nearshore rockfish off the coasts of Washington, Oregon and California. As part of the core team, the NWFSC participated in the development of this research plan and strengthened the consistency and coordination of this effort with the development of the NMFS research plan for west coast groundfish.

The plan outlines a multi-year, interdisciplinary program of scientific research for nearshore rockfish, associated species, their habitats, and ecological relationships along the west coast. Research would involve state, federal, and university scientists, and local fishermen in a three-part program: 1) a suite of comparable site-based studies in seven study regions along the entire coast; 2) broad scale studies such as genetics, stock assessments, and population models for nearshore species, and studies of management alternatives; and 3) communication, outreach, and feedback from managers, scientists, fishermen, and local communities through the life of the program.

For more information, please contact Cyreis Schmitt at (541) 867-0127 or

3.) Shelf Rockfish

West Coast

b.) Stock Assessment

Bank Rockfish - A stock assessment of Bank Rockfish (*Sebastes rufus*) was completed using a modified stock reduction model in stock synthesis. Results indicated that bank rockfish population size had declined primarily in the period prior to the early 1990's but that population levels had been relatively stable since that time. The results were hampered by the lack of a survey reliably assessing this species and because of the inability to estimate recruitment due to the lack of informative data on young age classes.

For more information, please contact Dr. Kevin Piner at or (541) 867-0340.

Canary Rockfish Rebuilding Analysis - The stock assessment for canary rockfish conducted in 1999 indicated that the stock continued to decline throughout the 1990s and had fallen below the overfished threshold set at 25% of unfished female spawner biomass. A rebuilding analysis was conducted in 2000 to determine how quickly the stock would be expected to recover as further fishing

restrictions are implemented. The first stage of the rebuilding analysis involved calculation of the rebuilding target, which is set at 40% of the unfished level of female spawner biomass; calculation of the expected rate of increase with no fishing through Monte Carlo resampling of recent levels of recruits per spawner; and determining whether successful rebuilding could occur in 10 years with no fishing. Because recruitment during the 1990s has been much reduced below historical levels, the rate of rebuilding is very slow and will take 41 years in the median case. The second stage involved calculation of mean generation time in order to determine the permissable time to rebuild (median time to rebuild with no fishing plus the mean generation time). In the final stage of the rebuilding analysis, we calculate that an annual catch of 73 mtons will allow rebuilding in 58 years. This is a tremendous reduction from the 1000 mton catch level of just a few years ago. Several aspects of this calculation involves substantial uncertainty: whether or not natural mortality of older females increases, demographic connections between canary rockfish off Oregon-Washington relative to California, and long-term climate influences on recruitment patterns.

For more information, please contact Dr. Richard Methot at or (206) 860-3365.

4.) Slope Rockfish

West Coast

b.) Stock Assessment

Darkblotched Rockfish - An assessment of darkblotched rockfish (*Sebastes crameri*) off the contiguous U.S. west coast was completed in 2000. The length_based version of the Stock Synthesis model utilized to model the population. Fishery data included catches and length and age frequency distributions. Fishery independent data included a biomass index and length and age frequency compositions from the NMFS triennial shelf, slope, and Pacific ocean perch surveys. Experimental logbook and Pacific ocean perch (*Sebastes alutus*) bycatch indices were also considered. All indices indicated a decline in biomass after the middle to late 1980's.

The species was declared overfished (spawning stock biomass was less than 25% of the unfished level) and a rebuilding plan is being developed. Uncertainties in the stock assessment affect spawning biomass estimates at both ends of the time line. Foreign catch in the early years of the fishery (1965-1976) was estimated to be 10% of catch previously attributed to Pacific ocean perch. A range of 0-20% was however considered possible. Increasing foreign catch withing that range increased unfished spawning biomass and it's percentage decline. In the most recent years, the 1994 year class was estimated to be very large. This year class had not yet entered the fishery, so information was scant.

