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

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

Thirty-Second Annual Meeting

June 4 - 6, 1991
Newport, Oregon

Prepared by:

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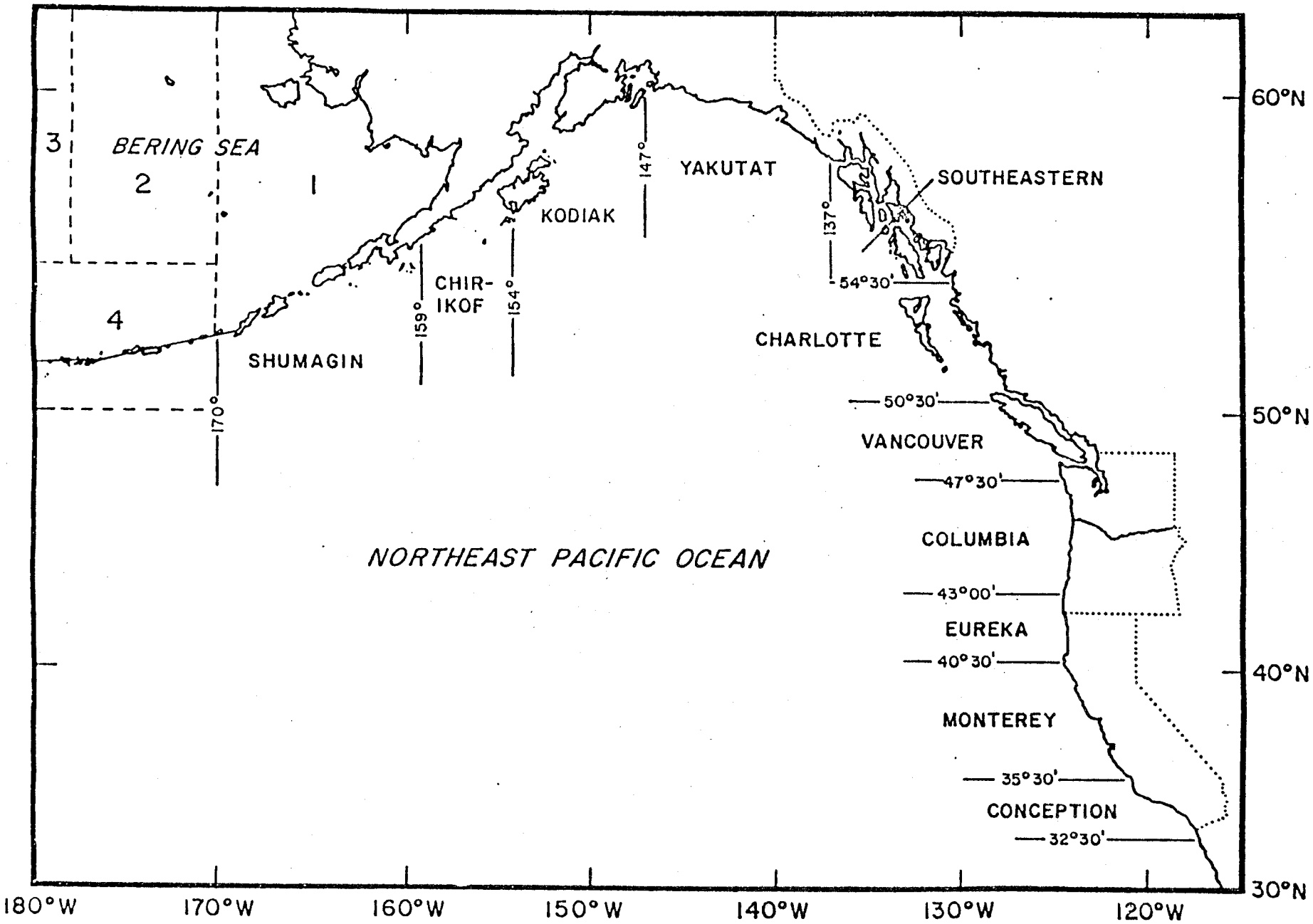
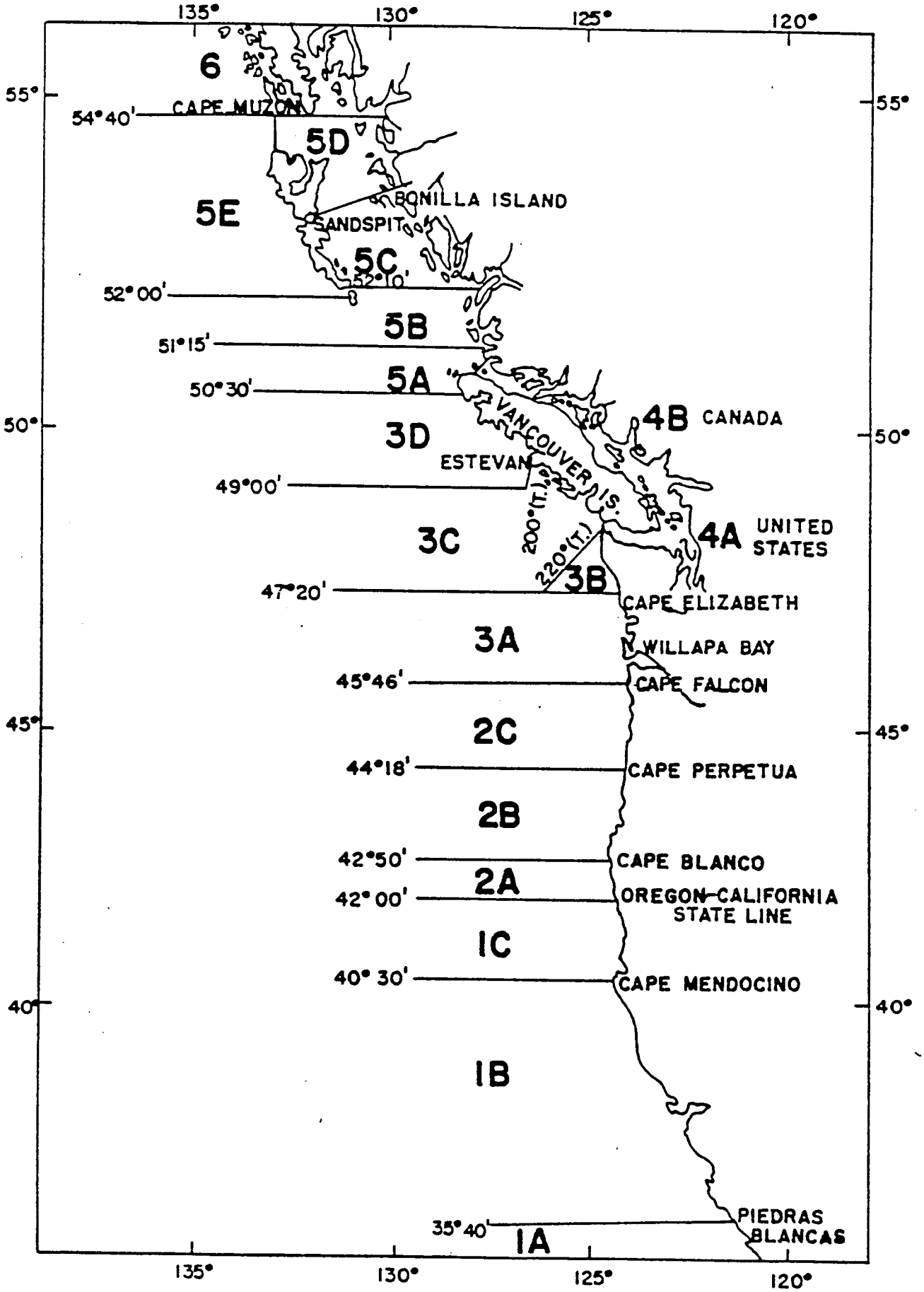
Oregon Department of Fish and Wildlife
Marine Region
Newport, Oregon

March 1992

Figure 1.--Statistical areas of the eastern Bering Sea and northeastern Pacific.




135°
130°
125°
120°
55°
50°
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40°
6
5D
5E
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CANADA
3D
4A
UNITED
STATES
3C
3B
3A
2C
2B
2A
1C
1B
1A
CAPE MUZON
54°40'
BONILLA ISLAND
SANDSPIT
52°10'
52°00'
51°15'
50°30'
ESTEVAN
49°00'
VANCOUVER IS.
200°(T.)
220°(T.)
47°20'
CAPE ELIZABETH
WILLAPA BAY
45°46'
CAPE FALCON
44°18'
CAPE PERPETUA
42°50'
CAPE BLANCO
42°00'
OREGON-CALIFORNIA
STATE LINE
40°30'
CAPE MENDOCINO
35°40'
PIEDRAS
BLANCAS

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LIST OF APPENDICES

I. CALL TO ORDER

Chairman, Mr. Mark Wilkins called to order the 32nd Annual Meeting of the Technical Subcommittee at 0808 hours on June 4, 1991, at Hatfield Marine Science Center Library in Newport, Oregon.

II. APPOINTMENT OF SECRETARY

Mr. William Barss of the Oregon Department of Fish and Wildlife, Newport, Oregon, was appointed to serve as secretary.

III. INTRODUCTIONS

Members and invited participants introduced themselves. Participants are listed below by agency, with members indicated by asterisks. A complete list of names and addresses of those attending is included as Appendix A.

Canada - Department of Fisheries and Oceans (DFO)

Biological Sciences Branch
* Mr. Mark Saunders

Fisheries Branch
Mr. Edward Zyblut

United States

National Marine Fisheries Service

Auke Bay Laboratory
Mr. Dave Clausen

Alaska Fisheries Science Center (AFSC)
* Mr. Mark Wilkins
Ms. Julie Pearce

Southwest Fisheries Center (SWFC)
Dr. Alec MacCall

Alaska Department of Fish & Game (ADFG)
* Mr. Barry Bracken

Washington Department of Fisheries (WDF)
* Mr Tom Jagielo

Oregon Department of Fish and Wildlife (ODFW)
* Mr. Bob Demory
Mr. Bill Barss (Secretary)
Mr. Mark Saelens
Ms. Claire Wood

California Department of Fish & Game (CDFG) - Not Represented

Pacific Fishery Management Council (PFMC)
Mr. Jim Glock

North Pacific Fisheries Management Council - Not Represented

Pacific States Marine Fisheries Commission (PSMFC)
Mr. Guy Thornburgh

International Pacific Halibut Commission
Mr. Calvin Blood

IV. APPROVAL OF THE 1990 REPORT AND THE 1991 AGENDA

The 1990 Report was in draft form and reviewed by TSC members for later approval. Mr. Bracken requested any suggestions for report changes be submitted as soon as possible. Several corrections were suggested during the meeting, and the report was subsequently approved with changes. TSC commended Mr. Bracken and ADFG staff for an excellent job.

The agenda was modified as presented in Appendix B and adopted.

V. TERMS OF REFERENCE

No changes in the terms of reference of the Technical Subcommittee were proposed. The Terms of Reference of the Technical Subcommittee 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 U.S. governments and encourage implementation of these recommendations.

VI. WORKING GROUP REPORTS

A. C.A.R.E.

The C.A.R.E. (Committee of Age Reading Experts) report was provided by Chairperson Craig Kastelle and presented to TSC by Vice Chair Mr. Barss. The full report is included as Appendix C.

C.A.R.E. meets on a two year schedule, and no formal meeting took place since the last T.S.C meeting. The next meeting is tentatively scheduled for a date just prior to the next T.S.C. meeting and Is expected to occur in May 1992.

The report included a summary of activities by C.A.R.E. members since the last report including calibration exchanges and workshops between agencies. The report also provided a list of possible topics for a May 1992 meeting of C.A.R.E., and requested T.S.C. recommendations for meeting topics and committee activities.

There was a general discussion on species of special concern regarding age and activities by agencies that are related to the C.A.R.E. area of concern. Species of special interest by TSC were Thornyheads (longspine and shortspine), Dover sole, sablefish and arrowtooth flounder.

Ms Pearce said that NMFS/REFM will start looking at thornyheads from samples collected by the NOAA ship Miller Freeman.

Mr. Saunders stated that he would like to see routine exchanges of aging structures from all commercial groundfish species.

Mr. Clausen said that they are losing an ager, so NMFS will need to train and recalibrate age determination by a new person. He also asked the rhetorical question "are sablefish ages any good?"

There was a general discussion regarding age determination activities and recommendations to CARE. Mr. Demory stressed the importance of validation studies and was assigned to draft a TSC recommendation regarding validation studies. The group further discussed which flatfish species were being aged now and which species needed validation. Validation is presently being conducted on halibut and English sole. Validation or additional validation was suggested for Dover sole, petrale sole, English sole and arrowtooth flounder.

Dr. MacCall suggested that the La Jolla lab be encouraged to participate in CARE and share their work on thornyheads and Dover sole. He also suggested that the CARE meeting include a hands-on workshop to look at otoliths, possibly on the last day of the meeting for those who wished to attend.

Discussion was made regarding CARE workshops. Mr. Demory stated that TSC should encourage regional get togethers on aging fish. Mr. Wilkins said that they should encourage exchanges of dialogue on aging of transboundary species, the establishment of comparable criteria, and exchanges of aging structures.

Dr. MacCall stated that Dr. Methot could speak to CARE with regard to statistical validation.

Dr. MacCall and Mr. Barss were selected to coordinate TSC recommendations to CARE.

B. PacFIN - PSMFC Data Series Project

There was a general discussion of PacFIN. The group discussed the usefulness of Van Houten's report on the data series up to 1980. PacFIN reports are now being used by TSC members as a base for their reports regarding landings. TSC was very complimentary of PacFIN.

There was a discussion on the two data bases provided by PacFIN. The PacFIN Management Data Base which is maintained in Seattle, and the Pac FIN Research Data Base which is maintained in LaJolla. MacCall suggested tying port sampling into the Research data base as a useful change. He also mentioned that PacFIN staff did not want to add sampling information, effort data or logbook data into their system at this time.

C. Stock Assessment Groups

1. Yellowtail Rockfish

The report from the working group on Yellowtail Rockfish Fisheries by Tagart and Stanley was given by Mr. Saunders. He summarized the report by saying that samples indicated that there were discrete stocks of yellowtail rockfish and that there was a transboundary stock. The working group would like additional samples from California. The full report is given in Appendix D.

It was mentioned that Mickey Eldridge could provide samples of California yellowtail rockfish.

Mr. Demory spoke about a study conducted by Dr. Bill Pearcy of Oregon State University (retired). His work with radio tagged yellowtail rockfish showed

dynamic vertical migrations of fish near Heceta Bank. Mr. Barss added more details about Dr. Pearcy's project. Some tags provided information on the depth of the fish. Fish were tracked from surface ship and submersible.

2. Pacific Whiting (Hake)

   The report from the working group was given by Mr. Saunders. The full report is given in Appendix E.

   Mr. Saunders stated that exchange of information on hake was necessary for assessment. The big issue was transboundary allocation. They were trying to establish a biological basis for allocation. There was no agency agreement on a split of the allocation between Canada and U.S.

   Research put the ABC at 257,000 mt in 1990, and the 1980 and 1984 year classes were strong and supported the fishery. There have been no strong year classes since 1984, so the stock has been stable or will decrease slightly. The estimated biomass is 1.6 million mt, which is down 24%. The expected over harvest for 1991 will be 29% of the ABC, but this is within the area of risk and within acceptable bounds.

   Mr. Zyblut stated that the allocation question is now being handled at the national level between governments.

   Mr. Jagielo said that WDF was reviewing its involvement in TSC, because the agency was frustrated with TSC's inability to resolve transboundary issues without going to the National level. Since TSC was not resolving management issues on hake and yellowtail rockfish, WDF was reconsidering its involvement with TSC.

   Mr. Zyblut and Dr. MacCall agreed that technical services by TSC were good and that biological issues received proper analysis by TSC.

   Mr. Demory stated that if the nations did not cooperate, the result would be small catches over time.

3. Dover Sole (particularly with regards to age validation)

   The report from the working group was given by Mr. Demory. This topic was not on the original agenda, so the report was verbal.

   The lack of age validation is a primary concern for Dover sole. In the summer of 1992, NMFS will conduct a flatfish survey which offers an opportunity to conduct an experiment which could validate age determination methods for several flatfish species including Dover sole. He suggested OTC injections of flatfish that are tagged with external tags.

Mr. Wilkins said that AFSC would conduct surveys in 1992. One would be a near shore flatfish survey conducted from Pt. Conception to the Canadian border at depths of about 15 to 100 fathoms. The second survey would be the triennial survey which is conducted in deeper water (30-200 fm).

Mr. Saunders said that he would like to see Canadian cooperation in the flatfish survey up to La Perouse Bank, especially covering the petrale sole area.

Dr. MacCall said the protocol is now known for getting authorization for OTC. We should include mention of the low catch rate of tagged fish when asking for authorization. He also said that the bone die calcein is showing promise for marking bones, and it fluoresces like OTC. He suggested writing him for details on calcein. Information on calcein can also be obtained from a report by C.A. Wilson D.W. Beckman and J.M Dean (1987) titled "Calcein as a flourescent marker of otoliths of larval and juvenile fish" published in TAFS 116:668-670.

Mr. Demory said that there have been three meetings on Dover aging. The next meeting should be in 1992. Precision was still a problem. Some success had been made in using resin for permanent storage of burned otoliths. Color photographs of otoliths (burned sections or thin sections) also made a good record.

4. Others

No report was given.

VII. REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENTS, MANAGEMENT, AND FISHERIES

A. Agency Overview

1. Alaska Department of Fish & Game

Mr. Bracken provided an agency overview of ADF&G.

a. Description of the State of Alaska Groundfish Program:

The Alaska Department of Fish and Game (ADF&G) has management jurisdiction over all groundfish fisheries within the internal waters of the state and to three miles from shore along the outer coast. In addition, a provision in the federal Gulf of Alaska Groundfish Fishery Management Plan gives the State of Alaska limited management authority for demersal shelf rockfish in the federal waters east of 137° W longitude.

The State of Alaska is divided into three maritime regions for marine fisheries management. For groundfish management the Southeast Region extends from the fisheries conservation line in Dixon Entrance north and westward to 147° W. Longitude. The Central Region includes the internal waters of Prince William Sound, Cook Inlet, and Bristol Bay. The Westward Region includes all territorial waters of the Gulf of Alaska west of 147° W. Longitude and the Bering Sea.

With the exception of the waters of Southeast Alaska, Prince William Sound, and Cook Inlet, all groundfish fisheries were managed in conjunction with the federal management of the adjacent Exclusive Economic Zone (EEZ) during 1990. The information related in this report are from the state-managed fisheries only.

1). Southeast Region

During 1990 the Southeast Region commercial fisheries Groundfish Project was staffed with the project leader in Petersburg, an assistant project leader and a resource assessment coordinator in Sitka, and part-time port samplers in Petersburg, Ketchikan, and Yakutat. In addition, an age reader in Kodiak was funded by the Southeast Region for part of the year.

The Southeast Region's groundfish project has responsibility for research and management of all commercial groundfish resources in territorial waters of the Eastern Gulf of Alaska. The project also cooperates with the federal government for management of the waters of the adjacent EEZ and the project leader participates as a member of the Gulf of Alaska Groundfish Plan Team.

Project activities center around fisheries monitoring and in-season management of the groundfish resources based on data collected from the fisheries and from resource assessment surveys. Primary tasks include fish ticket collection, editing, and data entry for both state and federal-managed fisheries; dockside sampling of lingcod and rockfish landings; skipper interview and logbook collection and data entry; and biological studies of important commercial species. Three resource assessment surveys were completed during the year. Regulation development and review and information dissemination also require considerable staff time.

2) Central Region

During 1990 the Central Region was staffed by one Biologist and a fish ticket editor in Homer. Both of these persons worked only part time on

groundfish issues. The only active management program conducted in the region was the monitoring of the Prince William Sound sablefish fishery.

3) Westward Region

In the Westward Region a Shellfish/Groundfish Coordinator was responsible for the oversight of fish ticket data entry and integration of data analysis of groundfish data from shellfish stock assessment surveys.

4) Headquarters

ADF&G personnel continued to enter fish tickets from the EEZ off Alaska during 1990 as the result of a renewed cooperative agreement with the National Marine Fisheries Service (NMFS) to accomplish that task. Fish tickets from all groundfish fisheries in federal waters were collected, edited, and entered on microcomputers by ADF&G personnel in five coastal communities. A programmer analyst working in the NMFS Regional Office in Juneau was responsible for setting up and maintaining the master database and for providing summary groundfish catch information to NMFS, ADF&G and PacFIN.

Names, titles, and addresses of full-time state groundfish personnel are shown as follows:

ALASKA DEPARTMENT OF FISH AND GAME
PERMANENT FULL-TIME GROUNDFISH STAFF DURING 1990

HEADQUARTERS

State-wide Groundfish Biometrician	David Carlile Box 3-2000 Juneau, AK 99802
Fish Ticket Programmer/Analyst	Galen Trombel Box 3-2000 Juneau, AK 99802

SOUTHEASTERN REGION

Project Leader	Barry E. Bracken P.O. Box 667, Petersburg, AK 99833

Port Biologist	Victoria M. O'Connell 304 Lake St. RM 103 Sitka, AK 99835-7563

CENTRAL REGION

Groundfish Biologist	William R. Bechtol 3298 Douglas Street Homer, AK 99603

WESTWARD REGION

Shellfish/Groundfish Coordinator	William Nippes 211 Mission Rd. Kodiak, AK 99615

b. Groundfish Management (General):

State groundfish fisheries are managed by the Department of Fish and Game under regulations set biennially by the Board of Fisheries. The department announces the open and closed fishing periods consistent with the established regulations, and has authority to close on-going fisheries for conservation reasons. The department also cooperates with NMFS for opening and closing fisheries which are managed jointly.