Projections of future levels of spawning biomass are greatly dependent upon the estimated size of that year class.

For more information please contact Dr. Jean Rogers at *jean.rogers@ noaa.gov* or at (541) 867_0153.

5.) Thornyheads

West Coast

a.) Research

Ageing Methods - An evaluation of shortspine thornyhead (*Sebastolobus alascanus*) age determination methods was conducted by the Cooperative Ageing Project. Five otolith preparation methods were compared to determine the effects of the preparation methods on the ages produced. In addition, growth models were produced from each method and compared with growth predicted from tag-recapture data to validate the growth form. Results indicated that preparation method was influential on the age produced and that ages were highly variable. No preparation method could proven to be superior and that the appropriate method for age determination of this species is still uncertain.

For more information, please contact Dr. Kevin Piner at or at (541) 867-0340.

6.) Sablefish

West Coast

a.) Research

Cooperative Sablefish Investigations: Estimating year class strength from a survey of pelagic juveniles - A pilot study was initiated in 1999 to determine the feasibility of using a survey of pelagic juvenile sablefish to estimate year class strength. NWFSC FRAM Division funded an OSU researcher (Dr. Steve Berkeley) to continue this survey in 2000, but at a reduced level of sampling coverage due to budget constraints. Each of three transect lines were sampled four times in 1999 (Washington, Oregon, California) but only the Oregon transect line was sampled in 2000. Stations were 2.5 nm apart starting at the 60 fm contour. All tows were 10 minutes, at night using a 1 m manta net (505m). The objectives of this study were to:

1. Determine density and size composition of neustonic sablefish off Oregon in 2000.

2. Determine differences in density and size composition of neustonic juvenile sablefish between the 1999 and 2000 year classes.

3. Determine age and growth rate of neustonic sablefish.

4. Estimate variation in stage survival of sablefish between 1999 and 2000.

5. Estimate number of tows required to detect changes in abundance.

6. Determine the sensitivity of our estimates to assumptions about spatial distribution, density, growth rate, and survival.

7. Recommend the most cost effective survey to provide a useful index of year class strength for the west coast stock of sablefish.

Results of both surveys are presented in contract reports to NMFS_NWFSC. Mean growth rate was 0.93mm/d, estimated from counts of daily growth increments on otoliths. There was no statistical difference in abundance between 1999 and 2000 along the Oregon transect line. Power tests indicated that our current sampling design would have a high probability of detecting population differences of 100%. Results also indicated that small differences in survival rate during the neustonic larval and early juvenile period could explain all observed differences in year class strength (as estimated by stock assessments). This suggests that growth rate, which would determine stage duration is potentially very important in determining year class size.

For more information, please contact Dr. Michael Schirripa at or (541) 867-0196.

Young Sablefish - For the GLOBEC and BPA Columbia River Plume projects, Fish Ecology Division (FE) staff have been conducting surface trawl surveys off Oregon and Washington and many young-of-the year sablefish have been captured. The GLOBEC survey was initiated in 2000, while the Plume survey was initiated in 1998. Interestingly no sablefish were captured in 1998 but they were relatively numerous in 2000. These surveys may provide additional information on sablefish early recruitment patterns.

For more information, please contact Dr. Robert Emmett at *robert.emmett@noaa.gov* or (541) 867-0109.

Sablefish Shrinkage

Currently, the minimum size of sablefish retained for commercial sale on the west coast is 22 inches. Questions from law enforcement regarding the effects of commercial fishing operations on the length of retained sablefish prompted a

study of potential sablefish shrinkage following capture. During the NWFSC's slope trawl survey, scientists conducted a pilot study on the effects of capture and retention on sablefish length.

While the catches during the survey were not as large as during normal commercial operations, the handling and care of the retained catch approximated those of normal fishing operations. Sablefish were randomly selected from the catch and marked with a numbered disk tag attached to the lower jaw or caudal peduncle with a small wire tie. Fish were measured to the nearest mm fork length and placed on ice in the fish hold. The tagged fish were recovered prior to and during offloading and were measured again prior to delivery to processors.