Fish tickets are required by regulation for all onshore landings to Alaskan ports and for all landings from state-managed fisheries. The catch data from the fish tickets is used as the primary means of tracking the in-season harvest levels. Fish tickets are collected from as many as thirty or more processors which accept groundfish within the state. The fish tickets are edited for accuracy and the data is entered on microcomputers in Petersburg, Sitka, Ketchikan, Homer, and Kodiak. Because of the intensity of many of the groundfish fisheries, a "soft data" accounting system using processor contacts is also utilized when necessary to track landings during a season.

c. Groundfish Research (General):

Groundfish research is currently being conducted by ADF&G only in Southeast Alaska. Groundfish research is divided into two major components; port sampling/ skipper interviews and resource assessment.

During 1990 port sampling and skipper interview programs were conducted in Sitka, Ketchikan, and Petersburg. Port sampling provides biological information from the landed catch and in recent years has been restricted to landings of rockfish, flatfish, and lingcod. This component

provides information on species composition and AWL data from important commercial species by management area. It also provides an opportunity to collect sex ratios and reproductive status from round deliveries of rockfish. Skipper interviews are conducted for landings of the key groundfish species. Interview effort concentrated on the state-managed sablefish, rockfish, and lingcod fisheries during 1990. This program is designed to provide detailed location and effort information which, when coupled with the fish ticket data, provides an estimate of CPUE for the landed catch by management area.

Three groundfish resource assessment surveys were conducted by ADF&G in Southeast Alaska during 1990. Two were designed to assess the relative abundance of sablefish and the other was designed to determine the relationship between near-shore rockfish species composition and abundance and habitat type. A more complete description is included in the sections on those species.

Catches of groundfish species are also monitored routinely during stock assessment surveys for other species. That information provides an indication of population trends for some commercially important groundfish species which are not assessed directly. Two surveys in particular, the Kodiak area-Alaska Peninsula crab trawl assessment survey and the Southeast area crab pot indexing survey provide information of the relative abundance and length frequency of commercial groundfish species such as flatfish, Pacific cod, and pollock.

2. Washington Department of Fisheries

Mr Jagielo presented the agency overview for WDF.

In 1991, the Washington Department of Fisheries Marine Fish Program merged with the Washington Department of Fisheries Shellfish Program. The program is called the "Marine Fish and Shellfish Program" (MF/SF Program). The new organizational structure includes a Puget Sound Marine Fish/Shellfish Division, a Coastal Marine Fish/Shellfish Division, and a Technical Services Division.

a. Coastal Marine Fish Management.

Coastal Marine Fish Management occurs within the Coastal MF/SF Division. This Division is responsible for management and research of groundfish in all coastal waters and in the outer Strait of Juan de Fuca. The Division also handles all issues requiring interstate, regional, federal or international cooperation. Division responsibilities include membership on the Groundfish Management Team (GMT) of the Pacific

Fishery Management Council (PFMC), membership on the Science and Statistical Sub-Committee (SSC) of the North Pacific Fishery Management Council, multi-jurisdictional management and stock assessment of groundfish stocks in state waters (0-3 miles) and in the Fisheries Conservation Zone (3-200 miles) adjacent to Washington, and joint research with other agencies or institutions on questions of mutual interest.

Effective management of the coastal groundfish stocks is primarily accomplished through membership on the GMT which develops annual estimates of "Acceptable Biological Catch" for major species/species groups and proposes management strategies to the PFMC. Division personnel implement Council decisions by drafting state regulations and coordinating state enforcement regarding groundfish management. Division personnel are stationed in major ports of landing to collect catch and biological data and other fishery related information.

b. Puget Sound Marine Fish Management.

The Puget Sound MF/SF Division defines Puget Sound as those waters east of the Sekiu River including the Strait of Juan de Fuca. Marine Fish management occurs in three units of this division: The Baitfish Unit, The Marine Fish Assessment Unit, and The Marine Fish Monitoring and Operations Unit.

The Baitfish Unit is responsible for all research and management of the baitfish resource; chiefly Pacific herring and smelt. The goal of this unit is to maintain sustainable yields of baitfish harvested by commercial and recreational fishermen. To achieve this goal the unit conducts extensive field sampling programs to determine annual spawning escapement, biological characteristics such as age, size and maturity of the fish, and biomass estimates of the commercial catch. From analysis of the data collected, a management plan is formulated and regulations are implemented to allow for an efficient harvest and conservation of the species while minimizing conflict between user groups. In addition this unit is responsible for the definition and resolution of environmental issues affecting the spawning habitats of baitfishes.

The Marine Fish Assessment Unit is partially supported by a Wallop-Breaux Project. The goal of this unit is to evaluate specific groundfish stocks in order to manage at the stock level. This unit performs analysis of fishery and biological data from regional field surveys and a historical data bases to evaluate stock trends, and resource conservation problems. With consideration of these trends a management plan is developed, implemented and evaluated.

The goal of the Marine Fish Monitoring and Operations Unit is to maintain sustainable yields of groundfish species to the various user groups while providing for the conservation of harvested fishes and minimize conflict between user groups. The unit is subdivided in regional management units which are responsible for the management and operations in their region. These Units perform extensive field sampling and analysis of fishery and biological characteristics in order to insure orderly harvest. This section is responsible for the development and evaluation of management strategies, usually gear and time/area restrictions.

c. Technical Services.

The Technical Services Division performs specialized work in support of stock assessment and harvest management activities of the other MF/SF Divisions. Areas of work covered by Technical Services include: hydroacoustics, age determination, computer data processing, and habitat investigations.

The Hydroacoustics Unit conducts biomass surveys for marine fish stock assessment from our 37-foot boat, M/V Pasquile, with specialized on-board hydroacoustic equipment. Species and areas surveyed on an on going basis include: black rockfish coastwide; true cod in Agate Pass; herring in Bellingham Bay, Hood Canal, Gulf of Georgia, and South Puget Sound; whiting in Port Susan; and sockeye salmon presmolts in Lake Washington. Other activities include bottom mapping coastwide and testing of new dual-beam hydroacoustic gear that will potentially provide greater accuracy in correlating target strength with actual biomass.

The Age Determination Unit conducts microscopic examination of otoliths, spines, and other bony structures from marine fish samples to determine the age of specimens in support of marine fish stock assessment.

The Data Management Unit provides a variety of data processing services to the Marine Fish Program including: operating and maintaining our shared computer resources; user training and support; maintaining the WDF Fish Ticket, Otter Trawl Logbook, and Biological Sample Databases; and designing and implementing new computer applications, including a PC-based Geographic Information System (GIS).

The Habitat Unit conducts studies to evaluate marine habitat important to Marine Fish resources.

3. Oregon Department of Fish and Wildlife

Mr. Demory gave the agency overview of ODFW. He described ODFW,s Habitat Mapping Program and its usefulness to display catch, value and port activity.

Oregon Department of Fish and Wildlife was involved with two stock assessments in 1990. These were canary rockfish and Dover sole. The assessment of canary rockfish completed an in-house assessment that had been underway for a three year period. The assessment of Dover sole was done in cooperation with AFSC and CDFG. We also supported an OSU graduate student who had undertaken a project on petrale sole.

4. Canada

Mr. Saunders provided an agency overview for PBS. Groundfish research and assessment activities are conducted by staff of the Groundfish Section at the Pacific Biological Station (PBS), Nanaimo, B.C. Canada. The Groundfish section is part of the Biological Sciences Branch of the Department of Fisheries and Oceans (DFO). Management and enforcement of groundfilsh resources are the responsibility of the Fisheries Branch of D.F.O.

PBS Groundfish Section Staff in 1990 are as follows:

Section Head, Groundfish	G. A. McFarlane
W. Andrews	Sablefish, hake, dogfish & pollock
K. Cooke	Hydroacoustics
J. Fargo	Hecate Strait/flatfish
G. Gillespie	Rockfish
C. Hand	Inshore rockfish and lingcod
P. Hoffas	Statistics/sampling
T. Johansson	Statistics/sampling
R. Kieser	Hydroacoustics
B. Leaman	Rockfish
W. Mitton	Sablefish, hake, dogfish & pollock
C. Neville	Strait of Georgia
L. Richards	Inshore rockfish and lingcod
K. Rutherford	Statistics/sampling
M. Saunders	Sablefish, hake, dogfish & pollock
R. Scarsbrook	Strait of Georgia
M. Smith	Sablefish, hake, dogfish & pollock
R. Stanley	Rockfish
B. Thomson	Strait of Georgia
A. Tyler	Hecate Strait/Pacific cod
N. Venables	Statistics/sampling
G. Workman	Inshore rockfish and lingcod

5. National Marine Fisheries Service - AFSC

Mr. Wilkins presented an agency overview for AFSC.

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), which is responsible for groundfish assessment in the Gulf of Alaska east of Cape St. Elias. 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. Recent publications produced by RACE, REFM, and ABL scientists will be presented at a later date as Appendix I.

a. RACE Division

In 1990 the primary activity of the RACE Division continued to be fishery-independent stock assessments of important groundfish species of the northeast Pacific Ocean and Bering Sea. Groundfish surveys were conducted by the Bering Sea, Gulf of Alaska, and West Coast subtasks. There were three bottom trawl surveys and two longline surveys conducted in 1990. Major emphasis was in the Gulf of Alaska, in keeping with the rotation of comprehensive surveys among three major geographic areas on a triennial basis. Hydroacoustic echo integration/midwater trawl surveys were conducted to assess spawning pollock stocks in the Gulf of Alaska in 1990 and early 1991. The focus will be in the Bering Sea and Aleutian Islands in 1991, including two US trawl surveys, cooperative trawl surveys aboard a Soviet research ship, and a hydroacoustic survey of the Aleutian Basin pollock stock.

b. 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 U.S. 200-mile Exclusive Economic Zone (EEZ) of the northeast Pacific Ocean and Bering Sea. Specifically, REFM's activities are organized under the Foreign Fisheries Observer Program and the following tasks: Age and Growth Studies, Socioeconomic Assessments, Resource Ecology and Ecosystems Modeling, and Status of Stocks and Multispecies Assessments. The work of these tasks culminates as technical reports and advice to the appropriate fishery management councils and international fisheries commissions. 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. Three stock assessment documents were prepared for West Coast stocks and 15 assessments were prepared for Gulf of Alaska and Bering Sea/Aleutian Islands stocks

c. NMFS - AFSC - Auke Bay Laboratory

In 1990, ABL's groundfish task participated in three resource assessment surveys in the Gulf of Alaska: 1) the 1990 triennial trawl survey in the eastern Gulf of Alaska, 2) the annual Japan-U.S. cooperative longline survey, and 3) the annual domestic longline survey. ABL also conducted joint research projects with the Alaska Department of Fish and Game (ADF&G) using the NOAA RV Townsend Cromwell. The Cromwell studies included a sablefish mark-recapture experiment in Clarence Strait, southeastern Alaska, and sablefish/rockfish early life history studies in offshore waters of the eastern Gulf of Alaska. Other research activities included an on going sablefish tag recovery program, juvenile sablefish studies, a sablefish food study, and an analysis of a 1989 experiment to estimate catchability of sablefish on survey longline gear. Groundfish task members also prepared three status of stock documents for the Gulf of Alaska: sablefish, slope rockfish, and pelagic shelf rockfish.

6. Pacific Fishery Management Council

Mr. Glock gave the agency overview for PFMC and highlighted major changes in 1990.

a. A major Plan Amendment provided for management plan changes through a Framework approach rather that the Amendment process.

b. The ABC for Pacific whiting was allocated between vessels that process and vessels that do not process, and there was a reserve established to meet shoreside processing needs.

c. The State of California is seeking to have its gillnet law affect both state and federal waters off California. PFMC is determining consistency of that law with the Groundfish Management Plan. The larger question is whether public demand can set fishery and PFMC policy.

d. Sablefish issues continue to be problems especially with Alaskan fixed gear vessels in the fishery.

e. Legal minimum mesh size for bottom trawl codends will be 4.5 inch between knots sometime after July 1, 1991.

f. Attendance by NPFMC at TSC is encouraged.

7. National Marine Fisheries Service - SWFC

Dr. MacCall provided an agency overview of SWFC.

Groundfish-related research is conducted by three major components of the NMFS Southwest Fisheries Science Center (SWFSC): the Coastal Division (La Jolla), directed by Dr. John Hunter; the Pacific Fisheries Environmental Group (Monterey), directed by Dr. Andrew Bakun; and the Tiburon Laboratory (Tiburon), directed by Dr. Alec MacCall.

a. Coastal Division (La Jolla)

The Coastal Fisheries Resources Division has been involved in three areas of groundfish research to support the management needs of the Pacific Fishery Management Council and to establish a firm basis for future research and optimum management.

Documentation of the distribution of groundfish spawning is being accomplished by analysis of fish eggs and larvae in historical CalCOFI plankton samples. This effort will aid future attempts to measure species abundance by egg and larvae surveys. Studies of environmental effects on recruitment also depend upon an accurate assessment of the spawning distribution in time and space.

The Division has initiated three projects designed to improve management of thornyhead (Sebastolobus spp.) stocks. The first project is a joint effort involving scientists at Scripps Institution of Oceanography that involves use of radioisotope ratios to validate criteria used to age shortspine thornyhead. The second project is an assessment for shortspine and longspine thornyhead in the Eureka area [INPFC areas 1C and 2A] (Jacobson 1990). An analysis of national and international economic factors that affect the fishery for thornyheads is also underway.

Two manuscripts were completed on estimating the biomass of Dover sole from ichthyoplankton and trawl data using a new approach called the fecundity reduction method. A manuscript describing relationships between biological characteristics of Dover sole and depth was published (Hunter et al. 1990) and information in this paper is currently being used in stock assessment work.

In cooperation with the SWFSC Tiburon Laboratory, the Coastal Division began field work to evaluate use of remotely operated underwater vehicles (ROV's) to estimate biomass of fish stocks (including Dover sole, thornyheads and sablefish) on the continental slope (200 to 1500 m). Visual transects recorded on video equipment were completed off Monterey in April aboard the Navy submersible Turtle and using a ROV developed by the Monterey Bay Aquarium Research Institute. The NMFS research vessel David Starr Jordan will trawl over the same ground later this year so that trawl data can be compared to data obtained by direct visual observation and video records. These studies are intended to develop new, cost effective means for measuring biomass, provide information about ecology of the slope community and help improve trawl based biomass estimates.

A molecular genetics project was begun this year to determine if genetic differences exist in species comprising the slope complex along the west coast of the U.S. and Alaska. Specimens have been collected and appropriate mitochondrial DNA methods have been developed. These studies will assist in identifying the optimal management unit for species in the slope complex and may indicate the extent to which recruitment is dependent on spawning in other regions.

Physiological studies of species in the slope complex were begun this year. These studies will result in development of energy budgets and identification of physiological characteristics that limit bathymetric distributions and movements of slope species. The research will lead to improved understanding of productivity on the slope and ecological consequences of fishing.

Coastal Division economists regularly develop and analyze information regarding the commercial and recreational groundfish fisheries off the Pacific Coast, emphasizing the California region. Regular data collection activities include the periodic updating of cost and earnings data for groundfish trawlers, fuel prices, and economic indices of trawl fishery productivity. The relevant multispecies/multifactor productivity theory is published in Dale Squire's NOAA Technical Report NMFS 67 ("Index numbers and productivity measurement in multispecies fisheries: An application to the Pacific Coast trawl fleet," July 1988). Pacific Coast trawl fleet harvest capacity was examined in SWFC Admin. Report LJ-88-24 (D. Squires and D. Huppert, October 1988, "Measuring harvest capacity in the Pacific Coast groundfish fleet"). Currently underway are modelling efforts which (1) examine the economical consequences of alternative allocations of sablefish between trawl and fixed gear fleets; and (2) a coastwide quadratic programming model which will evaluate shore-term economic effects of fishery regulations.

The Coastal Division's biological research is supplemented by economic investigations, particularly recreational fishery surveys, analysis of management options, and economic

characterization of groundfish fisheries. A manuscript describing the Southern California Angler Survey was completed that provides information about fishing effort, travel costs, ethnic participation, target species, and catch rates for the recreational groundfish fisheries. A similar survey for U.S. anglers in Mexican waters is currently underway. Two reports dealing with productivity in the multispecies common property groundfish fishery were published (Herrick and Squires 1990; Squires, D. 1990. Productivity measurement in common property resource industries: theory and application. SWFSC Admin. Rep. LJ-90-18), one report describing the groundfish and pink shrimp fishery (Squires, D., C. S. Korson, and J. C. Lanfersieck. 1990. Overview of the Pacific coast groundfish and pink shrimp fisheries, 1981-1989. SWFSC Admin. Rep. LJ-90-17), and a paper dealing with capacity utilization in the groundfish fishery (Squires 1990).

b. Pacific Fisheries Environmental Group (Monterey)

Pacific Fisheries Environmental Group (PFEG) develops methods to address the linkages between natural environmental variability and fish populations dynamics. Data series developed within the PFEG research program are made available to scientific collaborators. Co-location with the U.S. Navy's Fleet Numerical Oceanography Center provides access to ocean and atmospheric data on a global scale. The development of the NOAA Center for Ocean Analysis and Prediction (COAP) in Monterey is expected to enhance this data resource. Major categories of scientific activity at PFEG include: (1) Development of environmental index time series, (2) ocean anomaly diagnostic studies, (3) identification of environmental-biological causal linkages through interregional comparative studies, exploratory data analysis, empirical modeling etc., (4) development of appropriate environment-dependent fishery modeling methodologies, (5) development of biological time series for calibration, verification and parameter estimation. A major new research thrust for the coming several years will address effects of global climate change on the environment off the western U.S. In addition, PFEG oceanographic support of field

studies of the groundfish reproductive habitat will be strengthened by newly-acquired current profiling instrumentation.

c. Tiburon Laboratory (Tiburon)

Groundfish research at the Tiburon Laboratory is conducted by three interrelated investigations: Groundfish Analysis, Groundfish Communities and Groundfish Physiological Ecology.

The Groundfish Analysis Investigation develops methods to predict rockfish recruitment, sample groundfish landings and age groundfishes; staff members also study rockfish life histories, develop new management models and conduct stock assessments. In addition, there is participation on the Pacific Fishery Management Council's Groundfish Management Team and Scientific and Statistical Committee, principally in stock assessments and exploring management alternatives.

Recent publications include three data summaries from the recruitment cruises, a paper on harvesting policies for multi-species fisheries, and a paper on sexual dimorphisms of rockfish. Two papers on the early growth of rockfish and a paper on the dynamics of shortbelly rockfish are in press. Journals have indicated that papers on the diet of pelagic juvenile rockfish and depth distribution of pelagic juvenile fish will be accepted after minor revision.

The recruitment work, which aims to detect differences in relative strength of rockfish year-classes prior to their entry into the fishery, continues. Annual surveys using midwater trawls determine the relative abundance and distribution of first-year juvenile rockfishes off the coast of central California. Recently these surveys were expanded to include abundance and growth during an earlier larval stage. Factors that influence year-class strength are another area of study. In this work, staff members are evaluating interannual variation in oceanographic conditions, plankton abundance, juvenile rockfish diet, time of spawning, and growth rate. Oceanographic data are collected with a CTD and an acoustic doppler current profiler. Staff

members collaborate with staff of the PFEG in analyses of the oceanographic data.

A pilot study is being conducted to investigate the feasibility of estimating spawning biomass of shortbelly rockfish from larval production. A plankton cruise and two adult cruises were made in early 1991. Specimens are now being processed and we hope to complete a preliminary report by early 1992.

Work continues on simulations of stock assessments and management. A recently completed study that compares the utility of different types of auxiliary data is out for review.

Rockfish landings have been sampled since 1977 in a cooperative program with the California Department of Fish and Game. Since 1986 staff members have coordinated an expanded coastwide port sampling of sablefish landings. This effort aims to determine the age composition of the sablefish catch as well as the catches of several commercially important rockfish species. The data from these landings are compiled with software developed by project members and routinely used in stock assessments. The recent stock assessments of bocaccio, widow rockfish, other rockfish and sablefish are in large part products of this work.

The major objective of the Groundfish Communities Investigation is to determine how changes in the environment affect the distributions, abundances and the relative success of recruitment in groundfish species. Changes considered include regular seasonal transformations of the habitat, as well as changes associated with irregular environmental events like El Ninos. Emphasis is on how these changes affect interspecific relationships, particularly those between predator and prey. Because prey populations fluctuate widely in response to habitat transformations, the ability of specific predators to accept alternate prey in the absence of preferred prey is a major topic of study. Information from these studies should help managers anticipate not only the effects of environmental change on the relative availability of prey, but also the impact of fisheries for such important prey as shortbelly rockfish and anchovies. In

addition, recruitment strength is thought to correlate with certain elements of environmental change, and so is another topic of study.

The investigation also contributes to assessments of the lingcod stock for the Groundfish Management Team of the Pacific Fishery Management Council, and conducts research based on comments made in response to the stock assessment document. Present studies include age validation, examination of the fishery and modeling the basis of what may be a disturbed sex ratio.

The Groundfish Physiological Ecology Investigation is designed to determine the inherent and environmental factors most affecting condition and reproduction of several rockfish species. Research emphasis is on factors affecting the ability of individual populations to grow, reproduce and survive in their environment. Annual and geographical comparisons are made between fish sampled at Cordell Bank off California, and more northerly populations off Oregon, Washington and British Columbia. Information is integrated with that from other Investigations to elucidate factors affecting recruitment.

Current research is focused on yellowtail rockfish. Work includes examination and analysis of adult and juvenile specimens collected from commercial and sport groundfish fleets, and from cruises aboard the David Starr Jordan. Results of analyses and supportive laboratory experiments are used to determine which important characteristics of condition and reproduction will be used to form measures of health and effective fecundity.

Studies are performed on different levels of biological organization and include bioenergetic patterns, examinations for diseases, parasites and malformations, proximate analysis of tissues, determination of serum nutrient dynamics and estimates of viable fecundity and egg production. Results are combined with oceanographic, climatic, and other data to determine environmental factors relating to condition and reproductive variability and to place species populations in the context of their habits.

Dr. MacCall added that Jack Mackerel is no longer under the groundfish plan. The Navy environmental data base is becoming available to users through COAP.