For the first pass by survey vessels down the coast, a total of 406 fish were tagged. They ranged in size from 340-818 mm fork length (mean: 567 mm). Of these, 393 tagged fish were measured again at delivery and the amount of shrinkage ranged between 1 mm and 55 mm, and averaged 1.0 cm.

For the second pass by survey vessels down the coast, a total of 366 fish were tagged and they ranged from 333 -780 mm fork length, averaging 555 mm. Of these, 363 sablefish shrank between 1 and 31 mm, with an average of 10.7 mm shrinkage.

For more information, please contact Dan Kamikawa at (541) 867-0283 or dan.kamikawa@noaa.gov.

9.) Pacific Whiting

Puget Sound

b.) Stock Assessment

ESA Status Review - As described earlier for Pacific cod, NWFSC scientists conducted a status review of Pacific whiting in Puget Sound as a result of a petition to list 18 species of marine fish under the Endangered Species Act.

A NMFS Biological Review Team (BRT) concluded that inshore resident Pacific hake from Puget Sound and the Strait of Georgia constitute the Georgia Basin Pacific hake Distinct Population Segment (DPS). The BRT identified a variety of evidence to support their conclusion that Georgia Basin Pacific hake constitute a separate DPS relative to offshore Pacific hake: 1) Differences in annual migration behavior, 2) significant allozyme frequency differences between Puget Sound and offshore Pacific hake, 3) absence of the protozoan parasite *Kudoa paniformis* in inshore populations compared to its common occurrence in offshore

Pacific hake, 4) differences in otolith morphology between Strait of Georgia and offshore Pacific hake, 5) distinctiveness of the habitats of inshore Pacific hake (they spawn in deep, inshore basins that receive large freshwater inputs and are the only populations of Pacific hake that inhabit fjord-like environments), 6) wide geographic separation of inshore and offshore spawning locales, and 7) demographic data showing that inshore Pacific hake are generally smaller for a given age, mature at a smaller size, and reach a smaller maximum length than offshore fish. The BRT expressed several concerns about the available data; for example: 1) it is not clear whether demographic differences between Georgia Basic and offshore Pacific hake are driven by environmental or genetic differences, 2) some of the allozyme loci that show differences between Puget Sound and offshore Pacific hake have been shown to be under selection in other animals, and 3) there is no obvious physical barrier preventing mixing of offshore and Georgia Basic Pacific hake, especially during the June-August period when offshore Pacific hake may occur near the mouth of the Strait of Juan de Fuca.

With regard to extinction risk, the BRT concluded that the Georgia Basic Pacific hake DPS was not presently in danger of extinction, but could with nearly equal likelihood fall into either of two categories: 1) not in danger of extinction, nor likely to become so in the foreseeable future, or 2) not presently in danger of extinction, but likely to become so in the foreseeable future. As a whole, BRT gave slightly higher support to the first category. The biomass of Pacific hake in Port Susan during the spawning period has declined by 85% over the past 15 years, yet numbers have fluctuated around 30 million fish until dropping to less than 11 million in 2000. Over the same period, size composition and size-at-maturity for females have also decreased substantially. In contrast, such significant declines in biomass, fish size, or maturity, are not evident for Pacific hake populations in the Canadian portion of the Strait of Georgia and these populations are much larger than the Port Susan populations.

In addition to the concerns about the status of Puget Sound Pacific hake, the BRT identified several areas of uncertainty regarding the relationships among stocks and effects of potential risk factors. The extent of any mixing of spawning products or spawners among stocks within the Georgia Basin is unknown. Risk factors are also poorly known and for the most part, the BRT could only speculate on potential factors and their effects. For example, two hypothetical models of pinniped predation on Pacific hake in Port Susan were considered, but the results were inconclusive.