8. International Pacific Halibut Commission

Mr. Blood presented an agency overview of IPHC. Subsequently provided additional information for the TSC report is as follows.

1990 Removals:

The Pacific halibut fishery is affected by four major removal sources:

1) Commercial Fishery	- 61.2 million pounds
2) Bycatch	- 17.5 million pounds
3) Sport Fishery	- 5.9 million pounds
4) Wastage	- 3.3 million pounds

After reaching a peak biomass in 1986, the Pacific halibut resource is in decline. The rate of this decline has been approximately 5-10% per year and is expected to continue over the next several years.

Dr. MacCall commented that Pacific halibut are occasionally caught by California gillnet when the Pacific halibut season is closed. This presents a problem, since enforcement of the Pacific halibut season sometimes results in a virtual closure of the California halibut season in central California.

B. Review of Multispecies Studies by Agency

1. Washington Department of Fisheries

Mr. Jagielo stated that the growing importance of arrowtooth flounder drove a deep water complex (DWC) analysis by WDF. Martha Rickey produced the analysis which included Dover sole, sablefish, thornyheads and arrowtooth flounder in the DWC.

2. Oregon Department of Fish and Wildlife

Mr. Demory stated that ODFW has completed trip analysis on DWC. A substantial effort was made at an analysis of the deepwater complex fishery in

an effort to determine an appropriate trip limit for Dover sole in the Eureka-Vancouver area.

3. National Marine Fisheries Service - AFSC

Mr. Wilkins provided information of AFSC's three trawl surveys and other general programs.

a. Research activities

1) Bering Sea Crab - Groundfish Survey - A standard annual survey was conducted in the eastern Bering Sea from June to August 1990 to assess the abundance and biological condition of crab and groundfish. This was the 12th consecutive year in which this standard survey area, encompassing a major portion of the eastern Bering Sea continental shelf, has been sampled in this time series. For the third consecutive year the survey was performed aboard the chartered vessels Alaska and Ocean Hope 3. The two vessels sampled approximately 400 stations over an area of about 465,000 km2. In addition to catch data in numbers and weights for each species, 143,900 length measurements and 4,650 age structures were collected from the principal species. Other studies carried out during the survey were (1) collection of 7,857 stomachs from various groundfish species for food habit studies, (2) tagging of Pacific cod (Gadus macrocephalus) and red king crab (Paralithodes camtschatica) to study growth and migrations, (3) collection of blood samples from approximately 2,000 tanner crab (Chionocetes spp.) for studies of bitter crab disease, and (4) maturity data was collected for yellowfin sole (Limanda aspera) to study times and areas of spawning.

2) A Cooperative Bottom Trawl Survey US/USSR - This survey was conducted aboard the R/V Novokotovsk from May to July, 1990. The Novokotovsk sampled the same area as the U.S. vessel, although at a lesser density, but additionally sampled the northern eastern Bering Sea shelf and the northern portion of the Soviet Union continental shelf. This cooperative survey has provided the first set of

standardized data to study the distribution, abundance, and biological characteristics of groundfish and invertebrates in both the U.S. and U.S.S.R. Exclusive Economic Zones. Results of the cooperative survey showed that the two most abundant species of groundfish in the Soviet waters sampled (north of 60°N) were walleye pollock (Theragra chalcogramma) and Pacific cod. Catches of flatfish were much reduced in Soviet northern shelf waters compared to the eastern Bering Sea.

3) Bottom Trawl Survey of the Central and Western Gulf of Alaska - This survey was conducted between June 1 and September 12, 1990 aboard the chartered commercial trawlers Pat San Marie and Green Hope. It was the third comprehensive NMFS bottom trawl survey of central and western Gulf of Alaska groundfish resources. The survey has been scheduled to occur triennially since 1984. The survey in the central and western Gulf of Alaska was conducted by the AFSC's RACE Division; ABL had responsibility for completing the eastern Gulf of Alaska portion. In addition to the groundfish survey, a 4-day trawl survey to tag Pacific halibut (Hippoglossus stenolepis) was performed near the Canadian west coast in cooperation with the International Pacific Halibut Commission (IPHC).

The triennial groundfish surveys were designed to assess and monitor the abundance, distribution, and biological condition of various groundfish stocks in the Gulf of Alaska.. Sampling during the RACE legs extended from the Islands of Four Mountains (long. 170°W) to Cape St. Elias (long. 144°30'W), at pre-selected stations that ranged in depth from 11-285 fm (20-520 m).

Eight hundred seven randomly generated stations in the western and central Gulf were to be sampled during this survey. Successful tows were conducted at 508 of the 575 attempted stations, and 60 pre-selected stations located on untrawlable bottom were abandoned. Arrowtooth flounder (Atheresthes stomias) was the most commonly caught species, followed by walleye pollock (Theragra

chalcogramma), Pacific cod (Gadus macrocephalus), and Pacific halibut. In the two shallowest depth intervals, 1-100 m and 101-200 m, catches were dominated by arrowtooth flounder, walleye pollock, Pacific cod, and Pacific halibut. Important species found in the 201-300 m depth interval included arrowtooth flounder, walleye pollock, and sablefish (Anoplopoma fimbria). Catches from the 301-500 m depth interval were between 4 and 2 as large as those from the shallower intervals, and were dominated by giant grenadiers (Albatrossia pectoralis), rougheye and shortraker rockfishes (Sebastes aleutianus and S. borealis), shortspine thornyheads (Sebastolobus alascanus), and sablefish. Preliminary biomass estimates have been generated from survey data, but they are currently being reassessed in light of recent developments in the determination and application of fishing power correction (FPC) factors. Comparisons of current biomass to those from previous triennial surveys are awaiting the definition of a standardized approach to the FPC problem.

The ABL survey in the eastern Gulf used the NOAA RV Miller Freeman from 14 July to 4 September to sample offshore waters from the U.S.-Canada boundary in Dixon Entrance to Cape St. Elias west of Yakutat, Alaska. A total of 166 successful survey hauls were completed. The 1990 survey in the eastern Gulf focused much of its effort on the upper continental slope in waters 200-500 m depth, where rockfish are known to be abundant. Shallower waters of the continental shelf were also sampled, although less intensively. To facilitate Gulfwide analysis of abundance trends, the data from ABL's survey was combined with that from RACE's survey. ABL was responsible for analyzing the Gulfwide survey results for rockfish, and these results will be discussed in the rockfish section of Part VII B. For more information, contact Eric Brown (206-526-4104) and David Clausen (907-789-6049).

4) West Coast Upper Continental Slope Groundfish Trawl Survey - A bottom trawl survey of the continental slope waters (183-1,280 m) off southern Oregon and northern

California extended the coverage of previous investigations of the deeper groundfish resources off the Pacific coast. The RACE Division, with participants from the Southwest Fisheries Science Center's (SWFSC) La Jolla and Tiburon laboratories, conducted a comprehensive bottom trawl survey of continental slope groundfish resources 22 October-17 November aboard the NOAA ship Miller Freeman. The survey covered the upper continental slope (183-1,280 m) in the International North Pacific Fisheries Commission Eureka area, which extends from near Cape Mendocino, California (40°30'N) to Cape Blanco, Oregon (43°00'N). Of the 108 planned stations, 102 were successfully sampled with a polyethylene Noreastern trawl equipped with "mudsweep" roller gear and a 14 inch mesh codend liner. CTD casts were made at selected stations to describe the physical environment.

Primary survey objectives were to describe the abundance and distribution of key upper slope groundfish species, especially sablefish, Dover sole, arrowtooth flounder, and shortspine and longspine thornyhead; and to obtain biological data from these species. Additional studies addressed juvenile sablefish movements through tagging and description of the physical oceanography of the slope water column. Tissue samples were collected from shortspine and longspine thornyhead and Dover sole for studies of the ecology, physiology and energetics of slope fishes. Brain tissue and otoliths were collected from shortspine thornyhead for SWFSC (La Jolla) studies to determine if the density of lipofuscin granules in the brain can be used as an independent measure of age. Otoliths were also collected from longspine thornyhead. Scientists at SWFSC (La Jolla) will use thornyhead age data for assessing the status of these stocks, which have recently become more important in commercial landings. Researchers from SWFSC (Tiburon) collected stomach samples from sablefish, Dover sole, giant grenadier, deepsea sole, and shortspine and longspine thornyhead to describe slope community trophic interactions.

5) Age and Growth Studies - Kimura and Lyons (1991) have documented the Ageing Unit's reader/tester quality control system. This paper also explores possible usages for reader/tester data. We have recently completed a special pollock otolith exchange with the Pacific Biological Station. The purpose of this exchange was to examine how the presence of strong year-classes affects age determination. A manuscript using these data is currently being prepared. Age and growth studies related to individual species are presented by species below.

6) AFSC Food Habits Studies - The Food Habits Program continued regular collection of food habits information on key fish predators in the North Pacific. Program personnel and fishery observers collected fish stomachs from the eastern Bering Sea, Gulf of Alaska, and west coast of North America. About 9600 stomachs were collected in the Bering Sea and 4500 were collected in the Gulf of Alaska. Gulf of Alaska species sampled included walleye pollock, arrowtooth flounder, Pacific cod, Pacific halibut, sablefish, Pacific ocean perch, and miscellaneous rockfish species. Shipboard scans of fish stomach contents were performed on 1900 fish (primarily walleye pollock) in the eastern Bering Sea and about 500 Pacific hake off the west coast. Over 8100 stomachs were analyzed in the laboratory.

Hake food habits were analyzed by subarea to assist University of Washington researchers trying to determine whether hake infection by a myxosporidian parasite is diet related. Pollock cannibalism was examined with respect to degree of water column stratification. The limited amount of data showed no relationship between the presence of cannibalism and the degree of water stratification at a station. Flathead sole food habits in the Bering Sea were studied in detail. Flathead sole was determined to fill a unique niche in the Bering Sea ecosystem by its dependence on ophiuroids as a dominant food source. Bering Sea groundfish food habits were analyzed with respect to depth zone and prey type (benthic vs. pelagic) for University of

Alaska researchers attempting to map Bering Sea food webs. An analysis of commercially important prey consumption by Bering Sea groundfish from 1984 to 1986 was completed.

b. Management

Socioeconomic Task (REFM) - During 1990, the Socioeconomic Task was actively involved in providing economic information to the Pacific and North Pacific Fishery Management Councils, NMFS, other agencies, and the industry. This included preparing reports and publications, participating on Council plan teams, and preparing and reviewing research proposals and programs.

The major issues for which information was provided included the bycatch problem in the groundfish fisheries off Alaska, pollock roe-stripping, limited entry in the Alaska sablefish fishery and in the West Coast groundfish fishery, and the allocation of Alaska groundfish quotas between at-sea and on-shore processors.

Task members also contributed to the development of studies to evaluate economic effects of the Exxon Valdez oil spill in Prince William Sound, reviewed Sea Grant and Saltonstall-Kennedy proposals, assisted in NMFS efforts to readdress issues associated with the Marine Mammal Protection Act and Endangered species Act, and took the lead in a cooperative effort by NMFS and the Alaska Commercial Fisheries Entry Commission to collect processed product price information.

The reports and publications presented the results of research concerning fishery product exports from the Pacific Northwest and Alaska and the implications of the bycatch limits on groundfish fisheries. Task members also prepared a draft report that served as the economic component of the stock assessment and fishery evaluation for the Gulf of Alaska and Bering Sea/Aleutians Island groundfish fisheries.

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

c Fisheries

Observer Program - The Fisheries Observer Program is responsible for placement of observers on foreign and domestic vessels fishing in the EEZ of the northeastern Pacific Ocean and Bering Sea. Observers collect data which provide the basis for in-season management of foreign, joint venture and domestic fisheries by NMFS, and a means for evaluating and developing management strategies by regional management councils and NMFS. Observers play important roles in monitoring compliance to U.S. fishing regulations and provide information that is useful in promoting development of the U.S. fishing industry.

During 1990, the Observer Program deployed 98 observers to sample aboard vessels from five countries-- Japan, Republic of Korea, U.S.S.R., Poland, and the People's Republic of China. The observers spent about 4,500 days sampling in the Bering Sea and in waters off Washington, Oregon, and California. Observers covered 79% of the joint venture fishing effort. Coverage was 66% in the Bering Sea/Aleutian region and 94% off the Washington, Oregon, and California coasts. There was no joint venture or foreign fishing in the Gulf of Alaska in 1990.

In 1990, the domestic portion of the Observer Program was greatly expanded. The Program trained and deployed 637 observers to domestic vessels fishing off Alaska. The Program was responsible for defining the sampling duties and data collection methods used by observers, training of the observers prior to deployment, debriefing observers upon their return, and editing and managing the resulting data. The work in 1989 with domestic observers and the domestic industry provided valuable experience for the implementation of an expanded domestic observer program in 1990, as well as valuable data on the catches and operations of the domestic groundfish fishery.

For further information, contact Russell Nelson, (206) 526-4194.

4. Canada - PBS

Mr. Saunders provided information on DFO multi species studies.

a. Hecate Strait Project

Multispecies research in 1990 focused on studies of the distribution and abundance for 14 major species in Hecate Strait by examining survey catch-rate data from multispecies surveys of Hecate Strait conducted between 1984-89. Stable patterns of distribution were observed for Pacific sanddab, arrowtooth flounder, petrale sole and rock sole. Estimates of standing crop calculated from survey data indicated that the most abundant species in summer were arrowtooth flounder and spiny dogfish while big skate, ratfish and English sole predominated in winter. Decreases in abundance between 1984-87 were observed for spiny dogfish, English sole, ratfish, Pacific halibut, rock sole, Pacific sanddab, and petrale sole. Dover sole and rex sole showed increases in abundance over the same period while sablefish, big skate and arrowtooth flounder were at stable levels of abundance.

We examined this data in more detail, using agglomerative clustering techniques and identified four relatively stable fish assemblages. They were dominated by flatfish species and characterized by depth and bottom type. Geographical boundaries and dominant species within these assemblages remained fairly stable among surveys. We examined assemblage structures under the widely different fishing effort regimes in the north and south portions of the Strait and found no clear evidence that the fishing effort level in either portion of the Strait has significantly affected abundance of assemblage components or assemblage diversities.

b. Strait of Georgia

The program began in 1988 to study the marine community structure of the Strait of Georgia. The present study is looking at the early marine mortality of hatchery-released salmon due to predation. Ongoing field studies primarily are looking at the seasonal diet of spiny dogfish in the Big Qualicum river estuary. Associated research in 1991 includes an experimental modification of the behaviour of salmonids leaving the hatchery environment in an attempt to alter the spiny dogfish-salmonid predator-prey relationships.

C. By Species, by Agency

1. Pacific Cod

a. Alaska Department of Fish & Game

Mr. Bracken presented the ADF&G report on Pacific Cod.

1) Research

There are currently no research or stock assessment programs conducted by ADF&G specifically for Pacific cod. Catch rates and limited biological information is gathered during stock assessment surveys for other species. Anecdotal information from surveys for other species and from conversations with fishermen suggest that Pacific cod stocks in the Southeast area may be increasing after several years at relatively low levels.

2) Fisheries

Much of the Pacific cod harvested in Southeast Alaska is taken by longline gear and utilized as bait in fisheries for other species. In other areas of the state, Pacific cod are harvested in both state and federal waters and utilized primarily as food fish. A total of 475 mt of Pacific cod were reported from state-managed waters during 1990. Over 50% of the Pacific cod was reported from Prince William Sound with the remainder fairly evenly split between Cook Inlet and Southeast Alaska. An undetermined amount is also taken from within three miles of shore in the remainder of the Gulf of Alaska and the Bering Sea.

b. Washington Department of Fisheries

Mr. Jagielo reported on WDF Pacific cod studies.

In 1990, a stock assessment of the Pacific cod in Puget Sound was completed. Pacific cod had previously been one of the most important species to recreational and commercial fishers in Puget Sound. Catch, effort, and catch rate data were used to assess the status of cod stocks in Puget Sound. The analysis documented the collapse of the population. Contact: Wayne Palsson

c. Oregon Department of Fish and Wildlife

No report was given by ODFW.

d. National Marine Fisheries Service - AFSC

Mr. Wilkins reported on NMFS Pacific cod studies which included two surveys.

1) Research Activities

Japan-U.S. Cooperative Longline Survey - The thirteenth annual Japan-U.S. cooperative longline survey was conducted in the Aleutian Islands region, Bering Sea, and Gulf of Alaska from 29 April-9 September 1990. The Japanese longline vessel Fukuyoshi Maru No. 26 sampled 116 stations, setting 7,200 hooks, on 8.6 nm. of groundline, at each station. The depths sampled generally ranged between 100 and 1,000 m in the Aleutian Islands region and in the Gulf of Alaska, but in the Bering Sea stations were sometimes alternated between shallow sets (100-200 m) and deeper sets (200-1,000 m) where the continental slope was wide and gradual.

The primary objective was to obtain indices of sablefish and Pacific cod abundance, assessment of other major catch components such as Pacific halibut, arrowtooth flounder, Greenland turbot (Reinhardtius hippoglossoides), rockfish (Sebastes spp.), thornyheads, and grenadiers, sablefish tagging, and to collect biological information about sablefish. Scientists from AFSC (RACE Division and ABL) participated in the data gathering activities aboard the vessel and in the data editing and analysis phases.

Sablefish and Pacific cod made up most of the total catch. Sablefish were most abundant in the Gulf of Alaska, and Pacific cod were most abundant in the eastern Bering Sea. Catches of Pacific cod decreased in the Bering Sea in 1990. Over 4,300 sablefish were tagged, mostly in the Gulf of Alaska. Over 3,100 otoliths were collected from sablefish for aging studies.

Age and Growth (REFM) - Recent research on Pacific cod (Kimura and Lyons, 1990) has concluded that otoliths, with scales as backups for younger fish, are the best structures for ageing Pacific cod in the Bering Sea.

2) Stock Assessment

Biomass of Pacific cod (Gadus macrocephalus) in the eastern Bering Sea and Aleutian Islands remained relatively high during 1990, when a catch of 171,000 t was taken. Although down slightly from the record catch of 198,000 t taken in 1988, the 1990 catch was still the second highest in history.

While stock biomass appears to remain well above the historic average level, the trend is downward. Some cause for concern arises from estimates of 1989 and 1990 age 3 recruitment, which were below average. On the other hand, the number of age 1 fish encountered by the 1990 trawl survey was comparable to the numbers of age 1 fish encountered in 1983 and 1985, which corresponded to the good 1982 and 1984 year classes, respectively.

The Pacific cod assessment model constructed in 1988 was recalibrated to generate estimates of the 1991 ABC. Catch levels corresponding to the FMSY, F0.1, FMAX, and F=M harvest strategies were estimated. On the advice of the groundfish plan team, the Bayesian alternative strategy (FMELSY) developed in 1989 was not pursued for this year's assessment. For 1991, the Council set ABC according to the FMSY harvest strategy (F=0.156), giving a projected 1991 catch of 229,000 t for the eastern Bering Sea and Aleutian Islands combined. Total allowable catch was set at the same level, marking the first time in many years that ABC was fully subscribed (previously, the 2 million t cap governing the total groundfish TAC had constrained the Pacific cod TAC to a level well below ABC).

The Gulf of Alaska stock yielded a catch of 74,600 t in 1990, far surpassing the previous record of 41,800 t set in 1989. The stock reduction analysis used to assess this management unit was recalibrated, incorporating new data from the 1990 trawl survey and employing a regression approach that weights each survey biomass estimate by the reciprocal of its coefficient of variation. As in 1989, a correction factor was used to allow the model to exhibit

continuous growth and continuous harvest simultaneously. The F0.1 harvest strategy was used to set both ABC and TAC, giving a projected 1991 catch of 77,900 t.

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

e. Canada

Mr. Saunders presented the Canadian report on Pacific cod.

1) Research Programs

Analyses from distinctly different types of data indicated only minor differences in size-at-age between males and females (Foucher and Tyler 1990a). The finding adds confidence to our application of modal analysis of length frequency data for age determination from commercial landings.

Fecundity was compared for the south-west Vancouver Island and Hecate Strait stocks. Fish from Heçate Strait had a greater fecundity-at -size (weight) than did those from SW Vancouver Island (analysis of covariance, $p < 0.05$). The difference in fecundity was as much as 20% at the largest sizes. There was little variation among years, and the length-fecundity relationship for Hecate Strait was the same as reported in a study 25 years ago. Counts ranged from 0.23 to 5.67 million eggs depending on the length and weight of fish. Generally, smaller oocytes were found in smaller fish. Some senescent individuals were found in the SW Vancouver Island sample.

Oocytes from fish of each maturity stage were described. Two size groups of oocytes are usually present. All of the larger oocytes are vacuolated and have a smooth band around the nucleus. There is also a group of small oocytes that are non-vacuolated. The vacuolated oocytes undergo vitellogenesis (yolk deposition) by September, while the reserve group of oocytes remains undeveloped. In February, the oocytes are freed from the ovarian wall and become translucent as they become hydrated. The oocytes are then known as "ova". This stage seems to last for only a short period, perhaps less than a week. After spawning, a few translucent ova remain in the ovary, while others are being resorbed. There are also collapsed, empty follicles visible, and reserve group oocytes.

By measuring the diameters of oocytes we constructed histograms of oocyte size distributions. Early in the recovery stage following spawning, the distribution is unimodal with a size range of 20 to 110 microns. By August, just prior to vitellogenesis, the distribution is distinctly bimodal, with the larger group of oocytes ranging from 180 -300 microns. By January, just before spawning, some oocytes are as large as 800 microns. During this period, the group of small oocytes does not change its size distribution. At spawning in February or March, the ova are 1.00 to 1.02 mm.

2) Stock Assessments

A computer model was developed last year for estimating potential yields for the Hecate Strait cod stock. This is the largest stock of Pacific cod in the Canadian region. Our stock size estimates (text table below) indicate that spawning biomass at the start of 1991 will be adequate to provide good recruitment provided there are good conditions of mild water transport during the first quarter of the year. If fishing effort stays about the same as in 1989 and 1990, overfishing will not occur and the spawning stock at the end of the year will be within the acceptable range. Our estimate is 3152 t for the year-end spawning biomass. About one third of next year's catch will be from the 1989 year-class.

Year	Ending total biomass (t)	Ending spawning biomass (t)	Potential yield(t)	Estimated yield (t)
1990	8088	4029	3248	3514
1991	8676	3152	2777	3488

The 1991 estimated yield was calculated on the basis that trawling effort (h) would be the same in both 1990 and 1991.

Though we suggest that an annual quota is unnecessary at this time due to average levels of recruitment, combined with moderate fishing effort, the following catch limitations would insure that the spawning stock is not over fished:

Low-risk sustainable: 1800 t
Sustainable level: 2800 t
High risk sustainable: 3800 t

3) Management and Regulations

The provisional quota of 2800 t for 1991 was not implemented when it was discovered that recruitment continued to be above average.

With the present levels of fishing effort it was considered that the stock requires protective restrictions only when there has been a series of low year-classes.

Mr. Saunders stated that the fishery has been on very young fish, and the fishery was closed to protect the 1989 year class.

Mr. Demory asked why DFO used high risk for Pacific cod off Canada.

Mr. Zyblut said that they had gone to high risk for several years.

2. Shelf Rockfish

a. Alaska Department of Fish & Game

Mr. Bracken presented the ADF&G report of shelf rockfish.

1) Research

Port sampling, skipper interview, and logbook programs used by ADF&G to monitor the demersal shelf rockfish fishery continued through 1990 in Southeast Alaska.

The logbook and interview programs are designed to furnish detailed catch and effort information, to estimate at-sea discards, and to obtain more detailed information regarding specific harvest location. The port sampling program provides species composition from the landed catch and an opportunity to collect biological samples. During 1990 otoliths were obtained from principal demersal shelf rockfish species and sent to Kodiak for age determination. Data from these programs is entered on a microcomputer in Sitka.

An ADF&G staff biologist participated on a survey to determine species composition and distribution of larval slope rockfish off Southeast Alaska which was conducted by the NMFS Auke Bay Laboratory during May, 1990.

2) Stock Assessment

Funding was secured from the NOAA Undersea Research Program (NURP) for a near-shore rockfish survey to determine the relationship between species composition and abundance and habitat type. Two vastly different areas were examined during the survey. The first, Sitka Sound, is characterized by a large highly convoluted lava flow and has been heavily exploited for the past ten years. The other area, the

Fairweather Grounds, is a large bank of rocky pinnacles located approximately forty miles offshore in the East Yakutat area. The directed fishery for rockfish has been sporadic in that area, and it is assumed that the exploitation rate has been much lower than in Sitka Sound.

Line transect methods were used to determine the relationship between abundance and habitat type. A second year study will be conducted the end of May, 1991, and a report of the findings will be published after the completion of the second year of this study.

3) Management

The only component of the rockfish complex actively managed by the state at this time is the demersal shelf rockfish assemblage in Southeast Alaska. Rockfish management for this group is based upon a combination of seasons and guideline harvest ranges. The state has management authority for demersal shelf rockfish in both state and federal waters of Southeast Alaska. In state waters harvest of rockfish is restricted to hook-and-line gear only.

Separate harvest ranges have been established for each of five southeast management areas based upon the best available information on the condition of rockfish stocks in each area. No new regulations were adopted for rockfish in 1990, however, the state's management authority was increased to allow application of all state regulations to vessels fishing for demersal shelf rockfish in the EEZ off Southeast Alaska.

4) Fisheries

Harvest of rockfish from state-managed fisheries totaled 644 mt in 1990. Approximately 75% of the harvest was taken in Southeast Alaska, with most of the remainder reported from Prince William Sound. A very small amount of rockfish harvest was also reported from Cook Inlet. Virtually all rockfish harvest in state-managed fisheries is taken by hook-and-line gear either in directed fisheries or incidental to fisheries for other species.

A general discussion followed Mr. Bracken's report.

Mr. Blood asked if there was an allocation between commercial and sport.

Mr. Bracken said there was no allocation, but there was a bag of 5 rockfish per day with 10 in possession for sports fisheries in most of the state.

It was asked if there was a harvest guideline (HG). Mr. Bracken said that HG for demersal shelf rockfish outside was 250 mt and 150 mt for inside.

Mr. Bracken also mentioned that demersal rockfish were discarded during the 24 hour Pacific halibut season, because of the value, time, handling and that processors were glutted with halibut.

b. Washington Department of Fisheries

Mr. Jagielo gave the WDF report on shelf rockfish.

Black rockfish: The black rockfish tagging project was completed and several reports are in preparation. A management plan for black rockfish was submitted to the PFMC for approval. The field emphasis is now on winter maturity and fecundity sampling cruises. Sampling has been done with the vessel Corliss.

c. Canada

Mr. Saunders gave the DFO report on inshore rockfish.

1) Stock Assessment

With individual quotas (IQ) in the halibut fishery, larger rockfish landings by halibut vessels are anticipated. Combined with a growing directed line rockfish fishery, the pressure on rockfish stocks outside the Strait of Georgia is increasing. New age data for yelloweye rockfish indicate that a small proportion of the population is greater than 90 yr of age; thus, natural mortality rates are very low. Very few other data are available for these stocks and the 1991 quotas were based on 1989 reported landings. For the 1991 assessment, we plan to use GIS software to map habitat areas.

2) Management and Regulations

Area licensing was implemented for hook and line vessels. Fishermen will be required to choose, annually, to fish in either the Strait of Georgia or the remainder of the coast. In the Strait of Georgia, all rockfish except yelloweye must be kept alive while on board the vessel (20% dead allowed) to encourage a live rockfish fishery. Area specific quotas are in effect coastwide. Halibut fishermen are limited to a 15% rockfish bycatch.

d. Oregon Department of Fish and Wildlife

Mr. Demory presented the abstract of canary rockfish stock analysis. He added that canary rockfish are temporarily shelved, because of more pressing needs to study other species at this time.

Abstract by Golden, J. and C. Wood. 1990. Status of canary rockfish in the INPFC Vancouver, Columbia and Eureka areas and recommended ABC for 1991. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Stock assessment and fishery evaluation, vol 2. Pacific Fishery Management Council, Portland, OR.

"We used stock synthesis to estimate fishing mortality rates, recruitment and biomass levels for canary rockfish, Sebastes pinniger, in the INPFC Columbia area. Catch data from 1967-89, age composition data from 1980-1988 and trawl effort data from 1980-1987 were used in stock synthesis along with triennial trawl survey data from 1977-1989.

Stock synthesis runs were made with assumed virgin recruitments between 1.00 and 2.00 million recruits. The 1.00 million virgin recruitment scenario was rejected because of the poor stock synthesis likelihood values, unrealistic estimates of natural mortality for females and high estimates of fishing mortality in 1989. The 2.00 million virgin recruitment scenario was rejected due to uncertainty and inconsistency of recruitment estimates, declining trends in mean length and age as well as survey biomass (1983-1989), evidence which seem to be at odds with a low estimate of fishing mortality in 1989 provided by the model. Runs with virgin recruitments between 1.25 and 1.75 million fish produced average recruitments ranging from 1.10 to 1.33 million fish and fishing mortality rates in 1989 ranging from 0.370 to 0.143 respectively. The overall likelihood or goodness of fit was best for virgin recruitments between 1.25 and 1.75 million fish and natural mortality rates estimated for females aged 9 and older were consistent with the literature.

Acceptable biological catch was based on the fishing mortality rate F which produced a 35% reduction in virgin spawning biomass under equilibrium yield modeling. F at 35% virgin spawning biomass ranged from 0.135 to 0.190 and equilibrium yield ranged from 1,056 to 1,323 mt over the preferred range of recruitments. Acceptable biological catch estimates for 1991 ranged from 1,047 to 1,957 mt. Average catch from 1985-1989 was 1,320 mt in the INPFC Columbia area. We recommended an acceptable biological catch of 1,500 mt for the INPFC Columbia area in 1991 which is a sample average of the range given above. The current acceptable biological catch of 2,100 mt has not been achieved since established in 1984.

Catches in the INPFC Vancouver and Eureka areas have been close to or below current acceptable biological catch estimates of 800 and 600 mt respectively. We recommend no change in acceptable biological catch at this time until further work is completed on an assessment for these areas."

Management of canary rockfish is accomplished through the use of trip limits applied to the Sebastes complex. In recent years these were 40,000 pounds per trip south of the north jetty at Coos Bay, Oregon, and 25,000 pounds per trip per week north of the north jetty at Coos Bay. The council recommended a uniform trip limit of 25,000 pounds per trip per week for 1991.

e. National Marine Fisheries Service - AFSC

Mr. Wilkins presented the AFSC report.

Gulf of Alaska: Rockfish of the genus Sebastes are divided into three assemblage groups in the Gulf of Alaska for management purposes: slope rockfish, pelagic shelf rockfish, and demersal shelf rockfish. ABL has stock assessment responsibilities for slope and pelagic shelf rockfish, whereas ADF&G has the responsibility for demersal shelf rockfish.

3. Slope Rockfish

a. National Marine Fisheries Service - AFSC

Mr. Wilkins presented the AFSC report of slope rockfish.

1) Research Activities

Gulf of Alaska

a) 1990 Triennial Trawl Survey - The 1990 triennial trawl survey provided updated estimates of biomass for many species of rockfish in the Gulf of Alaska. Compared with the last triennial survey in 1987, biomass for most rockfish species declined substantially in 1990. For example, Gulfwide biomass of Pacific ocean perch, the most abundant rockfish species, decreased from 352,736 mt in 1987 to only 138,117 mt in 1990. The decline for

dusky rockfish was even greater, from 164,352 mt in 1987 to 28,309 mt in 1990. These large fluctuations in biomass over a 3 year period do not seem reasonable given the reported commercial catch and the low rates of natural mortality and slow growth of rockfish. The fluctuations suggest that the present trawl survey methodology may be inappropriate for assessment of rockfish stock condition. Rockfish size and age compositions from the 1990 survey, which may shed some light on the apparent declines in abundance, are not yet available.

b) AFSC Rockfish Stock Assessment Working Plan - AFSC rockfish survey and assessment scientists developed and initiated a plan to identify, develop, and prioritize research activities that would lead to improved rockfish stock assessments. This plan lays out research directions in the areas of improving estimates of exploitable biomass and determination of optimal exploitation rates. Some elements were developed in concert with industry, which has indicated a willingness to provide assistance and support for the research identified in the plan.

c) Sablefish and Rockfish Early Life History Studies - (See description of survey under VII.B.3.a. Sablefish) We (ABL) are presently analyzing the distribution of rockfish larvae from the oblique bongo net tows. Rockfish larvae were taken at all stations. Preliminary results show that oblique tows capture more rockfish larvae per unit volume than the neuston tows, indicating that the rockfish larvae were distributed through much of the water column rather than concentrated at the surface. Most of the rockfish larvae captured were still preflexion; thus, identification to species is very tentative. Twenty five "types" have been distinguished based on morphology and pigment patterns. Until identification of the rockfish larvae have been resolved, interpretation of the geographic distribution and relationship to oceanographic features remains speculative.

2) Stock Assessment

a) Bering Sea

Pacific ocean perch - The Pacific ocean perch resource in the eastern Bering Sea and Aleutian Islands region continues to remain at low levels of abundance compared to levels during the early 1960s. Results from recent stock assessments, however, indicate that recruitment has improved somewhat. Also, there appears to be an increasing trend in biomass in both regions. Unfortunately, overlapping confidence intervals between the trawl survey point estimates indicate that this trend may not be statistically significant. Because of the uncertainty regarding trawl survey biomass estimates, alternative survey methodologies are presently being explored that may lead to improved estimates in the future.

For further information, contact Daniel Ito at (206) 526-4231

b) Gulf of Alaska

Rockfish of the genus Sebastes are divided into three assemblage groups in the Gulf of Alaska for management purposes: slope rockfish, pelagic shelf rockfish, and demersal shelf rockfish. ABL has stock assessment responsibilities for slope and pelagic shelf rockfish, whereas ADF&G has this responsibility for demersal shelf rockfish.

Slope rockfish are defined as those species of Sebastes that, as adults, inhabit waters of the continental slope, generally in depths greater than 150-200 m. Eighteen species of rockfish are classified into the slope assemblage, the most abundant of which are Pacific ocean perch, and northern, rougheye, sharpchin, harlequin, and shortraker rockfish. The stock condition of slope rockfish is considered to be depressed compared to its former abundance in the early 1960's. Recent stock assessments

have been based mostly on triennial trawl surveys of the Gulf, the results of which are highly uncertain. The 1987 survey indicated stock abundance was increasing, whereas the 1990 survey showed a sharp decline. Because of the uncertainty regarding these surveys, exploitable biomass of slope rockfish is presently based on the average of the two surveys, and is estimated at 505,587 mt.

For more information, contact Jonathan Heifetz at (907) 789-6037.

c) West Coast

Pacific ocean perch - A rebuilding program was established for Pacific ocean perch in 1981 following depletion of this stock during the 1960s and early 1970s. An assessment in 1987 indicated that the stock remained depleted. A review in 1990 of recent commercial fishery length data did not indicated any significantly strong year classes entering the fishery. The research surveys, which generally capture younger fish did indicate some evidence of incoming strong year classes, although none rivalled the magnitude of the 1970 cohort. This signal is encouraging, but significant rebuilding has not occurred. A new assessment of the Pacific ocean perch resource will be conducted in 1992. This assessment will employ the stock synthesis model, a relatively new stock assessment tool for analyzing diverse stock assessment data.

For further information, contact Daniel Ito at (206) 526-4231

3) Management

Previously, the North Pacific Fishery Management Council (NPFMC) assigned a single ABC annually for the Pacific ocean perch complex. This complex is comprised of Pacific ocean perch, S. alutus; northern rockfish, S. polyspinis; rougheye rockfish, S. aleutianus; shortraker rockfish, S. borealis; and sharpchin rockfish, S. zacentrus. Recent evidence indicates

that commercial fishermen may be targeting upon certain species in the complex, especially shortraker and rougheye rockfish. There is an economic incentive to target on rougheye and shortraker rockfish because they command a much higher ex-vessel price than the other species in the complex. The ability and tendency of the commercial fishery to target on these species poses a major conservation concern. To prevent possible depletion of these more desirable species, the NPFMC in 1991 divided the Pacific ocean perch complex into management subgroups.

In the eastern Bering Sea region, the Pacific ocean perch complex has been divided into two subgroups -- a subgroup containing S. alutus only and a subgroup containing shortraker, rougheye, sharpchin, and northern rockfishes combined. In the Aleutian Islands region, the Pacific ocean perch complex has been divided into three subgroups -- a subgroup containing S. alutus only; a subgroup comprised of shortraker and rougheye rockfishes; and a subgroup containing northern and sharpchin rockfishes. Separate ABC's are now assigned to each management subgroup.

Similar to the case of Pacific ocean perch in the Bering Sea, the NPFMC had previously assigned a single acceptable biological catch (ABC) annually for the slope rockfish assemblage in the Gulf of Alaska. Recent evidence indicates commercial targeting upon certain species in the group, especially Pacific ocean perch and shortraker and rougheye rockfish. To prevent possible overexploitation of the more desirable species, the NPFMC in 1991 has divided the assemblage into three subgroups: Pacific ocean perch, shortraker/rougheye rockfish, and other slope rockfish. Separate ABC's are now assigned to each subgroup. Pacific ocean perch are now managed under an F=F(overfishing) strategy, in which the annual exploitation rate is set equal to F(overfishing) (0.025). The other two subgroups are managed under an F=M strategy. Based on these strategies, the 1991 ABC's are as follows: Pacific ocean perch, 5,800 mt; shortraker/rougheye rockfish, 2,000 mt; and other slope rockfish, 10,100 mt.

The pelagic shelf rockfish assemblage is comprised of five species that inhabit waters of the continental shelf of the Gulf of Alaska and that exhibit midwater, schooling behavior. Dusky rockfish is by far the most abundant species in the group. Similar to slope rockfish, current exploitable biomass for the pelagic shelf assemblage is based on the average of the biomasses estimated in the 1987 and 1990 triennial trawl surveys: 96,330 mt. Pelagic shelf rockfish are presently managed using an F=M strategy, in which the annual exploitation rate is set equal to the rate of natural mortality. Because natural mortality is unknown for dusky rockfish, the natural mortality for Pacific ocean perch (0.05) is used as a substitute. Applying this exploitation rate to the current exploitable biomass yields an ABC of 4,800 mt.

b. National Marine Fisheries Service - SWFC

Dr. MacCall presented the SWFC report on slope rockfish.

1) Widow Rockfish - Cohort analysis and the stock synthesis model were used to estimate fishing mortality rates and population size for widow rockfish, using 1979-1990 landings estimates and 1980-1989 age composition data. Estimates of 1991 biomass were similar to recommended equilibrium levels. Acceptable biological catch was 7,000 mt. Future yields are expected to be similar to the 1991 ABC.

2) Bocaccio - A new assessment of bocaccio was conducted by applying the stock synthesis model to data from trawl, set net and recreational fisheries and NMFS trawl surveys. All data sources indicate a declining resource, and the model estimates that biomass has fallen from about 75,000 mt in 1978 to 7,000 to 14,000 mt in 1990. A significant fraction of the observed decline is due to poor recruitment since 1978. The ABC for 1991 was set at 800 mt.

3) Trends in Length Distribution - Trends in length distribution of commercially important California rockfish

species were analyzed to determine the present status of their populations. These analyses supplemented analyses of age distribution for chilipepper, bocaccio, widow and yellowtail rockfishes, but where age data are lacking, as for the splitnose rockfish, they are the primary means of assessing present status. The results suggest significant fishing mortality, and regulations have been made more restrictive.

4) Pilot Larval Production Survey - The pilot larval production survey by the Tiburon Laboratory was aimed specifically for shortbelly rockfish because this species is very abundant and larvae can be identified. Preliminary results indicate that the most serious problem may be in obtaining representative samples of the adult population. We found considerable differences in the size and age compositions of catches made during two surveys for adults. This result suggests that only a portion of the stock is available at a given time and that the available portion may not be representative of the entire population.

c. Alaska Department of Fish & Game

Mr. Bracken gave the ADF&G report of slope rockfish.

An ADF&G staff biologist participated on a survey to determine species composition and distribution of larval slope rockfish off Southeast Alaska which was conducted by the NMFS Auke Bay Laboratory during May, 1990.

d. Washington Department of Fisheries

Mr. Jagielo presented the WDF report of slope rockfish.

Yellowtail rockfish: Jack Tagart completed his PhD on Yellowtail rockfish, and worked with Rick Stanley as a member of the Yellowtail Rockfish Working Group. Contact: Jack Tagart.

There was a general discussion on slope and shelf rockfish.

Mr. Zyblut said Canada was trying to see how to allocate between trawl and hook-in-line fishers without much success.

Mr. Demory asked if trip limits were causing much discard off Canada.

Mr. Zyblut said trip limits were causing discard, but they data on it with the lack of an observer program and the absence of good logbooks for discard.

Mr. Glock asked Mr. Zyblut if Canada considered quarterly quotas.

Mr. Zyblut said Canada was concerned about dumping and small trip limits but had found no solution. He thought they might go to a complex in the future.

Dr. MacCall said that California may have been under the effect of a mild El Nino. Rockfish have been in poor condition associated with warm oceanic water and low food abundance.

Mr. Saunders asked what would California gillnet fishermen (rockfish) do if gillnetting is eliminated.

Dr. MacCall said that some of them will probably turn to hook and line fishing.

e. Canada

Mr. Saunders reported on slope rockfish for Canada.

1) Research Programs

A report of investigations into the school structure of slope rockfishes in Areas 3D/5A was completed. This report summarizes observations on diel behaviour and biomass distribution, presented in our 1990 submission. A primary paper on visual and measurement artifacts associated with high-resolution digital data has also been submitted. Our investigations of school structure showed that artifacts become apparent when the measurement of acoustic characteristics approach the spatial resolution of the beam pattern. These artifacts have become significant in our attempts to describe the detailed structure of rockfish schools, and their behaviour.

An October cruise investigated the three-dimensional positioning of rockfish schools and their response to trawling. Observations of fish positions before, during, and after trawling by a fishing vessel were made from an acoustic vessel, using a towed acoustic array. This pilot work investigated the degree of ship coordination and instrument duplication required to obtain meaningful measurements. In general, the displacement of fish distributions generated by a single pass of the trawl is of such small physical magnitude that vessels may not be able to

operate safely, within the proximity required for detection. Joint work by two vessels may be confined to detection of the greater magnitude responses generated by repeated passes of the trawl, or may require equipping the trawl net with a signal generator, so that it could be found and observed by the acoustic vessel. For single vessel observations, joint use of the vessel sounder, a towed acoustic array, and a trawl sonar may provide the best opportunity to observe effects.

A report on the parasite fauna of Sebastes flavidus was published. Results of this work identified several parasites that were subsequently used to examine the stock structure of S. flavidus in the INPFC Columbia-Charlotte region. A primary paper on this work has been submitted for publication. In addition, the potential for broad-scale movement of S. flavidus is being examined through a joint examination of Canadian and U.S. tagging results. Preliminary analysis of intra- and inter-annual variation in the infection and demographic characteristics of the S. alutus gill parasite used for stock delineation showed a high level of seasonal variation but greater stability among years, for most stocks.

A new program examining the larval and juvenile life stages of commercial rockfish stocks was initiated in 1991. A cruise was completed in March, 1991 which focused on S. alutus spawning aggregations and larval concentrations. Most adult fish were in late oocyte development or spawning stages. Observed larval distribution was largely confined to the immediate area of spawning adults and larval development was not greatly advanced over intra-ovarian larvae from unspawned females. Two cruises examining shallow water distribution of juveniles are planned for mid-1991. This program is intended to provide information on the recruitment process for rockfishes, and assist in the development of long-term management strategies for these species.