In 2001, much new informaiton is expected to become available that will likely resolve many of the uncertainties about the status and relationship of stocks of Pacific hake within the Georgia Basin DPS. When it is available, the BRT urges that this new information be considered and extinction risk be reevaluated.

For more information, please contact Cyreis Schmitt at (541) 867-0127 or cyreis.schmitt@noaa.gov.

West Coast

a.) Research

Winter Spawning Distributions - A joint U.S.-Canadian hydroacoustic survey was undertaken in January-February, 2001 to determine the winter Pacific whiting spawning distribution and dynamics of the migration to and from their summer feeding grounds. The research survey was conducted aboard the RV *Ricker* and echosounding transects were mapped from Queen Charlotte Islands to the U.S./Mexico border. In addition to mid-water trawls deployed to sample suspected spawning aggregations of whiting, CTD and ADCP profiles and plankton tow were conducted to characterize ocean conditions at spawning locations. Results of this research cruise are presently being analyzed.

For more information, please contact Dr. Tom Helser at or (206) 860-6782 or Dr. Mark Saunders, DFO.

Pre-recruit Surveys - In 2000, the Pacific Whiting Conservation Cooperative PWCC in conjunction with the Midwater Trawlers Cooperative (MTC) combined its prerecruit research efforts with the NMFS Southwest Center's Tiburon Lab's young-of-the year index survey. The Tiburon survey conducted during May and June between Monterey Bay and Pt. Arenas, California has been carried out since 1983 targets on juvenile rockfish since 1983. This survey also takes young-of-the-year Pacific whiting in sufficient quantities to establish an index of prerecruit abundance. This index appears to be indicative of relative year-class strength, but it covers only a small portion of the distributional range of whiting. The PWCC-MTC survey followed the sampling protocol of the Tiburon survey, but over a broader area. The purpose of the survey was to determine if broader spatial coverage will yield better indices of prerecruit whiting abundance. The PWCC-MTC surveyed to the south and north of the NMFS survey area to determine the extent of young-of-the-year whiting distribution, and conducted side-by-side comparative trawls with the NOAA *RV David Starr Jordan* in Monterey Bay.

The fishing vessel *Excalibur* of Newport, Oregon was chartered to carry out the survey. The vessel was captained by Mike Retherford and staffed with a crew of two fishermen. The Scientific party consisted of: Vidar Wespestad, PWCC; Mark Chandler, NMFS, Silver Spring, MD; Robert Meyer, PWCC, and Marion Mann from the NMFS Northwest Science Center's Hatfield Science Center, Newport, OR. NMFS, Northwest Fisheries Science Center provided vessel charter funding for the survey.

A total of 120 hauls were completed over the course of the survey in the primary survey area between Point Conception (latitude 34º 45' N) and Newport, Oregon (latitude 44° 30'N). A total of 39 species of fish and invertebrates were taken in the survey. Pacific whiting accounted for nearly 50% of the fish catch, and age 0 whiting (n=236) comprised less than 1% of the catch. A larger number of age 1 and 2 whiting were also captured. Northern lampfish and flatfish larvae were the next most abundant fish species captured. Salps and jellyfish were the most abundant invertebrates. Most of the jellyfish were taken in one very large (9 t) haul in Monterey Bay.

Length was measured from 1,442 Pacific whiting, 888 immature whiting, 270 males and 284 females. The composite length frequency was multiimodal, with a small mode at 2 cm, and others at 22 cm, 34 cm and 46 cm. These length modes likely correspond to the ages of 0, 1, 2 and 4+. The 22 and 34 cm modes are at the average modal size for ages 1 and 2, which are normally 25 and 34 cm (Dorn, pers. comm.). Analysis of the length frequency data by water depth indicates that young-of-the-year whiting were concentrated over the outer continental shelf. Conversely, age 1 and 2 whiting appear to be more concentrated shallower depths. However, the small sample size prevents reaching conclusive results regarding distribution relative to depth.