Three papers were completed from two 1989 cruises that compared rockfish communities from trawlable and untrawlable habitats off the northwest coast of Vancouver Island. The first paper described sunken gill net catches from both habitats. On the trawlable area, the catch was numerically dominated by Pacific ocean perch, splitnose rockfish, greenstriped rockfish, and bocaccio. On the untrawlable area, the catch was numerically dominated by sharpchin rockfish and redbanded rockfish. The second paper examined echo integration data from the bottom-oriented fish assemblages. Because the diel behaviour of the fish differed over trawlable and untrawlable habitats, features of the hydroacoustic data also differed, and these features could be used to classify the hydroacoustic data according to bottom type. The third paper used high-resolution acoustic data to obtain approximate fish school dimension.

2) Stock Assessment

Biologists from the two countries are continuing their cooperative assessment of the Vancouver Area S. flavidus stock. Genetic and parasite samples are being used to delineate stocks. A report on this work is presented elsewhere. Revised catch-at-age analysis of the Queen Charlotte Sound stock resulted in a lowering of the estimated upper bound of sustainable yield. Recent age samples from the S. brevispinis stock in Queen Charlotte Sound indicate that fishing mortality may be higher than previously estimated and yield estimates were revised downward.

Stock assessments for slope rockfish will be revised and updated over the next one or two years. This work will include a new catch-age analysis for Pacific ocean perch (POP) stocks in Queen Charlotte Sound. In addition, simulation studies are planned to examine management options for the slope rockfish assemblage. As a first step, the POP biological sample database was updated. We have also re-examined POP CPUE data; interpretation of CPUE trends has been complicated by restrictive trip limits.

A review of the impact of extended fisheries jurisdiction on the conservation and management of marine fisheries resources on the west coast of Canada was published. It noted that, while some stocks had not recovered from pre-extension fishing, most had improved records of production. The benefits of the jurisdictional change were largely associated with data capture, assessments, and enforcement. Some changes to the scheduling of assessment activities, to reflect the underlying biology of the species, were also suggested. The effects of joint catch of several slope and shelf rockfish species on the management of the rockfish stocks was also examined. The joint occurrence of these species results in a complex management program which attempts to achieve multiple objectives, which are often contradictory. Measures have been generally successful although the Goose Is. Gully stock of S. alutus has been maintained well below optimum levels.

The results of a review of rockfish sampling procedures were implemented for all commercial sampling. These sample criteria have also been applied to research vessel sampling.

3) Management and Regulations

The majority of commercially harvested rockfishes are managed using a combination of quarterly quotas and trip limits. The management goals

are to provide an orderly harvest, to stay within assigned quotas and to extend the fishing season for at least 10 months.

In 1991, shelf and slope rockfishes are being managed by coastwide quota, i.e., there are no quotas for specific stocks, although assessments are conducted on a stock by stock basis. Quarterly quotas are managed under a graded set of trip limits depending on the amount of quota remaining in the quarter. In addition, vessels have the option of declaring (for a six month period) two or three trips per 30-day interval, with different trip limits for the two types.

In order to provide sufficient protection for the Goose Island Gully S. alutus stock, the area is closed to S. alutus fishing until June 1 and a 4.5 t trip limit will be imposed upon attainment of the area quota.

4. Thornyheads

a. Alaska Department of Fish & Game

Mr. Bracken made a few comments about thornyheads. He said that they appear to be declining and they may have a protracted reproductive period.

b. Oregon Department of Fish and Wildlife

Mr. Demory reported for ODFW of thornyheads.

Considerable data on thornyheads has been collected out of Charleston by Mike Hosie and Mark Franklin. Data includes information on reproduction and maturity. Longspine thornyhead were found to be spawning during four months with a peak in April. Males and females mature at the same size. Collected otoliths have been sent to La Jolla. Hosie and Franklin have drafted a report summarizing their information on thornyheads.

Mr. Barss added that ODFW has sent aging structures (Otoliths and thin sections of otoliths) from very large shortspine thornyheads to NMFS at La Jolla to cooperate with their studies.

c. National Marine Fisheries Service - AFSC

Mr. Wilkins presented the AFSC report on thornyheads.

Thornyheads are managed under the North Pacific Fishery Management Council's Gulf of Alaska Groundfish Fishery

Management Plan. Catches were exclusively foreign in the late 70's and early 80's and were less than 1,400 t. With the decrease in foreign quota in the Gulf catches deceased in the mid 80's before peaking in 1989 at 3,079 t as the domestic fishing industry grew. Catches decreased 46% from 1989 to 1990. In 1990 the ex-vessel value of the catch was $1.4 million.

Based on trawl survey data in the Gulf of Alaska abundance of thornyheads has sharply declined from 99,000 t in 1987 to 26,000 t in 1990. There is no evidence the fishery is responsible for the decline. Since the abundance of thornyheads was first measured in 1984, landings have never exceeded 6.5% of the best interpolated estimate of biomass and throughout 1984-1988 landings did not exceed 4%. The stock is fully utilized and is harvested under an F=M strategy. In 1991 the Acceptable Biological Catch is 1,800 t.

For further information contact Pierre Dawson (206) 526-4245.

d. National Marine Fisheries Service - SWFC

Dr. MacCall presented the SWFC report on thornyheads.

The SWFSC Coastal Division has initiated a joint effort involving scientists at Scripps Institution of Oceanography that involves use of radioisotope rations to validate criteria used to age shortspine thornyhead. Preliminary results indicate failure of the method.

Work at La Jolla from sections indicates ages up to 147 years for shortspine thornyheads and 40 to 50 years for longspine thornyheads. Estimates of fishing mortality (F) are now 0.02 m- 0.03 for shortspine thornyhead and about three times larger for longspine thornyheads. Validation is needed for the determination of age by counting rings on the otoliths. The technique of determining the age of thornyheads from the cores of their otoliths has had mixed success. While the first attempt did not work, the second attempt at analyzing otolith cores was successfull, confirming ages based on annuli. Isotopes from the nuclear bomb testing and use in the 1940's may also provide a way of determining an approximation of age for old otoliths.

5. Sablefish

a. Alaska Department of Fish & Game

Mr. Bracken presented the ADF&G report on sablefish.

1) Research

An intensive skipper interview program is conducted during the Southeast area fisheries to obtain detailed catch and effort information from the participants. This program also provides an opportunity to collect tags recovered during the fisheries.

During 1990 ADF&G cooperated with the NMFS Auke Bay Laboratory to conduct a pre-fishery tagging study in the Southern Inside Area of Southeast Alaska. Approximately 1,669 tags were deployed from the NOAA ship Townsend Cromwell one month prior to the fishery. An extensive tag recovery effort was implemented during the fishery with over 70% of the landings interviewed for tag recovery information. Analysis of the data collected is continuing.

2) Stock Assessment

Sablefish stock assessment surveys were conducted in each of the two inside management areas for the third consecutive year during 1990. The surveys use snap-on longline gear set on randomly selected stations for a standardized fishing period. The purpose is to determine annual changes in relative abundance. These surveys are also designed to provide unbiased biological samples from the sablefish populations. Every tenth fish captured is sampled for AWL, sex, and maturity. Otoliths taken during these surveys are sent to the ADF&G aging lab in Kodiak for age determination.

Preliminary results of the surveys show that the decline observed in the Northern Southeast Inside area between 1988 and 1989 tapered off in 1990 and the 2% reduction in catch rate during the 1990 survey was not significant. Conversely, the results of the 1990 survey indicate significant declines in the abundance of sablefish again in the Southern Southeast Inside management area continued to decline significantly between 1989 and 1990. Data from these surveys is still being analyzed.

Both of these surveys are part of a five-year study and analysis will continue until the completion of the project in 1992. Summaries of the methods used and cruise reports showing preliminary data are available by request from Mr. Bracken.

The cost of these surveys is partially offset by the sale of the fish caught. A vessel is chartered at a set daily rate to conduct the survey. The fish

caught are processed according to industry standards and the state receives all revenue from the sale of the fish.

3) Management

There are three separate internal water areas in Alaska which are managed exclusively by the state. The Northern Southeast Inside, the Southern Southeast Inside areas, and Prince William Sound each have separate seasons and guideline harvest ranges.

The season framework in both of the Southeast Inside management areas allows for some flexibility to avoid conflicts with other fisheries and with periods of large tides which tend to concentrate the effort and result in more lost gear. The Prince William Sound fishery is opened in conjunction with the offshore waters of the Gulf of Alaska and continues until the annual harvest objective is reached.

An annual harvest objective is selected within the guideline harvest range for each area based upon the best available information on current stock condition. In the Southeast areas the season length is set prior to the opening according to the estimated time required by the existing fleet to capture the harvest objective.

4) Fisheries

In the Northern Southeast Inside area 121 vessels harvested 975 mt dressed weight in 24 hours. In the Southern Southeast Inside area 29 vessels harvested approximately 220 mt dressed weight in a 72-hour fishery.

Although both of the Southeast area fisheries are under limited entry, the number of vessels participating in each area exceeds the optimum level established by law by a considerable amount. This factor is compounded because there is no control on vessel size or amount of gear fished. As a result, the individual fishing power of the vessels has increased dramatically in recent years.

The Prince William Sound fishery opened by regulation on April 1 and continued until August 7 when the annual harvest objective of 100 mt was taken.

The offshore fishery (0-3 miles) is managed in conjunction with the federal-managed fishery in the EEZ. The state issues emergency orders to open and close the fishery consistent with field orders issued by NMFS.

A discussion followed Mr. Bracken's presentation.

Mr. Zyblut asked if any pots were being fished off Alaska.

Mr. Bracken said that three vessels have permits, but they did not fish because they can not compete with the longliners.

Mr. Saunders asked if there were any killer whale problems this year.

Mr. Bracken answered that he had not received reports of killer whales taking sablefish from the longlines this year.

Mr. Bracken said that ADF&G now reviews regulations on a three year schedule, and changes for regulations will not be considered for change this year.

Mr. Demory asked if there was about the level of high-grading in the sablefish fishery in short seasons.

Mr. Bracken said that there is no high-grading because the speed of handling required during a short season does not allow time for sorting the catch at sea.
Mr. Demory asked if there was any sampling at the dock.

Mr. Bracken answered that there was no dock sampling of commercial catch, because there was independent biological sampling of the stocks.

The subject of derelict gear was discussed. Mr. Bracken said that the short season did result in some gear being cut off or lost at sea.

b. Oregon Department of Fish and Wildlife

Mr. Demory presented the ODFW report on sablefish.

ODFW activities are limited to collecting biological samples according to a coastwide protocol.

c. Canada

Mr. Saunders gave the Canadian report on sablefish.

1) Research Programs

A species interaction trawl survey was continued in August to assess the impact of sablefish on hake and herring stocks in the La Perouse region of the Vancouver Area.

A coastwide biological sampling survey of sablefish was conducted in November.

A study examining the effects of external tags on sablefish growth was completed. Tagged juveniles from the strong 1977 year-class were sampled for nine years. Tagged fish grew significantly slower, were larger and older at 50% maturity and had higher mortality rates. If these results apply to other species and other tag types, there could be errors in the estimation of biological parameters obtained from tagging studies.

A second study examined discreteness of sablefish stocks inhabiting seamounts using trematode parasites as a biological tag. Results indicated that based on prevalence of trematode parasites, sablefish populations on individual seamounts were discrete and could be managed as separate stock units.

An examination of biotic and abiotic factors controlling year-class success was completed. Results suggest that strong year-classes are associated with large scale increases in copepod abundance which in turn are associated with changes in productivity in the North Pacific Ocean.

2) Stock Assessment

Nominal CPUE was standardized to account for variation due to trap type. Records from vessels with skippers having one or more years of experience were selected. Standardized CPUE increased slightly in 1989 (preliminary) to 22.6 kg/trap from 21.2 kg/trap in 1988. The stock is considered to be in good condition.

The impact of IQ's on assessment indices and the variability in trap-caught biological samples with area and depth are currently under review.

3) Management and Regulations

Sablefish are managed by quota with a 5000 t coastwide quota in effect for 1991. The quota is split between trawl (8.75%) and longline/trap (91.25%) vessels. Both trawl and longline licenses are limited entry.

In 1991 longline/trap license holders are again entitled to an individual vessel quota. The fishermen are entitled to a proportion of the quota rather than a permanent tonnage. This experimental program is in its second and final year and a review of its effectiveness has been initiated. The allocation of quota is based on a combination of vessel size criteria and the best landing from the previous two years. An

observer program, paid for by fishermen and overseen by a consultant, is used to verify the landings in five designated ports.

Mr. Saunders added that there are problems verifying age distributions with depth of capture that need to be resolved.

He also said that the individual vessel quotas are changing the Canadian sablefish fishery. Some fishermen now fish to maximize bycatch. Also with individual quotas, there is an extended fishing season which is logistically harder to sample. Some crew members have not faired as well with individual quotas, since there is no incentive to use efficient crews. Many crewmen are now unemployed. In addition, the cost of transferring quota to a vessel has been passed on to the crew.

Mr. Saunders said vessels were keeping mandatory logbooks.

Mr. Bracken asked if there was any indicating of new, good recruitment.

Mr. Saunders said that there was no quantitative evidence of good recruitment, however, anecdotal reports and trawl discards indicate moderate levels of recruitment.

Mr. Saunders said that preliminary work with a large beam trawl, targeting on juvenile salmon in the surface waters (0-10 m) off the west coast of Vancouver Island, appears to successfully capture young sablefish. He anticipates further work using the gear to examine juvenile sablefish distribution and abundance.

d. National Marine Fisheries Service - AFSC

Mr. Clausen reported on Alaska sablefish for AFSC.

1) Research Activities

a) Gulf of Alaska

(1) Japan-U.S. Cooperative Longline Survey - (See description of survey under VII.1.a. Pacific cod research activities) Compared to recent cooperative longline survey results from recent years, catches of sablefish declined substantially in all areas except in the northwest end of the sample pattern in the Bering Sea where catches have been small. Survey results showed that sablefish relative population number (RPN) declined

24.0% for the upper continental slope of the Gulf of Alaska from 1989 to 1990, a decrease that was statistically significant. Declines were seen in all areas of the Gulf, with an especially large decrease in the Kodiak area. These results are markedly different from the results observed in a duplicate longline survey of the Gulf of Alaska, the 1990 domestic longline survey. This latter survey also fished the same 47 standard stations, but it reported a 21% increase in sablefish RPN for the upper continental slope of the Gulf of Alaska. The two surveys found nearly identical trends in sablefish RPN between 1988 and 1989, and it is unknown why the 1990 results are so different. There were no apparent changes in standardization in either survey in 1990. Both surveys are planned to continue in 1991, which will provide another year of comparisons.

(2) NMFS Domestic Longline Survey of the Gulf of Alaska - The fourth annual NMFS longline survey of the upper continental slope and deep gullies of the Gulf of Alaska was conducted aboard the chartered U.S. longline vessel Ocean Prowler. Inclusive dates were from 26 June to 12 September 1990. This research program has been a joint effort of RACE Division and ABL, since its inception in 1987.

As in past surveys, the primary objective was to determine the relative abundance and size composition of four slope-resident groundfish species: sablefish, shortspine thornyhead, and rougheye and shortraker rockfishes, and secondarily to determine the relative abundance and size compositions of other species such as Pacific cod, grenadiers (Macrouridae), arrowtooth flounder, and Pacific halibut.

Forty-five stations were sampled along the upper continental slope of the Gulf of Alaska at a rate of one station per day. These stations correspond to the same locations sampled by the Japan-U.S. cooperative longline survey of the Gulf of Alaska, that has been conducted

since 1979. Surveyed depths ranged from 200-1,000 m, although depths less than 150 m or more than 1,00 m were sampled occasionally. Twenty-seven stations were sampled in gullies at the rate of two stations per day. Twenty-six of these stations are additional to those routinely sampled by the cooperative longline survey. One station (NMFS survey station 42 and cooperative survey station 103) near Baranof Island is considered to be a shelf station. Five stations were repeated to study catch rate variability.

The NMFS sampling gear was identical to the cooperative survey gear with respect to numbers of hooks, bait, and groundline length at each slope station, but differed in hook type, gangion length and thickness, and anchoring arrangement.

Prior to the initiation of sampling in gullies, certain assumptions had been made to extrapolate sablefish CPUE's and size compositions from the cooperative longline survey upper slope stations to deep gully areas that were not actually sampled. Results of the 1988-1990 NMFS longline surveys show that extrapolated relative population estimates were not appropriate. The 1989 NMFS survey detected a statistically significant decrease in numbers of sablefish on the upper continental slope from the previous year, most of which was associated with decreases in the Shumagin and Chirikof INPFC statistical areas. The 1990 NMFS survey detected a statistically significant increase in numbers of sablefish on the upper continental slope, mostly associated with increases in the Shumagin, Chirikof, and Kodiak INPFC areas. In 1988 and 1989 sablefish abundance in the two major gullies in the western Gulf of Alaska (Shumagin Gully and Shelikof Trough) was mostly unchanged. However, in 1990 sablefish numbers in those gullies decreased remarkably, and increased by the same amount on the upper continental slope near those gullies. Overall, 1990 sablefish abundance on the upper continental slope appears to be the same as in

1988 because of recruitment from nearby gullies.

(3) Sablefish Tag Recovery Program - Since 1983, ABL has tagged and released sablefish for migration, population and age studies in the eastern Gulf of Alaska. Tag releases currently total 80,389. Recovered tags total 3,747. Since 1985, 19,695 juvenile sablefish (age 1-2) have been tagged and released in inshore waters of southeastern Alaska. So far, 157 fish tagged as juveniles have been recovered on commercial longline gear. Preliminary results of juvenile recoveries indicate an age of recruitment to longline gear of ~4-5 years of age. Also noted was a tendency for juveniles to migrate from southeastern Alaska release sites to the following INPFC areas: 36% - Yakutat, Kodiak, and Chirikof; 37% - Southeastern outside waters; 20% -remaining in Southeastern inshore waters; and 7% - Charlotte and Vancouver.

For more information, contact Ellen Varosi at (907) 789-6059.

(4) Sablefish and Rockfish Early Life History Studies - Sablefish were the most abundant fish larvae taken at neuston stations during the May 1990 cruise of the NOAA RV Townsend Cromwell. Sablefish larvae 4.6-17.0 mm long were taken at 55 of 67 stations between lat. 54°30'N (Dixon Entrance) and lat. 58°N (Cross Sound) and west from the coast to long. 140°W. Large catches were recorded offshore beyond the continental slope during hours of darkness. The highest catch was 4,340 sablefish (46 per 10 square meters) for one fifteen minute tow 160 km offshore. Catches of 100->4,000 sablefish larvae occurred at 14 of 55 positive stations. These results are unusual, because sablefish are generally rare in standard plankton tows; even when sampling with neuston nets, other studies show catches seldom exceed a few tens per sample. Stations on the continental shelf yielded small catches (0-17) both day and night. The offshore distribution of sablefish larvae is hypothesized to be the result of freshwater driven

surface circulation. Although it was not evident during May 1990, the Sitka Eddy when present is a possible mechanism by which the older sablefish larvae or small juveniles may be recruited to nearshore or continental shelf nursery areas in the late summer or early fall.

Oblique bongo net tows to 300 m or near bottom at 67 stations yielded fewer sablefish larvae than the neuston tows. Only 38 stations were positive with catches of only 1-26 per tow. The oblique tow data have not been completely analyzed, but the sparsity of sablefish in the oblique tows appears to confirm that the sablefish larvae were concentrated near the surface and probably confined to the neuston layer both day and night.

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

(5) Tagging Experiment in Clarence Strait - ABL used the NOAA RV Townsend Cromwell to conduct a sablefish mark-recapture experiment in a study area in Clarence Strait, near Ketchikan, Alaska. The experiment was a cooperative study with ADG&G, and the main objective was to obtain a sablefish population estimate for the study area. During the period 27 April - 5 May, 18 longline stations were fished in Clarence Strait, and 1,669 tagged sablefish were released. The tagged fish were recovered approximately 6 weeks later in the Clarence Strait commercial fishery for sablefish, which began June 15. A total of 25 tags were recovered, which translates to a 1.5% recovery rate. This mark-recapture data from Clarence Strait is still being analyzed, and a population estimate is not yet available.

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

(6) Catchability Coefficient Study in Chatham Strait - ABL completed an analysis of a sablefish experiment conducted in Chatham Strait, southeastern Alaska, in

1989. The methods of this study, which was done in cooperation with ADF&G, were reported in last year's AFSC TSC document. A prime objective of the experiment was to estimate the catchability coefficient (q) of sablefish caught on survey longline gear. This estimate of q could then be applied to the Gulf of Alaska domestic longline survey to obtain a population estimate of sablefish in the Gulf. In the 1989 Chatham experiment, the NOAA RV Townsend Cromwell was used to determine sablefish catch rates immediately before and after the 23-24 September commercial fishery. The average experimental catch rate declined 18.3%, which suggested that a substantial percentage of the sablefish population in Chatham Strait was removed by the fishery. The ABL analysis, however, indicates that this decrease in catch rate was unreasonably large, and that the true decrease in sablefish population caused by the fishery was likely somewhat less. An unbiased estimate of q, therefore, could not be computed. Possible reasons for the low catch rates after the fishery include: 1) the most vulnerable fish (i.e., the most active feeders) may have been removed by the fishery; and 2) increased food may have been available to fish after the fishery, due to discard of bait and fish entrails.

ABL and ADF&G are planning a follow-up study in Chatham Strait in July-October 1991 which will attempt to obtain a more accurate estimate of the percent of sablefish removed in the fishery. In addition to long-lining, trawling will be done before and after the fishery to compute alternative catch rates that will not be affected by changes in fish behavior.

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

(7)AFSC Age and Growth - Validation research is currently centered on sablefish. In 1988, the Auke Bay Laboratory released 5,808 sablefish with OTC marks. So far, over 50 pairs of OTC marked otoliths have been recovered.