For more information, please contact Dr. Tom Helser at *tom.helser@noaa.gov* or (206) 860-6782.

b.) Stock Assessment

The Pacific whiting stock assessment was updated by Northwest and Alaska Fishery Science Center's staff. Since the last Pacific whiting assessment in 1998, limited new data were available for the 2000 update. Fishery age composition data were available for the 1998 and 1999 U.S. and Canadian fisheries, and indices of whiting recruitment were available from the 1999 and 2000 SWFSC larval rockfish survey. Although these data contain relatively little information concerning absolute abundance, they can provide an indication of the strength of recruiting year classes. A coastwide acoustic survey, the primary index of whiting abundance, is planned for summer of 2001. Recent fishery composition data and recruitment indices were evaluated for consistency with 1998 model projections in a preliminary ADMB assessment model run. This ADMB model used the same configuration as the 1998 assessment, but included the new fisheries age composition and recruit indices.

Results of the ADMB modeling runs were as follows:

1) Fishery age composition and recruitment indices showed no indication

strong recruiting year classes, and suggested a continuing pattern of weak to moderate year classes consistent with the 1998 assessment.

2) Preliminary assessment model runs showed only minor differences in biomass and recruitment estimates.

3) Whiting catch in 2000 will be approximately 75% of the ABC due to the scarcity of fishable aggregations of whiting off northern Washington and southeast Vancouver Island. Although an unharvested quota would tend to increase the stock size, catches in 1999 exceeded the ABC by 46,000 tons, and estimates of 1995 and 1996 year class strength are slightly lower the preliminary model runs.

4) The allowable harvest in 2001 was recommended to be set based on the 1998 assessment projections. Projected 2001 total yield from the 1998 assessment was 238,000 t coastwide (Pacific Whiting Assessment Update for 2000).

For more information, please contact Dr. Tom Helser at *tom.helser@noaa.gov* or (206) 860-6782.

10. Walleye Pollock

Puget Sound

b.) Stock Assessment

ESA Status Review - As was mentioned in Section C. 1., a NMFS team, including scientists with the NWFSC, formed a biological review team (BRT), composed of Federal scientists with expertise in one or more groundfish species, to conduct a status review for the gadid species. With respect to walleye pollock, the BRT concluded that aggregations of spawning walleye pollock in the eastern North Pacific Ocean, south of a provisional northern boundary of 140E W, are part of a single DPS. This DPS was named the Lower boreal Eastern Pacific walleye pollock DPS. The provisional northern boundary of this DPS coincides with the northern and western stock boundary for Southeast Alaska walleye pollock. Although the BRT could not with any certainty identify multiple populations or DPSs of walleye pollock with in the Lower boreal Eastern Pacific walleye pollock DPS, they acknowledged the possibility that more than one DPS for walleye pollock may exist in the range from Puget Sound to Southeast Alaska, for example none of the BRT members ruled out the possibility that there could be a DPS for walleye pollock at the level of the Georgia Basin.

The BRT concluded that walleye pollock in the Lower boreal Eastern Pacific walleye pollock DPS are not be in danger of extinction, nor are they likely to become so in the foreseeable future if the present trends continue. However,

most BRT members could not rule out the possibility that walleye pollock in this DPS, although not presently in danger of extinction, are likely to become so in the foreseeable future. Information on the status of walleye pollock in the DPS was very limited and usually based on catches or catch rates in recreational or commercial fisheries, and this lack of suitable data to assess extinction risk was a cause of concern to the BRT. The abundance of walleye pollock in Puget Sound is at low levels, especially in the southern areas, but stocks outside of Puget Sound did not appear to be at or declining to such low levels.

For more information, please contact Dr. Bruce McCain at bruce.mccain@noaa.gov or (541) 867-0346.

12.) Pacific Mackerel and Sardines

West Coast

a.) Research

Pacific Mackerel, jack mackerel, and Pacific sardines are presently abundant off Oregon and Washington. Sardines support a purse-seine fishery off Astoria. Presently, fish catches from the GLOBEC and BPA Columbia River Plume surface trawling surveys and Predator/Baitfish surveys off the Columbia River are being used as annual relative indices of abundance. The Fish Ecology (FE) division is working with the SWFSC to develop a coast-wide estimate of Pacific sardine abundance. A graduate student working with FE is working on the bioenergetics and feeding habits of sardines.

For more information, please contact Dr. Robert Emmett at *robert.emmett@noaa.gov* or (541) 867-0109.

D. Other Related Studies

1.) Planning and Coordinating Groundfish Research Programs

The NWFSC worked with the AFSC and SWFSC to produce a NMFS comprehensive research plan for west coast groundfish. The plan will guide NMFS groundfish research coastwide for the next three to five years. It is intended to identify scientific information needed for management to achieve healthy fish stocks important to fisheries. It also is designed to identify the priorities for research so that the research can be focused on the most important work.

The plan lays out what is currently being done by NMFS and what is needed to have adequate data for west coast groundfish managment. For public comment, NMFS held four public meetings along the coast and with PFMC adviso-

ry bodies and also got scientific peer review comments on the draft plan. These comments have been incorporated into the revised plan.

We have prepared an implementation plan for the NWFSC and SWFSC funding for west coast groundfish in FY 2001.

We are establishing a coastwide research forum that will meet each year to discuss what research needs to be done, what can be done on existing funds and to identify what other critical research is needed and plan a united approach for obtaining more funds. We envision that the forum would involve both NMFS Centers, three states, PFMC, PSFMC and some constituents.

The goals of this research forum are to find ways to meet more of the research needs for west coast groundfish and maximize research through promoting cooperation and collaboration; identify specific priority research projects, likely participants and opportunities for collaborative research; and identify and pursue strategies and opportunities to acquire additional funding or other resources.

To prepare for the forum, we contracted for the preparation of a draft gap analysis, comparing current research activities by all states and NMFS to the needs identified in the coastwide research plan. We anticipate that this will be the basis for discussions at the research forum.

In 2000, the NWFSC coordinated the Stock Assessment and Review (STAR) process for assessment of west coast groundfish. Review panels were convened to review assessments for lingcod, bank rockfish, darkblotched rockfish, yellowtail rockfish, Pacific ocean perch, and widow rockfish.

For more information, please contact Cyreis Schmitt at (541) 867-0127 or cyreis.schmitt@noaa.gov.

2) Electronic Fish Catch Logbook Project

The prototype Electronic Fish Catch Logbook (EFCL) is designed to simplify commercial fishing logbook data entry, increase the amount and uses of fishery dependent data, aid in data verification and improve access to data. The EFCL project began in 1997 and bench testing of the prototype is nearing completion. In field trials on board commercial trawlers, testing will involve validating the software components developed by two outside firms.

The EFCL is expected to allow quicker and more accurate reporting of logbook data nd reconciliation with fish ticket information, and eventually, reporting of observer data. The database is also designed to provide confidential access to informaiton that will enable fishers to make fishing business decisions and pro-

vide processors with advance notice of vessels catch to improve processing efficiency and marketing.

For more information, please contact Stewart Toshach at (206) 860-5604 or stewart.toshach@noaa.gov.

3.) Cooperative Resource Surveys

The NWFSC conducted its third annual bottom trawl resource survey for Dover sole, sablefish, shortspine and longspine thornyheads, and other groundfish inhabiting the slope zone (100 to 700 fathoms deep) off the coasts of Washington, Oregon, and California. These surveys are designed to provide information to determine the relative abundance of these species in the region and to characterize their distribution.

The NWFSC uses chartered, commercial fishing vessels to conduct independent, replicate surveys and uses standard trawl gear to match the boats' characteristics. Fishing vessels *Coast Pride, Excalibur, Sea Eagle*, and *Captain Jack* were contracted to survey the area from Cape Flattery, WA to Pt. Conception, CA, beginning the first week of July and continuing through September.