Craig Kastelle (REFM) has made considerable progress on his Master's thesis, which is an attempt to validate the Unit's sablefish ageing criteria using the radioisotopes Pb-210 and Ra-226. A draft of this thesis is expected to be completed in 1991, and so far results appear encouraging.

b) Stock Assessment

Sablefish of the Gulf of Alaska, Bering Sea and Aleutians are considered one large stock. Therefore, to alleviate some of the departures from a closed population assumption that occur in separate analyses, these three regions are combined into one analysis for stock assessment. Historic biomass estimates as determined by stock reduction analysis showed a declining stock trend through 1978. During these years the stock was heavily exploited by foreign fisheries. Estimates of exploitable biomass after 1979 were determined by scaling relative biomass indices from an annual longline survey to estimates of absolute biomass, based on comparisons of longline and bottom trawl survey catch rates. Stock abundance increased after 1980 peaking in 1985 at nearly 400,000 mt. Lower exploitation rates and a strong 1977 year class which recruited in 1982, led to this improved stock condition. After 1986, the stock has been fairly stable but showing a slight decline. Although the stock is declining there is no evidence that it is being overfished. The decline is attributed to the lack of significant recruitment in recent years. The stock is at a high level and considered to be in good condition. The 1991 estimate of exploitable biomass for the Bering Sea/Aleutian Islands region is 54,100 mt, and 194,000 mt for the Gulf of Alaska. Sablefish are fully utilized and are harvested under an F0.1 strategy. The 1991 Acceptable Biological Catches were 3,100 mt for the Bering Sea, 3,200 mt for the Aleutians, and 22,500 mt for the Gulf of Alaska.

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

Mr. Wilkins reported on West Coast sablefish for AFSC.

2) West Coast

a) Research Activities

The annual trap survey to obtain indices of sablefish abundance that was planned to take place off California had to be cancelled to allow higher priority surveys in other areas to be conducted. This survey is currently conducted as pairs of observations made in alternate years off Washington/Oregon one year and off California the next. The advisability of scaling this survey back to one pair of observations every three years is currently being evaluated.

Although the index survey was cancelled, a continental slope trawl survey was conducted in the INPFC Eureka area, providing area swept biomass estimates for sablefish, as well as for other components the deep water assemblage. Biomass, population, and size composition estimates generated for sablefish, Dover sole, and thornyheads have been incorporated into the 1991 stock assessments for these west coast species.

b) Stock Assessment

The landed catch of sablefish in 1989 was 9,028 mt, close to the ABC of 8,900 mt. The west coast sablefish stock was assessed in 1990 through application of the synthesis model to fishery size and age composition data from 1986-1989 and trawl and pot survey data. There were two significant changes in this year's assessment. First, the assessment was split into northern (U.S.-Vancouver and Columbia INPFC areas) and southern areas on the basis of known low rates of mixing of adult sablefish, and new evidence of slower growth among fish captured off California. Second, greater reliance was placed on the trawl survey biomass estimates from southern Oregon

because this area constitutes a significant fraction of the northern assessment area and a survey in 1989 replicated abundance levels observed in 1984 and 1988. The recommended assessment results that match this biomass level do not, however, provide a good match to the decline in the pot survey's estimate of sablefish abundance. The northern area's assessment indicates that the biomass of age 3+ sablefish was about 80,400 mt at the beginning of 1990 and the biomass of mature females was 36,100 mt. This level of spawning biomass is intermediate between 38,800 mt (35% of virgin spawning biomass) and 31,800 mt (spawning biomass that produces MSY under previously assumed level of recruitment density-dependence), so this area's stock is judged to be approximately at its optimum level. Application of the F35% exploitation policy to the expected 1991 biomass produces a recommended landed yield of 4,130 mt for the northern area, plus an expected trawl discard of 600 mt. The assessment in the southern area has greater uncertainty because of the lesser amount of survey data. The recommended assessment indicates that the biomass of age 3+ fish at the beginning of 1990 was 87,600 mt and the biomass of mature females was 45,200 mt. This level of spawning biomass is above 39,300 mt (35% of virgin spawning biomass) and 33,400 mt (spawning biomass that produces MSY under previously assumed level of recruitment density-dependence). Application of the F35% exploitation policy to the expected 1991 biomass produces a recommended landed yield of 4,730 mt for the southern area, plus an expected trawl discard of 690 mt.

For further information, contact Richard Methot at (206) 526-6525

Mr. Blood asked about the time of release for OTC tagged sablefish.

Mr. Wilkins said that they were released prior to the fishery.

Dr. MacCall said that there were new FDA rules for the use of OTC. It is still best to release OTC injected fish 21 days prior to the main opening of a

fishing season. If there are low OTC tag return rates expected from a fishery, then there seems to be little problem in obtaining FDA permission to use OTC.

Mr. Bracken said that tagged adult sablefish appear to be quite stable, while juveniles move.

Mr. Saunders said that tagged juveniles experience reduced growth in comparison to untagged fish from the same cohort.

6. Flatfish

a. Washington Department of Fisheries

Mr. Jugielo reported on flatfish for WDF.

1) Arrowtooth Flounder.

Martha Ricky has been analyzing our data on the catch, effort, geographical distribution and biology of arrowtooth flounder. Preliminary results suggested that our aging data is "suspect" and age validation work may be needed. She is now beginning a year long study for the purpose of documenting the time of spawning and proportion mature by age. Trawl landings will be sampled bi-weekly for one year to track changes in the Gonadal Somatic Index (GSI). A report analyzing the relative co-occurrence of "deepwater complex" species (arrowtooth flounder, sablefish, Dover sole, thornyheads) was completed.
Contact: Martha Rickey

2). Halibut.

In 1990, a Recreational Halibut Fisheries Investigations project provided an in-season estimate of the North Coast recreational fisheries for quota management and a post-season estimate for the South Coast and Puget Sound fisheries. Members of the project assist in the development of a catch sharing plan with input from a public advisory group. The project sees to the development and institution of the annual catch record card program, and in-season monitoring of this fishery in all areas.
Contact: Darcy Wildermuth

Mr. Jugielo said that WDF is especially interested in validating the aging technique used on arrowtooth flounder. They are not confident with their results from age determination. WDF also needs information on arrowtooth spawning.

b. Oregon Department of Fish and Wildlife

Mr. Demory reported on flatfish for ODFW.

1) Dover Sole - Methot, R., R. Demory, F. Henry, and J. Turnock. 1990. Assessment of west coast Dover sole in 1990 and recommendations to management in 1991. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Stock assessment and fishery evaluation, vol. 1. Pacific Fishery Management Council, Portland, OR.

"Size and age composition data from the INPFC Eureka and Columbia areas were analyzed by stock synthesis, a separable catch-at-age model. Strong and weak year classes are not obvious in the age composition data so this preliminary assessment was conducted under the assumption of constant recruitment. Sharp increases in the percentage of small Dover sole occurred beginning in 1983-84. The model accommodated this change by having separate availability and retention patterns for the periods 1971-1983 and 1984-present. Two plausible levels of recruitment are identified for each area, and result in an approximately two-fold range in estimated current biomass. In the Eureka area, recent landed catches have declined to about 4000 mt and the stock seems to be in equilibrium. MSY, estimated under an assumed level of density-dependent recruitment, is in the range 4200 -5300 mt. The current female spawning biomass is estimated to be above the target level. The recommended yield is calculated by applying F35% (fishing mortality that reduces female spawning biomass per recruit to 35% of its unfished level) to the exploitable biomass. This results in yields for 1991 in the range 7973 to 11898 mt. An ABC equal to the lower end of this range is recommended. In the Columbia area, recent landed catches have increased to about 8000 mt. MSY is estimated to be in the range 3400 - 4800 mt. Application of $F_{35\%}$ in 1991 would produce yields of 4160 - 7960 mt. We recommend that the ABC in 1991 be set equal to the mid-point of this range, 6100 mt. If the lower biomass scenario is correct, then continued harvests of 8000 mt will drive the stock below its target level in about three years."

As a result of the stock assessment, the Pacific Fishery Management Council (Council) recommended a trip limit of 27,500 pounds per trip per week on the deepwater complex in the Eureka, Columbia and Vancouver areas. The deepwater complex is composed of Dover sole, thornyhead and sablefish. The amount of Dover sole within the cap was allowed to fluctuate.

2) Petrale Sole - Castillo, G. 1991. Year-class strength and age composition of female petrale sole (Eopsetta jordani) off Oregon.

Department of Fisheries and Wildlife, Oregon State University.

"Preliminary cohort analyses and summed CPUE estimates in petrale sole suggested large variations of year-class strength in PMFC statistical areas 3A and 2B for the 1958 to 1970 year-classes, inclusive.

Although the CPUE index showed a temporal decrease in year-class strength in the PMFC areas 3A and 2B, a trend in year-class strength for the same period was not supported by more reliable estimates made using cohort analysis.

Year-class strength indices of petrale sole based on numbers of females attaining ages 6 and 8 were significantly correlated between FMPC areas 3A and 2B ($P < 0.05$). The cohorts 1963 to 1965 inclusive may have been the weakest. The 1961 and 1968 cohorts were likely the strongest.

Petrale sole catches in PMFC area 2B showed large temporal variations in the proportion of fish caught up to 100 fathoms in relation to the total catches of this species. A general increase in fishing depth was observed in areas 3A and 2B from 1982 to 1989.

The updated age composition of female petrale sole for PMFC 3A and 2B showed a large percentage of age groups 13+ in 1982 which was also evident since 1980. This increase in the percentage of older fish is ascribed to the expansion of the bottom trawl fishery into deeper areas. From 1985 to 1989 a large percentage decrease of age groups over age 9 was detected."

Management of petrale sole is accomplished through the use of minimum codend mesh size.

Discussion followed about deepwater complex.

Mr. Zyblut asked about mesh sizes.

Mr. Saunders asked if varying mesh size would adequately protect petrale sole.

Mr. Bracken asked if there was any market size restrictions.

c. Canada

Mr. Saunders gave the report for Canadian report on flatfish.

1) Research Programs

A study of the reproductive biology of English sole in Hecate Strait was completed. The oocyte maturation cycle for the species appears to be one year in duration. Vitellogenesis occurred in May-June. Peak spawning for fish larger than 40cm occurred in September-October, while peak spawning for fish smaller than 40 cm occurred in November. However, a few of the smallest specimens were ripe as late as March. In the near future, we will investigate recruitment mechanisms for English sole.

2) Stock Assessment

Stock assessments were completed for the major stocks of commercial flatfish species. Recruitment for rock sole in Hecate Strait in 1990 appears to be declining from the record high levels in 1989. Recruitment for English sole appears to be increasing and estimates of sustainable yield have been revised upward from 700 t to 850 t. Landings of Dover sole off the west coast of Vancouver Island remained at around 1300 t in 1990, similar to 1989. Yield for this stock is estimated to be 1000-2000 t assuming the stock is intermediate in size to the Washington State and International Area 5C-E stocks. Preliminary age composition data indicates that the growth rate for this stock is significantly different from that of the Area 5C-E stock. Fish from the west coast of Vancouver Island stock grow more slowly and attain a smaller maximum size.

3) Management and Regulations

Flatfish are managed using a combination of area specific quotas and/or trip limits.

Petrale sole are subject to a 20 t trip limit from January 1 to March 31, 1990. After March 31, no trip limit is in effect.

Rock sole are subject to a 13.6 t trip limit coastwide.

Dover sole in International Areas 3C-D are subject to a 1300 t quota, while in International Areas 5C-E combined, a 1000 t quota is in place for Dover sole.

An 850 t quota is in place for English sole in Hecate Strait.

d. National Marine Fisheries Service - AFSC

Mr. Wilkins gave the report for AFSC on flatfish.

1) Stock Assessment

a) Bering Sea

Assessments for the various species of Bering Sea flatfish are summarized below:

Species	Assessment Method	Projected biomass	Exploitation rate	ABC	TAC
Yellowfin Sole	Cohort analysis	1,790,000	F0.1	250,600	135,000
Greenland turbot	Stock Reduction analysis	384,600	Low recent catch	7,000	7,000
Arrowtooth flounder	Survey	590,400	F0.1	116,400	20,000
Rock Sole	Survey	1,363,700	FMSY	246,500	90,000
Other Flatfish	Survey	1,223,000	FMSY	219,700	64,675

The abundance of most of the species of flatfish in the eastern Bering Sea have shown substantial increases during the 1970s and 1980s, and many are currently at observed peak levels of abundance. Yellowfin sole (Limanda aspera), which suffered a severe decline in abundance from overfishing in the early 1960s, is the second most abundant species in this region after walleye pollock. The total harvest of yellowfin sole in the eastern Bering Sea in 1990 was 80,500 t, down from 153,150 t in 1989 due to the bycatch cap on incidental catches of halibut and crab species. The catch remains well below the 1990 TAC of 176,500 t. The fishery harvests a wide range of age classes with over 30% of the 1989 catch older than 17 years. The stock remains at high abundance levels after rebuilding during the late 1970s and early 1980s from a series of stronger than average year classes spawned from

1968-77. In the 1990 assessment, fishery catch-at-age information was used in cohort analysis and the stock synthesis model to discern the age-structured population abundance, believed to be at more than 2.5 million t. Fishing mortality values were developed from a yield per recruit model to evaluate potential harvesting strategies. For 1991 a F0.1 value of 0.14 was used to develop an ABC of 250,600 t.

Rock sole catches from the eastern Bering Sea in 1990 was 24,100 t, primarily from a valuable roe fishery conducted during the winter spawning period. Harvest levels remain well below the TAC of 67,400 t. Biomass estimates from the 1990 demersal trawl survey indicate the population abundance is at 1.4 million t, continuing the trend of biomass increase seen during the 1980s. Survey age composition from the 1989 survey indicates that 89% of the rock sole population numbers are ages 3-8, corresponding to the 1981-86 year classes. Analysis of life history parameters from a dynamic pool model provide fishing mortality values at Fmsy (F=0.176) and F0.1 (F=0.159) to explore possible harvest strategies. An ABC of 246,500 t (TAC is 90,00 t) was developed for 1991 based on the F0.1 exploitation rate.

Survey data have indicated that the other two principal species of small shelf flatfish in the eastern Bering Sea were also at observed high levels of abundance in 1990. The estimates were 632,300 t for flathead sole (Hippoglossoides elassodon), and 525,500 t for Alaska plaice (Pleuronectes quardrituberculatus). The abundance of these species remains high, and recruitment continues to be strong for flathead sole. Considering that the abundance of these species are high (above Bmsy) and expected to remain so, it is appropriate to use the Fmsy exploitation rate to estimate the 1991 ABCs. For flathead sole, Fmsy = 0.176 giving an ABC of 106,500 t for the Bering Sea/Aleutian Islands region in 1991. Alaska plaice ABC is set at 99,000 t for 1991 using the same exploitation rate.

The conditions of the two principal species of large flatfish in the eastern Bering Sea, arrowtooth flounder (Atheresthes stomias) and Greenland turbot (Reinhardtius hippoglossoides), differ. Based on survey estimates, the abundance of arrowtooth flounder has increased from less than 100,000 t in 1982 to 459,200 t in 1990. Over this same period, recruitment of Greenland turbot has been very low and the presence of juvenile fish reported from the Bering Sea shelf and slope has been notably reduced. Assessments of the adult population, which occupy continental slope waters, is limited to triennial surveys such as in 1988, but these surveys incompletely sample this portion of the population. Because of the poor recruitment that has been observed since the early 1980s, exploitation of the adult population has been restricted and the TAC has been set at 7,000 t. Arrowtooth flounder remain lightly exploited with the 1990 catch of 4,200 t taken primarily in the pursuit of other species.

b) Gulf of Alaska

Management of the Gulf of Alaska flatfish resource has been divided into four categories by the North Pacific Fishery Management Council for 1991. These categories include: "shallow water flatfish", "deep water flatfish", arrowtooth flounder, and flathead sole. This reclassification was made because of the significant difference in halibut bycatch rates in directed fisheries targeting on shallow and deep water flatfish species. Arrowtooth flounder, because of its present high abundance and perceived low commercial value, was separated from the group and managed under a separate TAC. Flathead sole are also managed under a separate TAC because they overlap the distributions of the shallow and deep water categories.

Due to halibut bycatch in commercial trawl fisheries, the total catch of Gulf of Alaska flatfish species was 15,400 t in 1990, well below the TAC of 64,000 t. Biomass estimates from the 1990 Gulf of Alaska trawl survey

indicates the total flatfish resource continues to increase with some species declining (rex and rock sole), some increasing (flathead sole and arrowtooth flounder) and some remaining stable (yellowfin sole). Trawl survey size compositions indicate the continued presence of juvenile fish recruiting to the stock for most species. Although the flatfish species are generally thought to be near or above virgin levels, they are managed under the F0.1 approach since this strategy may represents a fishery which maintains a larger spawning stock and mean size.

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

c) West Coast

Dover sole - Size and age composition data from the INPFC Eureka and Columbia areas were analyzed by the stock synthesis model. The assessment for the Columbia area included data from trawl surveys conducted by NMFS on the continental slope off southern Oregon. Strong and weak year classes are not obvious in the age composition data, so this preliminary assessment was conducted under the assumption of constant recruitment. Sharp increases in the percentage of small Dover sole occurred beginning in 1983-84, probably related to changes in market acceptance and in codend mesh sizes. The model accommodated these changes by introducing a new estimate of size-specific availability at that point in the time series. Two plausible levels of recruitment are identified for each area, and result in an approximately two-fold range in estimated current biomass.

In the Eureka area, recent landed catches have declined to about 4000 mt and the stock seems to be in equilibrium, although lack of auxiliary data and movement of the fishery into deeper water hamper quantitative assessment. MSY, estimated under an assumed level of density-dependent recruitment, is in the range 4200 - 5300 mt. The current female spawning biomass is estimated to be well above the

target level, and the range of F35% yields for 1991 is 7970 - 11,900 mt. In the Columbia area recent landed catches have increased to about 8000 mt. MSY is estimated to be in the range 3400 - 4800 mt. Female spawning biomass in 1991 is estimated to be in the range 30,500 - 67,600 mt, which is 37 - 56% of virgin spawning biomass and above the target level of spawning biomass. Application of F35% in 1991 would produce yields of 4160 - 7960 mt.

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

2) Management

Halibut Bycatch - REFM scientists conducted an analysis of historical halibut bycatch incidence in foreign fleets for the International Pacific Halibut Commission bycatch working group.

e. National Marine Fisheries Service - SWFC

Dr. MacCall reported on flatfish for SWFC.

He spoke briefly about Dover sole research by the Coastal Division in La Jolla

f. International Pacific Halibut Commission

Mr. Blood reported on Pacific halibut for IPHC.

1) Bycatch Investigations:

a) Underwater Video System - The IPHC is continuing research to reduce by-catch in trawl directed fisheries. One project is a cooperative project with the National Marine Fisheries Service (NMFS) using an underwater video system to study halibut and target species behavior. Preliminary results from a 1991 survey were promising and a later cruise will be scheduled for late summer or early fall of 1991.
Contact: Steve Kaimmer

b) Observer Data - The IPHC is also analyzing observer data to determine whether day-night differences occur in bottom trawl bycatch rates. Some fishermen reported bycatch to be higher at night, and recommended that the NPFMC ban night fishing. The results showed that most changes in bottom trawl bycatch were caused by changes in groundfish species composition: Pacific cod and rock sole had higher bycatch rates, day or night, and yellowfin sole and pollock had lower bycatch rates. After adjusting for changes in species composition, higher night-time bycatch rates were found in only a small number of cases that were not consistent from year to year. Although results to date have not been useful in suggesting change in management, we will continue to examine the data in hopes of finding practical management solutions to the by catch problem.

Contact: Dr. Bob Trumble

2) Stock Assessment and Other Related Studies

Much of the research that is conducted every year by the Commission staff is aimed at validating and improving the procedures and assumptions that go into the halibut stock assessment. This year's research studies include investigations on population assessment procedures, migration, the effect of species composition on CPUE, and stock and age identification.

a) CAGEAN - The catch-at-age analysis procedure CAGEAN, a procedure developed and used by the Commission staff, is being used for stock assessment analysis on many different fish stocks throughout the world. The staff is currently investigating new and improved approaches to stock assessment that deal with the questions of variability in the dynamics of the stock and the effects this may have on stock assessment. Research indicates that while CAGEAN estimates are good some improvement could occur if this variability were taken into account. Future investigations will focus on the nature of this variability in halibut stock

dynamics and the prospects for using this information for improving assessments.

b) Tagging Studies - In both the assessment of stock abundance and in determining the impact of bycatch questions arise with regard to fish movement. Tagging studies, used to address these questions, have been an ongoing area of research since the Commission's inception. Tag recovery data for fish released in 1980 and 1981 in Areas 3A and 3B indicate movement of juveniles southward at rates of 19-20% per year from Area 3B, 7-10% per year from Area 3A, 16-23% per year from Area 2C, and 3-4% per year from Area 2B. These movement rates will be compared with the movement and survivorship rates of adults to determine the effect that bycatch in one area has on exploitable stock biomass in another.

   Tagging studies indicate that once halibut become adults they tend to remain in a given management area. One question that this brings to mind is how isolated (biologically, genetically, etc.) these fish are from area to area. Otolith microstructure, DNA, and parasite research is being used to address the questions of adult stock separation by looking for area by area differences in morphological, genetic, and biological characteristics of adults. Currently, halibut are assumed to mix fairly well prior to recruitment. High area fidelity by subcomponents of the stock might suggest that growth, fecundity, or recruitment could vary by area. This is a complicated question that may require an extended analysis depending on the preliminary results.