Each vessel was chartered for four weeks and they operated in pairs, alternating transects along the coast. The survey followed a stratified random sampling scheme with 15-minute tows, at five stations at randomly selected depths ranging from 100 to 700 fathoms, and arranged along east-west transects. The transects were spaced 10 minutes of latitude apart. Each vessel occupied a unique set of 20 transects covering the entire north-south extent of the survey.

For more information, please contact Teresa Turk at (206) 860-3460 or teresa.turk@noaa.gov.

4) Summary of GIS Program for West Coast Essential Fish Habitat

Synthesis and compilation of data sets for the West Coast Groundfish Habitat GIS has been an ongoing effort in 2000. Datasets that have been added include floating kelp data for Washington (1996), Oregon (1990) and California (1989). This data was provided by state agencies, Washington Department of Natural Resources, Oregon Department of Fish and Game, and California Department of Fish and Game. Floating kelp is a critical habitat for many species of groundfish, so these data are great addition to the habitat database. In addition, we acquired an improved source of bathymetry data for use in coastwide stock assessments. This data has a spatial resolution of 1 minute lat/long cells and was acquired from the Naval Oceanographic Office.

In addition to coastwide datasets, our habitat investigations in Heceta Bank, Oregon have contributed to the GIS database, including multibeam imagery, detailed bathymetry contours, historical fish survey transects, and manned submersible and remotely-operated-vehicle transects with associated species/habitat information.

For more information, please contact Allison Bailey at (206) 860-6794 or Allison.Bailey@noaa.gov.

5) Cooperative Ageing Unit

Twelve months of in_kind supervision and "lead worker" oversight were provided for the Cooperative Ageing Project (CAP) with Pacific States Marine Fisheries Commission and Oregon Dept. of Fish and Wildlife. The Ageing Unit production-aged darkblotched rockfish, shortspine thornyhead, sablefish, Dover sole, and black rockfish for stock assessment purposes, and finshed up production work on bank rockfish and Pacific Ocean perch. This work resulted in 23,152 specimens aged for the year.

A fourth age reader was hired full_time in 2000, however, another resigned to return to university. This age reader is being brought back under a one_year contract this March, and a sixth age reader is to be hired this summer (2001).

Contact Bob Mikus for more information on ageing by the CAP at (541) 867_0300 x247 or bob.mikus@hmsc.orst.edu.

6) Fish/Habitat Associations

Diversity, quality, and extent of bottom habitats likely are among the most significant environmental determinants of distribution, abundance, and diversity of these species. Because of the close association between groundfish species, and often-rugged heterogeneous bottom substrata of varying relief, these resources are difficult to assess using conventional survey techniques. Also, the broad spatial extent of these fisheries combined with the lack of habitat-specific estimates of abundance generally has precluded careful examination of the nature of the exploited habitats, the relationships among species and habitats, and the degree to which fishing activities have affected these habitats.

Recently, a number of regional west coast research programs have begun to build a foundation for a systematic approach to classification of marine habitats in both shallow and deep water. In small specific geographic areas, the relationship between groundfish assemblages, and these habitats has been delineated using in situ methodologies, and in some cases, using remote geophysical mapping tech-

niques. The challenge is now to efficiently relate small-scale observations and assessments of animal-habitat associations to the large geographic scales on which demersal fisheries operate. Large-scale seafloor habitat characterization is critical to the accurate assessment of groundfish populations on a spatial scale pertinent to animal distributions, fisheries and those physical, biological and anthropological (e.g., fishing gear impacts) processes that influence them. The above considerations led to the formation of an interdisciplinary team of researchers from the NW and SW Fisheries Science Centers, the Pacific Marine Environmental Laboratory, Oregon State University, Washington State University, and a host of other government, academic, and private institutions, and the writing of a successful proposal to initiate a project to study Heceta Bank, Oregon.