   Contact: Dr. Pat Sullivan

c) Newport Tagging Study - A smaller scale tagging study was conducted on grounds off of Newport, Oregon (Area 2A) in 1989 in order to determine the feasibility of using tagging data to independently assess stock abundance in this and other areas. Results indicate that as a simple, reliable, alternative stock assessment procedure the tagging

approach fails. However, as an exploratory mechanism for examining the behavior of the stock and of the fishery this study provided many interesting results. For example, tag returns from all sources (longline, sport, troll, and trawl) indicate the northward movement of adult fish from this Area, as 2% of the recovered tags were found north of Area 2A in 1989, while in 1990 9% of the recovered tags were found north of this Area. Recoveries from trawl-caught fish make up the greater portion of the returns observed by fishery type and indicate that halibut were on the grounds all year round. The average release size of these trawl caught fish did not appear to change substantially over time, ranging seasonally on average from 80 cm to 90 cm, suggesting that the size composition of the smaller fish in this area did not change much between seasons.

d) CPUE - Catch per unit effort experiments continued this year using baited longline gear with hook-timers. Preliminary results indicate that the simple model used to characterize hooking success was relatively successful at reproducing the patterns of bait attack with time. The measured catch rates were affected by the choice of study area (and so presumably changed with changes in bottom type, relative abundance, and species composition) and by changes in bait type. Future research will focus more on examining the factors that influence these rates.

e) Aging Studies - Otolith samples, used for determining the age composition of the halibut catch, are collected from port landings. These samples make up an important component of the stock assessment. Examining the accuracy of the ages obtained from these samples is an ongoing area of research. In 1982 and 1983 fish injected with a substance that leaves a fluorescent mark on the otolith were tagged and released. These marks, in conjunction with data available on how long the fish were at large, indicate that the aging technique in current use is valid for most halibut.

Mr. Blood added that Pacific halibut are in a period of decline. A 5-10% decline is expected to continue. The sport catch is increasing, which presents a challenging situation.

IPHC will hold a July 22 meeting at Sandpoint on the bycatch issue.

Mr. Demory asked if there was a gear group working on trawls with respect to bycatch. He was referred to Craig Rose (NMFS) and the Bycatch project. They would like to develop a trawl that would minimize the catch of halibut.

g. Alaska Department of Fish & Game

Mr. Bracken reported on flatfish for ADF&G.

1) Research

Port samples were taken from the landed catch of flatfish from state waters of Southeast Alaska during 1990 to determine species composition and to obtain length frequency of primary species. A mandatory logbook program in effect for this fishery provides information on CPUE of target species and an estimate of at-sea discards.

2) Management

Trawl fisheries for flatfish are allowed in the internal waters of Southeast Alaska only under the terms of a special permit issued by the department. The permits are generally issued for no more than a month at a time and specify the area and gear configuration allowed. Mandatory logbooks are required and some areas cannot be fished without an ADF&G observer on board. This restrictive management is necessary because of reduced flatfish stocks and because of a history of very high bycatch rates of prohibited species, particularly crab and halibut, in flatfish trawl fisheries conducted in the internal waters of the state.

3) Fishery

The flatfish trawl fishery was restricted to only three small areas during the 1989-90 and 1990-91 seasons with a harvest objective set for each area. A total of 135 mt was taken during 1990 with most of the catch comprised of starry flounder.

Like Pacific cod, the flatfish fisheries in offshore waters are managed in conjunction with the fishery in the adjacent EEZ. The actual amount harvested within three miles of shore is not known.

A discussion followed Mr. Brackens's report.

Mr. Bracken stated his concern that in Alaska vessels are prospecting for halibut prior to the halibut season under the guise of fishing for other species. This is a possible cause of mortality on a declining stock of Pacific halibut. Alaska recommends a long line closure which would start several weeks before the halibut season. There has been a 3 day closure prior to the halibut season which is not adequate.

Mr. Bracken said that it is possible to determine the sex of a dressed halibut by looking at the gonad pocket.

Mr. Demory asked what fisheries are impacting Pacific halibut bycatch.

Mr. Bracken said that the Pacific cod and flatfish fisheries are often shut down as the result of Pacific halibut bycatch.

Mr. Bracken said that the observer program in Alaska is paid for by the fishing vessels, and the observers are trained by NMFS and contracted by individual observer companies.

7. Pacific Whiting (Hake)

a. Canada

Mr. Saunders gave the DFO report on Pacific whiting.

1) Research Programs

Monitoring and biological sampling of offshore Pacific hake was continued through an extensive observer program.

A hydroacoustic survey of offshore hake biomass was conducted from the La Perouse region to Queen Charlotte Sound. Hake were found along the 200 m contour extending into Queen Charlotte Sound. Assuming a target strength value of -35.0 dB/kg, the biomass of hake in the Canadian zone was 317,338 mt of which 178,802 mt was found north of 49 degrees north latitude.

The 6th annual species interaction trawl survey was conducted in August to assess the impact of Pacific hake and other predators on herring survival and recruitment.

Studies examining variation in hake length-at-age off Vancouver Island were completed. Male and female hake sampled in the summer off southern Vancouver Island show a general decline, plus marked variability, in mean lengths-at-age since 1976. Multiple regression analysis related the length-at-age pattern to von Bertalanffy and density-dependent growth, length-selective fishing mortalities and a suite of oceanographic covariates (sea level height, temperature, and salinity anomalies). Because offshore Pacific hake migrate annually between southern California and British Columbia, with larger fish migrating further north, we deduce that the summer fishery in Canadian waters selectively removes the larger hake each year causing a decline over time in mean lengths-at-age.

A cruise was conducted in February of 1990 to examine the winter distribution of offshore hake from Canada to the U.S./Mexico border. Spawning concentrations were found at approximately 35 and 37 degrees north latitude and from 60 to 100 nm offshore. The age and length frequencies, age and growth parameters and occurrence of parasites (Kudoa sp.) matched those of concentrations fished during summer months in nearshore areas.

2) Stock Assessment

Hydroacoustic and swept-volume trawl estimates were determined for hake in the Strait of Georgia during March 1987.

A discussion of offshore hake stock status is presented in the progress report of the Can/U.S. working group on Pacific hake.

3) Management and Regulations

Hake off the west coast of Vancouver Island are managed by annual quota. A proportion of the quota is retained for domestic fisheries and in 1990 as in previous years, the remainder was allocated to a joint-venture fishery. Each country participating in the joint-venture fishery negotiates for an allocation. The total Canadian quota for 1991 is 98,000 mt.

In the Strait of Georgia the 1991 quota is 11,000 mt.

Mr. Saunders reported that DFO has a large observer program which includes coverage on foreign boats and the new joint venture fishery. Canada is having an increasing domestic component to the Pacific whiting fishery.

DFO has found spawning concentrations of hake off Southern California some 100 to 125 miles offshore.

There was then a general discussion of research and papers on hake. There is a paper on interactions between herring and hake. There is a paper on rations size and feeding.

b. National Marine Fisheries Service - AFSC

Mr. Wilkins reported on Pacific whiting for AFSC.

1) Stock Assessment

The total harvest of Pacific whiting by the U.S. and Canada in 1990 is expected to be 269,500 mt, down from a high of 309,000 mt in 1989. The fishery continues to be supported by the strong 1980 and 1984 year classes. Assessment surveys in 1989 estimated the population biomass as 1.637 million t, a decline of 24% from estimates made in 1986, but a lesser decline than projected in last year's assessment. In the 1990 assessment, the stock synthesis model was used to estimate age-structured population abundance, past levels of female spawning biomass, and recruitment for the 1959-87 year classes. The assessment model was revised to include geographic structure and to estimate the parameters of a function defining the age-specific, annual migration of fish across the U.S.-Canada border. Recruitment estimates and fishery selectivity coefficients from the stock synthesis model were used with an age-structured simulation model to estimate sustainable yield under different harvesting strategies and levels of reduction in female spawning biomass. Several harvesting strategies were explored: a constant F strategy; a variable F strategy, where fishing mortality for a particular year is proportional to the level of female spawning biomass; and a hybrid strategy that combines features of the other two policies. The hybrid strategy avoids the extreme variability in yield of the variable F strategy, yet increases protection of the stock at low levels of female spawning biomass. Long-term average yield depends on risk levels defined as the frequency with which female spawning biomass is expected to fall below a cautionary level of

457,000 mt. Estimates of average yield ranged from 168,000 to 227,000 t for the constant F strategy, and from 187,000 to 235,000 t for the hybrid strategy over a reasonable range of low biomass frequency. When a hybrid fishing strategy is applied to the projected numbers at age in 1991, the potential coastwide yield is calculated to be 253,000 t. The prospects in the immediate future for the Pacific whiting resource are for stable or declining yields depending on the timing of the next strong year class.

2) Research

Research on Pacific whiting in 1990-91 focused on development of the geographically structured assessment model and estimation of the age and size at maturity.

For further information, contact Martin Dorn at (206) 526-6548

c. National Marine Fisheries Service - SWFC

Dr. MacCall reported on Pacific whiting for SWFC.

He said that the Mexicans are considering fishing for hake off Mexico. It will possibly be a joint venture fishery between Mexico and Japan. There is concern that this may be a roe fishery.

d. Washington Department of Fisheries

Mr. Jagielo reported on Pacific whiting for WDF.

Each year, a management plan is developed for the commercial harvest of the Central Sound whiting resource. Harvest quotas, fishing areas and periods are recommended. All fishing activity is closely monitored and a summary of the fishery is provided.
Contact: Gary Davis.

e. Alaska Department of Fish & Game

No report was provided on Pacific whiting for ADF&G

f. Oregon Department of Fish and Wildlife

Mr. Demory briefly reported on ODFW bycatch sampling of domestic hake trawlers. An observer will be hired by ODFW to observe hake catches by Oregon trawlers fishing out of Newport, Oregon. The observer will be trained and supervised by ODFW. The catch will be observed at sea and as it is off loaded in Newport. The primary purpose of the observer is to document any bycatch by the trawlers while fishing for hake.

The observer will start working about June 1, but ODFW biologists completed two observer trips in May to help set up the project. They observed very little bycatch and no catch of salmon.

8. Dogfish

a. Alaska Department of Fish & Game

Mr. Bracken reported on dogfish for ADF&G.

1) Research

The relative catch rate of dogfish is being monitored in the Southern Southeast Inside area in conjunction with the Southern Area sablefish survey.

2) Management

There are no seasons, gear restrictions, or harvest limits for dogfish in the territorial waters of the state at this time. No directed fisheries for dogfish were reported in state waters during 1990.

b. Washington Department of Fisheries

Mr. Jagielo reported on dogfish for WDF.

A dogfish tagging and assessment study was conducted in East Sound (Area 7E) in 1990. This project estimated the stock size of the spiny dogfish population in West Sound and gained information on their migration and interception by other gears. The information resulted in a harvest recommendation for the East Sound dogfish fishery.
Contact: Gary Davis

Dr. MacCall asked if there was any recreational fishery for dogfish.

Mr. Jagielo answered that there was no recreational fishery for dogfish.

c. Canada

Mr. Saunders reported on dogfish for DFO.

1) 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.

Analysis of dogfish age-at-maturity was completed. Female dogfish mature at 35 years of age in the Strait of Georgia. It appears that this age is optimal with respect to the reproductive output of a cohort.

A biological sampling program was continued to look at diet, sex, size, fecundity, and movement of spiny dogfish in nearshore waters of the Strait of Georgia.

2) Stock Assessment

An age-structured deterministic model developed by Wood et al. (1979) continues to be used to evaluate the condition of the stocks in the Strait of Georgia and offshore. At current levels of harvest both offshore and in the Strait of Georgia, the stock is predicted to increase steadily over the next 5-10 years.

3) Management and Regulations

Dogfish are managed by annual quota with separate quotas in place for the Strait of Georgia (3,000 mt) and for the remainder of the coast (15,000 mt).

Mr. Saunders added that PBS is still getting back tags from dogfish. He also said that Canada has a study on interaction between dogfish and salmon. They are looking at dogfish predation on juvenile salmon and its impact on the hatchery program.

Mr. Saunders said that there are low but consistent landings of dogfish.

Mr. Bracken asked where the market was for dogfish.

Mr. Saunders said that there was no domestic market, but backs and bellies are exported to Europe while some headed and gutted product, along with fins go to Japan.

Mr. Glock mentioned that mesh size in trawls used to catch dogfish is a concern of some fishermen. Some would like to use small mesh trawls when fishing for dogfish.

9. Lingcod

a. Alaska Department of Fish & Game

Mr. Bracken reported on lingcod for ADF&G.

1) Research

A preliminary study which was begun during the winter of 1988 continued through 1990. It is designed to determine lingcod nesting locations, spawn timing, and the timing and duration of lingcod nest-guarding in Southeast Alaska. This study is being accomplished using a two-stage approach. An on-board observer participated with cooperating local fishermen to obtain sex and size samples from the directed lingcod "dinglebar" fishery. In addition, dive transects were completed in diver depths in areas adjacent to known harvest locations to observe nesting lingcod.

Preliminary data suggests that the spawning and nest guarding period extends later in the year in Southeast Alaska compared to published information from other areas.

2) Management

Beginning in July 1989 lingcod fisheries were managed with a 27-inch year round minimum size limit. This is the first commercial regulation for this species in the state and was in response to increased targeting on small fish by an expanding directed fishery. New regulations which will provide for a January 1 to May 31 closure inside the surfline and a directed fisheries quota will be implemented in 1991.

3) Fishery

Most of the lingcod taken in Alaskan waters come from the Southeast area. Lingcod are landed incidental to hook-and-line fisheries for other species and, in recent years, have been the target of an expanding "dinglebar" fishery. Dinglebar gear is power troll gear modified to fish for bottomfish.

A total of 355 mt of lingcod was reported during 1990. Of that, 140 mt was taken by dinglebar gear, 164 mt was landed on longline gear, and 51 mt was landed incidental to the power troll fishery for salmon.

A discussion followed Mr. Bracken's report.

Mr. Bracken added that nest guarding by lingcod has been seen into May and that the surf line closure on fishing includes protection for all bays. A minimum size limit of 27 inches or 20 1/2 inches for dressed fish is used in Alaska. Lingcod catch has increased dramatically in recent years.

Mr. Zyblut asked what dingle bar gear was.

Mr. Bracken described dingle bar gear as modified troll gear with special terminal end tackle. The breakaway end uses an inexpensive disposable weight so that the gear can be fished over very rough ground. The gear is trolled slowly along or over rough reefs. Mr. Bracken then gave some of the locations where dingle bar gear is fished off Alaska.

Mr. Zyblut asked why Alaska had a 27 inch size limit.

Mr. Bracken answered that the size limit was based on the size of females at full maturity which also protects the smaller next guarding males.

b. Washington Department of Fisheries

Mr. Jagielo reported on lingcod for WDF.

The nearshore tagging study at Neah Bay is in its sixth year. We are computing estimates of abundance, survival, and fishing mortality. The scope of the work expanded this year to include both offshore and nearshore tagging releases, for the purpose of estimating the net mixing rates between the two areas. Also, a stock assessment of lingcod in areas 3A/3B/3C is in progress. This assessment is using the "Stock Synthesis" approach of Rick Methot. A paper on movement of tagged lingcod at Neah Bay, and a paper describing the development of the tagging model used for estimation of population parameters at Neah Bay were completed.
Contact: Tom Jagielo

Mr. Bracken asked how WDF handled the lingcod and what type of tags were used.

Mr. Jagielo said that WDF used twist tie tags and the fish were caught on dingle bar gear. The fish are robust. WDF has double tagged recoveries on 70 fish with no tags missing. He does not recommend anchor tags for lingcod, and dart tags have growth which causes loss of tag identification information.

The twist tie tag is an Australian tag (Hall Print) which is placed loosely on the opercular plate of the fish.

Mr. Jagielo said that WDF has tried to catch offshore lingcod with trawl, but has had poor catches to date with that gear.

c. Canada

Mr. Saunders reported on lingcod for Canada.

1) Research Programs

Lingcod research over the next year will emphasize monitoring and rebuilding regimes for depleted stocks in the Strait of Georgia. There are four parts to the proposed program. First, approximately 3,000 juvenile lingcod will be tagged and transplanted from offshore areas to the Gulf Islands. Second, SCUBA surveys will monitor reef areas where the releases occurred. Third, trawl surveys at selected sites will be conducted for young-of-the-year lingcod. It is hoped that these surveys will provide a useful abundance index. Fourth, a small number of transplanted lingcod will be tracked using ultrasonic tags. An ultrasonic tracking study on adult fish was completed in April 1991. Male lingcod, relocated over 2 km away, returned to the exact site of their capture within 24-72 hours, with all movement occurring at night.

2) Stock Assessment

The assessment is unchanged from the previous report.

3) Management and Regulations

The Strait of Georgia is closed to the commercial harvest of lingcod for 1991. A size limit of 65 cm is being implemented for the sport fishery, along with a one fish per day limit, and a June 1 - September 30 season. The commercial size limit is 58 cm for the remainder of the coast.

d. National Marine Fisheries Service - SWFC

Dr. MacCall reported on lingcod for SWFC.

Lingcod research at the SWFSC Tiburon Laboratory consists of an age validation study, completion of an analysis of commercial trawl data by trip, and initiation of an analysis of recreational catch data. To date, we have tagged and injected with oxytetracycline (OTC) 251 lingcod, and have recovered 13 of these fish. Four of the recovered fish were at liberty long

enough to have put on one ring, confirming our ageing from fin ray sections as annual rings. To reach the original target of 50 recovered lingcod with at least one annual ring, we will need to increase the number of tagged fish. An important question is whether the nucleus represents one or more annual rings. To answer this question, we are currently collecting young-of-the-year lingcod using beach seines that will be injected with OTC and grown out at the Bodega Marine Laboratory. This will be done annually for several years.

We have completed a final draft of an analysis of the PacFIN lingcod landings data by trip. The analysis shows that a large percentage of the lingcod trawl landings come from a small percentage of the trips that land lingcod. This indicates that some targeting on lingcod is occurring, and that sampling lingcod landings will be difficult since missing these rare large landings could introduce substantial bias if they are different than the majority of the lingcod trips. A limited subset of individual vessels is the only consistent factor associated with these large landings. Finally, we have initiated an analysis of the recreational lingcod catch using the marine recreational survey data, because recreational catch is a relative large portion (approximately one third) of the total lingcod catch.

Dr. MacCall reported that one of the lingcod which was tagged off California was recovered off Oregon.

e. Pacific Fishery Management Council

Mr. Glock reported that there is a decrease in the bag limit for lingcod caught in federal waters. The limit is 5 fish with a 22 inch minimum size off California.

10. Other Species

a. Alaska Department of Fish & Game

Mr. Bracken reported on other species for ADF&G.

There were no regulations in effect for other species of groundfish in state waters of Alaska during 1990. An "emerging fisheries" policy is being developed for new fisheries which will reduce the possibility that a fishery can escalate out of control before regulations can be developed.

A small target fishery for hagfish continued in 1990, but landings were mall. One vessel has been maintaining logbooks and one landing was sampled for length frequency.

Mr. Bracken added that there has been an increase in small sleeper sharks. These are sub adult fish at about 4-5 feet in length and 250 - 300 pounds. There are more sharks now than ever before recorded.

There was a general discussion of the hagfish fishery.

Mr. Zyblut asked how extensive was Alaska's hagfish fishery and how were the fish handled.

Mr. Bracken answered that the fishery was small and sporadic and two species were caught. The fish don't seem to follow the fish keys, so they may be different species or sub-species.

b. Washington Department of Fisheries

Mr. Jagielo reported on other species for WDF.

1). Walleye Pollock.

A stock assessment of Walleye Pollock is near completion. Walleye pollock provides for two localized fisheries in Puget Sound. A commercial fishery in the Strait of Georgia occasionally harvests spawning pollock that move to the U.S. from Canadian waters. A local stock near Tacoma has provided the foundation for the development of a once thriving charter fishery. Catch-at-age, catch rate, and trawl survey data have been used to evaluate the southern stock of pollock.
Contact: Wayne Palsson

2). Smelt.

A study of the Laconner smelt fishery was completed. This special fishery for smelt occurs along the waterfront at Laconner. Creel survey methods were developed to estimate catch and effort during two years of the fishery.
Contact: Sue Hoffman

Mr. Jagielo added about smelt that the Laconner smelt fishery was an exciting derby fishery. He also added that habitat studies for surf smelt were being conducted.

c. Oregon Department of Fish and Wildlife

Mr. Barss reported on hagfish for ODFW.

From Abstract by Barss, W. 1990. The Oregon hagfish fishery and results of sampling Pacific hagfish and black hagfish in 1988 and 1989

(manuscript).

"In 1988, the Oregon Department of Fish and Wildlife began sampling and monitoring the development of a new fishery off the coast of Oregon on Pacific hagfish Eptratretus stouti and black hagfish E. deani. Hagfish landings by Oregon trap vessels were 25,782 pounds in 1988 and 344,187 pounds in 1989. Whole frozen fish were shipped to South Korea for the "eel skin" leather market. In 1988 through 1989, we sampled 924 Pacific hagfish and 897 black hagfish from commercial and research catches. Mean length of fish sampled from commercial landings was 39.6 cm for Pacific hagfish, and 34.5 cm for black hagfish. Weight-length relationships (W-aLb) were calculated for males and females of both species. Fifty percent maturity for male and female Pacific hagfish was 35 cm and 42 cm respectively. Fifty percent maturity for male and female black hagfish was 34 cm and 38 cm respectively. Data indicated that both species may either spawn throughout the year or have a protracted spawning period. Mature females of both species had one to three distinct sizes of eggs but usually contained only one size group over 5 mm in length. Mature Pacific hagfish females averaged 28 eggs over 5 mm in length, and black hagfish females averaged 14 eggs over 5 mm in length. Hemaphroditism was found in 0.2% of the Pacific hagfish."

Management of hagfish at this time is limited to a biodegradable escape exit installed on traps.

d. Canada

Mr. Saunders reported on other species for DFO.