Heceta Bank is the largest of the heavily fished rocky banks on the outer continental shelf off Oregon. Since the late 1980s 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 abundance of rockfish (genus *Sebastes*) and other benthic populations of fishes and 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 in review with Fishery Bulletin). The third phase of the study
is represents an on-going NOAA NURP program (West Coast and Polar Regions Undersea Research Center) to conduct an interdisciplinary and comprehensive study of the habitats of the Bank, using state-of-the-art survey strategies, instrumentation, and data analysis. The project is focusing 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? In June 2000, a diverse team of marine geologists, fisheries scientists, invertebrate biologists and ecologists, conservation biologists, commercial fisherman and educators, participated in a 10-day cruise aboard the R/V *Ronald Brown* with the ROPOS remotely operated vehicle (ROV)and two-person submersible Delta to Heceta Bank. The ROV and submersible were used to explore and intensively sample five of the original treansect sites in addition to extensive transects over new areas identified on the seafloor imagery. In the months following the cruise, the interdisciplinary group of scientists involved in the Heceta Project continued to work on the data and samples collected in preparation for their second field season in June / July 2001.

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, please contact Waldo Wakefield at (541) 867-0243 or Waldo.Wakefield @noaa.gov.

7) Economics Research Program

During 2000, 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, particularly in the areas of fleet capacity estimation, fixed-gear sablefish management, and strategic plan development. The program also addresses requirements of the Regulatory Flexibility Act, including community impact analyses of proposed and alternative management options.

For more information please contact Dr. Jim Hastie at jim.hastie@noaa.gov or (206) 860-3412.

8) Predation Studies

Since 1998 the Fish Ecology Division has been surface trawling off the Columbia River for predatory fishes that may be feeding on salmonids. All trawling was conducted at night to capture the nocturnally migrating Pacific hake. Potential predatory fishes include Pacific hake, Pacific mackerel, jack mackerel, and dogfish shark. Preliminary analysis showed two incidents of hake feeding on salmon. However, this may have been net feeding. No other predatory fishes were found to feed on salmonids. Baitfish abundance (sardine, smelt, and anchovy) may play an important role as alternative prey (instead of salmonids). Abundance of Pacific hake declined significantly in 1999 and 2000, probably related to cooling ocean temperatures.

For more information, please contact Dr. Robert Emmett at robert.emmett@noaa.gov or (541) 867-0109.

9.) Fishing Industry and Research Scientists Together (FIRST) Project

The Fishing Industry and Research Scientists Together (FIRST) Project was a

cooperative project involving the National Marine Fisheries Service (NMFS), Oregon seafood processing plants, and the Oregon Department of Fish and Wildlife (ODF&W). This study was an Oregon State University thesis project which explored the feasibility of implementing a more comprehensive cooperative sampling program for Pacific West coast groundfish in the future with the goal of improving the precision and accuracy of estimates derived from the samples.

Fishery dependent data—length distributions, sex ratios, maturity schedules, and species composition of landed catches—are necessary for stock assessments. These data are currently collected by state port biologists using a sampling design that randomly selects samples from a small percentage of a very large target population. Sampling programs may need to increase the sample size and possibly expand data collection times into evenings and weekends. This must also be accomplished in an economically reasonable manner, which is a significant challenge. Working cooperatively with the seafood processing plants is one way to meet these challenges.

The FIRST Project explored the feasibility of implementing a cooperative sampling program for Pacific West Coast groundfish, with the goal of improving the precision and accuracy of estimates derived from the fishery dependent samples. The study was a cooperative project utilizing seafood processing plant workers to collect fish length frequency data. There is evidence that the seafood plant workers can measure fish with reasonable accuracy. This cooperative effort has the potential to dramatically increase the sample size and the coverage of sampled catch landings.

For more information please contact Tonya Builder at *tonya.builder@noaa.gov* or at (541) 867_0237.

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