1) Walleye Pollock

a) Research Programs

A study examining age determination structures from five stocks of pollock in the northeast Pacific Ocean was completed. It was found that the most appropriate structure/method for age determination may vary among stocks. Pectoral fin-ray sections, otolith surfaces and burnt otolith sections are all suitable structures for stocks consisting of mainly younger fish. For these stocks, the pectoral fin-ray annuli were the easiest to identify. For other stocks, the burnt otolith section consistently produced older age estimates. Using burnt otolith cross-sections it was still possible to identify strong year-classes in Bering Sea pollock in 1978 and 1973.

b) Stock Assessment

The assessment of pollock stocks has not changed since the previous report. The Strait of Georgia quota is based on a surplus production calculation given the biomass as assessed in 1981 and 1988 using hydroacoustic and swept-volume survey methods.

c) Management and Regulations

Pollock are managed by annual quota in the Strait of Georgia (3,700 mt). Given extreme variation in availability and uncertainty regarding stock discreteness, fishing is not restricted in other areas of the coast.

2) Hagfish

Pacific hagfish have been experimentally fished off the west coast of Vancouver Island since 1988. Permits are issued and managed by Fisheries Division staff. Participation in the fishery has ranged from 0 -11 vessels depending on the time of year and market demand. Catch and effort data and monthly biological samples have been collected from all vessels active in the fishery. Two study areas have been established to monitor monthly changes in abundance, sex ratios and female gonadal conditions. Collection and analysis of CPUE and length frequencies will be continued to determine sustainable harvest levels for the Pacific hagfish.

e. National Marine Fisheries Service - AFSC

Mr. Wilkins reported on other species for AFSC.

1) Walleye Pollock

a) Stock Assessment

(1) Gulf of Alaska

Estimates of the total biomass of the walleye pollock (Theragra chalcogramma) stock are derived from bottom trawl surveys and annual hydroacoustic surveys. Summer bottom trawl surveys of the Western and Central management areas were made in the summers of 1984, 1987 and 1990. An additional survey of the Kodiak INPFC area was made in the fall of 1989. Hydroacoustic surveys have been conducted in Shelikof Strait during the spawning period (March) on an annual basis since 1981 with the exception of 1982. In earlier

years it was assumed that the majority of pollock in the Gulf of Alaska returned to Shelikof Strait to spawn. Therefore, it was assumed that the biomass of the spawning stock in Shelikof Strait was representative of the Gulf wide pollock stock.

Biomass estimates derived from the two survey types do not show similar trends. The bottom trawl surveys indicate that the pollock stock biomass remained relatively stable between 1984 and 1990. The 1984, 1987 and 1990 gulfwide biomass estimates were 691,915 t, 849,026 t and 799,154 t respectively. The 1989 bottom trawl biomass estimate in the Kodiak INPFC area alone was 652,544 t. Biomass estimates based on the annual hydroacoustic surveys show a sharp decline from 3.7 million t in 1981 to 381,594 t in 1990 (ages 2 - 12). Clearly, the abundance trends bottom trawl and hydroacoustic surveys are not in agreement.

The stock synthesis model was used to assess the status of the Gulf of Alaska pollock stock in 1991. Two configurations of the model were considered in which both the hydroacoustic and bottom trawl data sets were included. Each configuration of the model was run assuming natural mortality was equal to 0.3.

In the first configuration (Model A) a low emphasis was placed on hydroacoustic data. In the second configuration (Model B), the hydroaocustic biomass estimates were treated as indices of abundance, and the only quantitative biomass estimate included in the model was the 1990 bottom trawl estimate. A high emphasis was placed on the 1990 bottom trawl estimate to insure that the model provided a close approximation to this value.

The necessity for developing Model B was based on the observation that the 1981 and 1983 biomass estimates produced from Model A were much lower than the estimates of biomass from hydroacoustic surveys of

Shelikof Strait. Likewise, the recent hydroacoustic survey biomass estimates from Shelikof Strait have been much lower than the gulfwide bottom trawl estimates. One explanation for the observed discrepancies between the two models is that the abundance of pollock in the demersal habitat remains relatively constant while the pelagic fraction of the stock may vary considerably depending on year class strength. Model B is an attempt to reconcile these problems. Weighting the hydroacoustic time series equally to the fishery data, provides a mechanism for accounting for the large population estimates observed in the early 1980's. Tuning to the 1990 bottom trawl biomass estimate adjusts the ending biomass to a level that was observed in the recent gulfwide bottom trawl survey. Model B provided the best integration of the available data. The relative fit of both models to recent data is similar, however Model B provided a better fit to the early time series.

The updated time series of recruitment and spawner stock biomass levels provided from the stock synthesis Model B was used to evaluate the relationship between spawners and recruitment. As in previous analyses there appears to be a strong density dependent mechanism which reduces year class success when the spawning population is large, however, the time series of data is too short to support this conclusion.

A deterministic model was developed for the estimation of Fmsy. The model was a yield-per-recruit model which was modified to incorporate estimates of age specific fishing mortality, and maturity-at-age. Additional runs of the model were made under constant recruitment conditions. Under the assumption of a asymptotic spawner recruit relationship, estimates of F_{msy} and $F_{0.1}$ derived from parameters from Model B were 0.115 and 0.098 respectively. The estimate of spawning stock biomass associated with F_{msy} was 785,075 t (Table 10). Under the assumption of constant

recruitment, the estimates of F_{max} and $F_{0.1}$ were 0.457 and 0.240.

There was sufficient concern with the stock-recruitment relationship, that the estimates of fishing mortality associated with sustainable yields may be inaccurate. Therefore, the overfishing level of fishing mortality was defined as the rate that results in the biomass-per-recruit ratio falling below 30% of the pristine level. This fishing mortality rate was 0.416.

Projections were initiated for two initial population vector scenarios. The two initial population vectors were estimated from the results of synthesis Models A and B. The projections were made under the assumption that yield would be set equal to 10% of the biomass age 3+. A pessimistic outlook regarding future recruitment of the 1989, 1990 and 1991 year classes was used in the projections to provide a cautious approach regarding the incoming year class.

The projections were initiated with the expected age composition of the stock in 1991. Considering the current condition of the stock, an ABC of 100,000 t was recommended for 1991. The recommended ABC of 100,000 t is well below the yield associated with overfishing which would be 385,000 t.

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

(2) Bering Sea and Aleutian Islands

Pollock abundance in the eastern Bering Sea was estimated with two age-structured methods, cohort analysis and CAGEAN, with data up to and including the 1989 catch-at-age and 1988 combined hydroacoustic and bottom trawl survey. Cohort analysis indicates a minor decrease in abundance while the CAGEAN results indicate a sharp drop in biomass since the peak value in

1985. The confidence interval around the 1989 CAGEAN estimate overlaps the cohort analysis and trawl survey biomass estimates. The cohort analysis biomass estimates were chosen over CAGEAN because the cohort analysis uses more age-specific information from the surveys than does CAGEAN.

Current abundance is above Bmsy (5.9 million t). The strong 1982 and 1984 year-classes now contribute substantially to the fishery. Recruitment of age-three pollock in 1990-92 is projected to be slightly below the median of the past decade. The ABC for this stock was computed with an exploitation rate corresponding to $F_{0.1} = 0.31$ which is close to $F_{msy} = 0.33$ obtained by Quinn and Collie. Application of this fishing mortality rate gives a 1991 eastern Bering Sea ABC of 1,676,000 t. The ABC is greater than in 1990 because 1991 projected biomass is higher than the value projected for 1990 in 1989. Exploitation at the $F_{0.1}$ rate when abundance is greater than Bmsy does not violate the Council's overfishing definition.

The Aleutian Islands pollock stock has not been surveyed since 1986, when the exploitable biomass was 524,074 t. Biomass in 1991 was projected by assuming that the proportional decline in abundance since 1986 in the Aleutian Islands was the same as in the eastern Bering Sea (0.77 x 1986 biomass). Application of a catch to biomass ratio of 0.25 yielded an ABC of 85,102 for the Aleutian Islands stock. This is lower than the 1990 ABC because a different approach was used to estimate exploitable biomass.

Pollock taken near Bogoslof Island have a consistently different age composition and slower growth rates compared with the eastern Bering Sea stock. A hydroacoustic survey in the winter of 1989 estimated the abundance of Bogoslof pollock to be 2.1 million t. Projecting this biomass to 1991 and applying an exploitation rate of 0.25 resulted in a 1991 ABC of

286,000 t for the Bogoslof fishery. However, it is likely that these pollock are also caught outside the U.S. EEZ and that the entire Bogoslof ABC may be caught in international waters. Therefore the Bogoslof ABC is not added to the eastern Bering Sea ABC for the purpose of determining the Bering Sea pollock TAC.

Large catches continue to be removed from the international zone of the Aleutian Basin (donut hole). The 1988 catch of 1.5 million t exceeded the catch from the U.S. EEZ. Data collected to date suggest that donut hole pollock are related through spawning and recruitment to pollock on the surrounding continental shelves. Future ABCs in the U.S. EEZ may need to be adjusted for catches taken elsewhere.

For further information contact Dr. Vidar Wespestad, (206) 526-4249.

b) Management

REFM scientists provided analytic assistance on many current fisheries management issues involving pollock. These included: 1) Provided analysis for the section 7 (Endangered Species Act) biological opinion concerning the interaction between the Gulf of Alaska commercial pollock fishery and the threatened Steller sea lion population; 2) Provided an environmental impact statement for the proposed amendment to the Bering Sea/Gulf of Alaska FMP to allocate Gulf of Alaska pollock and cod and Bering Sea pollock between the inshore and offshore components of the industry; 3) Provided an analysis of Bering Sea pollock stock structure to various international research organizations. REFM also organized and hosted an International workshop on pollock assessments in the Bering Sea.

2) Squid

Research

A cooperative squid jigging research survey was conducted aboard four Japanese squid jig vessels by the AFSC and Japanese participants during August and September, 1990 to determine the distribution and abundance neon flying squid (Ommastrephes bartrami) and examine the feasibility of harvesting this species with jig gear. Four Japanese vessels, each with one U.S. scientist aboard and one with a Japanese scientist, fished at 142 stations in the U.S. Exclusive Economic Zone off Washington and Oregon using overhead attraction lights, automatic jigging machines, and handlines. Although operations were scheduled to last 80 days beginning 1 August, the project was discontinued on 4 September because the vessels had failed to locate significant aggregations of squid. Information on catch, effort, and biological characteristics were collected from target and bycatch species.

Mr. Wilkins report was followed by a general discussion of stock studies.

Mr. Saunders asked about the findings of the stock discreteness study.

Mr. Wilkins answered that the Bering sea work shows seasonal movement.

Mr. Wilkins added that the warm ocean conditions were not good for squid. It was found that handlining which uses larger jigs was more productive than using the automatic jigging machines. The machines work well only with spawning aggregations of squid.

There was a general discussion of Japanese squid vessels, gear and how the gear was fished.

Mr. Zyblut said that possibly two Japanese squid vessels might fish off B.C. this summer.

Mr. Wilkins said that there would probably be no experimental squid fishery off the U.S. this year. NRC (Alversons Group along with Cpt Fisher) was promoting squid work off Oregon.

There was a discussion of shark fisheries.

Dr. MacCall said that there has been a decline in the thresher shark fishery off California.

The group then discussed the mako shark fishery off California which is on juvenile shark.

D. Other Related Studies

1. Alaska Department of Fish & Game

Mr. Bracken gave the ADF&G report of other related studies.

Table 1. Total landings (t landed weight) from State of Alaska managed groundfish fisheries in Southeast Alaska, Prince William Sound, and Cook Inlet by major species group, 1989 and 1990.

Species	1989	1990
Sablefish	1,470	1,200
Rockfish	652	644
Flatfish	117	137
Pacific cod	186	475
Lingcod	186	229
Total	2,611	2,754

a. Age Reading Laboratory

During 1990 ADF&G began to establish a full-time age reading laboratory. The lab is located in Douglas within the Southeast Regional Office complex and will be used for both groundfish and thermal marked salmonid otolith reading. Initial groundfish aging emphasis will be on sablefish and near -shore rockfish with the possible inclusion of lingcod at a later date.

Funding for this facility did not become available until late in the year and so progress during 1990 was limited to purchase of equipment and recruitment for an age-reading technician. The lab was set up and reader training began early in 1991. It is anticipated that the lab will be fully operational by mid-1991.

b. Halibut Bycatch Observer Contract

During 1990 ADF&G received a contract from the International Pacific Halibut Commission to place observers aboard groundfish vessels to determine bycatch rates of halibut. By agreement, a portion of the contract money was used to help NMFS with their debriefing program for the mandatory federal groundfish observer program.

Information on the results of this work are available from Bill Nippes, ADF&G, Kodiak, Alaska.

c. Pacific Cod Pot Catch Rate Study

During 1990 ADF&G worked on a cooperative study with the Alaska Fisheries Development Foundation and the fishing industry to determine the effectiveness of various tunnel opening configurations in groundfish pots. The purpose was to find an opening configuration which would effectively reduce crab and halibut bycatch while retaining Pacific cod of the desired market size. The results of this study have not yet been published, but preliminary information can be obtained from Dave Carlile, ADF&G, Juneau, Alaska.

A discussion followed Mr. Bracken's report.

Mr. Demory asked if ADF&G expects to see Alaska allowing the retention of Pacific halibut bycatch in the future.

Mr. Bracken answered that politics would not allow halibut bycatch retention. In the long run, the NPFMC may eliminate the use of non selective gear by large trawlers from some areas because of bicatch problems.

Mr. Demory asked if it was appropriate to consider Pacific cod and Pacific halibut and maybe sablefish and rockfish as a species complex for longliners under an IQ system.

There was then a discussion about Pacific cod pots.

Mr. Saunders asked about the effectiveness of cod pots.

Mr. Bracken answered that Pacific cod pots are reported to be most effective during the spawning season when the fish are concentrated. Long line gear is generally considered to be better during the rest of the year. He added that mesh size in traps should eliminate juvenile catch problems.

2. Washington Department of Fisheries

Mr. Jagielo reported on other related studies for WDF.

a. Marine Fish Shore Fisheries.

Using a "Bus-Route" experimental design, catch, effort, and biological information are being collected from shore-based recreational fisheries targeting marine fish along the Washington coast. We are now in the first year of a three year project. Work from this study will illuminate catch and effort trends in coastal shore based fisheries for management purposes. The sampling methodology from this project will be evaluated for its potential use in other coastal marine fish recreational fisheries.
Contact: Farron Wallace

b. Puget Sound Pelagic Resources Assessment.

Since the early 1970's, the Acoustics Unit has conducted hydroacoustic surveys of Pacific herring and Pacific whiting to estimate population abundance, distribution, and migratory timing throughout Puget Sound. These surveys provide resource managers with real-time, in-season biomass estimates which are used to set harvest quotas and manage fisheries.
Contact: Steve Burton/Norm Lemberg

c. Rockfish Assessment in Puget Sound

In the past year, the Acoustics Unit has been developing assessment techniques suitable for rocky reef habitats. Underwater video and observations by SCUBA divers are being used in conjunction with acoustics for species identification. Once developed, the assessment methodology shall be implemented in five sub-regions (south Sound, central Sound, north Sound, San Juan Islands, and the Strait of Juan de Fuca). The sub-regions will be the focus of intensive surveys, once every five years on a sequential revolving basis, to determine rockfish density, distribution, and abundance between 5-150 m.
Contact: John Boettner/Norm Lemberg

d. Rockfish Assessment - Coastal Washington.

Presently, the Acoustics Unit is engaging in its sixth year of a Wallop-Breaux funded project to assess the status of black rockfish in the neritic zone of coastal Washington. The overall objectives of these investigations have been to (1) estimate the total available black rockfish habitat with bottom mapping surveys, (2) develop a coast-wide acoustic survey plan, and (3) implement acoustic surveys in conjunction with biological sampling using mid-water trawl and set nets. Our future goal is to append biological and habitat data bases to the recently acquired Geographic Information System

(GIS) and generate distributional coverages of fish density for management purposes.
Contact: John Boettner/Steve Burton/George Kautsky

e. Development of Hydroacoustic Survey Methods for Pacific Cod.

Pacific cod are difficult to assess because they don't have reliable structures for aging and because they are semi-pelagic. Two years of studies were conducted to determine the feasibility of assessing cod biomass with hydroacoustic technology. The results were favorable for the cod stock in Agate Passage.
Contact: Norm Lembaerg/Stevae Burton/Wayne Palsson

f. Target Strength Investigations with Dual and Split Beam Sonar.

Since 1987, the Acoustics Unit has employed dual and split beam sonar to obtain target strength data on species routinely assessed. These data are critical for scaling echo integrated data to obtain fish biomass estimates. Additionally, real-time information on fish size is useful for directing biological sampling activities.
Contact: George Kautsky/Steve Burton

g. Charter Fleet Study.

The results of an intensive study of Puget Sound's charter fleet ware published. Voluntary logbooks and dockside monitoring provided information to estimate the magnitude of the charter fishery for bottomfish.
Contact: Greg Lippert

h. Dive Charter Study.

Seven years of observer data provided for an in-depth study of the fishery for bottomfish by dive charters in the San Juan Islands. Dive trips, divers, and the bottomfish catch were characterized.
Contact: Greg Lippert/Wayne Palsson

i. Development of Creel Survey Methods for Discrete Marine Fisheries.

Boat-based fisheries for lingcod and Pacific cod have evolved at Tacoma Narrows and Agate Passage. These are unique marine fisheries since all of the effort can be observed at once. Creel survey techniques and estimation methods were developed for the management of these fisheries. A paper was presented at the American Fisheries Society Symposium on Creel Survey Methods in April 1990. The paper was completed in summer 1990 for inclusion in the proceedings.
Contact: Wayne Palsson

j. Angler Opinions About the Management of Bottomfish in Puget Sound.

A telephone survey was conducted to obtain unbiased views of bottomfish management in Puget Sound. With the prospect of increasing effort and reduced opportunity, we found out what kinds of regulations anglers would prefer.
Contact: Cyreis Schmitt

k. Management Plan for Puget Sound Recreational Fisheries for Bottomfish.

The results of five years of special studies were synthesized, and a recreational fishery plan was developed for recreational bottomfish fisheries. Management constraints were identified and melded into a rational protocol for maximizing angler opportunity, minimizing regulation complexity, and conserving stocks.
Contact: Cyreis Schmitt

l. Development of a Reef Map of Puget Sound.

Geographical Information Systems (GIS) are being developed for Puget Sound that will provide WDF with a map of reefs in Puget Sound. Staff participated in an interagency task force to identify data sources and formats and to prioritize the inclusion of information layers in a Puget Sound GIS.
Contact Wayne Palsson

m. Development of the "Habitat-Density" Method of Reef-fish Assessment.

Fishery-dependent data often provides poor information about stock abundance. Traditional methods of direct assessment are lacking for reef-fishes. We are applying new acoustic and video technology to this problem by developing a remote method to estimate densities of lingcod and rockfish. Using the reef map, estimates of total abundance of these species may be possible.
Contact: Wayne Palsson

n. Fishery-based Stock Assessment of Rockfish and Lingcod.

Catch, effort, and catch rate data from recreational fisheries have been used in production models and stock assessments for lingcod and rockfish. These results are being evaluated and regulation changes are being considered.
Contact: Cyreis Schmitt

o. Trawl Survey of Puget Sound.

Bi-annual trawl surveys of Puget Sound were initiated in 1987 with the main goal of estimating flatfish abundance. The data are being compiled and new surveys conducted so that these species and others can be assessed. A stock assessment of English sole is being conducted by Paul Mongillo. Contact: Cyreis Schmitt

Mr. Clausen asked how the acoustic work was going for WDF.

Mr. Jagielo made reference to a report of WDF acoustic work.

A discussion followed about WDF's GIS system.

There was then a discussion of artificial reefs.

3. Oregon Department of Fish and Wildlife

Mr. Demory and Barss gave the ODFW report of other related studies.

Submersible project:

We continued our cooperative study with Oregon State University on deep-reef fish assemblages off Oregon which began in 1987. We used the submersible Delta to re-sample our six permanent stations at Heceta Bank, sample eight stations at Coquille Bank, and sample three stations at Daisy Bank (Nelson Island). Data will be used to compare the habitat structure and fish/invertebrate assemblages occupying the only three deepwater rocky banks on the Oregon continental shelf. Data from Heceta Bank will also be used to document interannual variation in fish assemblage structure over a period of four years. By tracking acoustically tagged yellowtail rockfish at Heceta Bank we found that this species exhibits strong homing tendencies and short-distance diurnal migrations.

Mr. Barss added that ODFW would conduct a cooperative study with Oregon State University by using a submersible and hydroachoustic gear to study Stonewall Bank in 1991.

There was a general discussion about submersibles.

Mr. Bracken stated that a problem with submersibles was that they could not be used in water shallower than about 20 fathoms, because there were ballest problems in shallow water.

Mr. Blood asked if any halibut activity was seen from submersibles off Oregon.

Mr. Barss said that several halibut had been observed on Heceta Bank after the first year of the four year study and also on Daisy Bank in 1990. Pacific halibut were able to blend in with the bottom and were hard to see. The halibut were strong swimmers and it was often difficult to get close to them with the submersible.

Mr. Jagielo asked if lingcod spawning activity was seen from the submersible.

Mr. Barss said that the dives were conducted in August and September which is the wrong time of year to observe spawning activity of lingcod, and no spawning activity was seen.

4. Canada

Mr. Saunders reported for DFO on other related studies.

a) La Perouse Program

This cooperative research project, with the Institute of Ocean Sciences, was continued in 1990. As in past years, the primary objective is to measure the amount of inter-annual variation in physical and biological conditions on La Perouse Bank. The maximum anticipated life of this multi-disciplinary study is 10 years, which should encompass one (and possibly 2) ENSO events. After this period we should be able to identify the dominant physical processes affecting the circulation and water property structure, quantify the statistical variability of the seasonal cycle and begin to obtain estimates of the impact of inter-annual Pacific herring, sablefish and Pacific hake. These species have experienced strong fluctuations in recruitment success recently, that seem to be associated with long-term changes in oceanic conditions.

Considering the diversity in the life history biology of the species being studied, the Fisheries group is developing specific hypotheses to explain recruitment variability for each case. At this point in time, a predator and food-based hypothesis is being tested to explain year-class strength variations in herring; a food-based hypothesis is being tested for sablefish, and a transport-based hypothesis for Pacific cod.

b) Statistics and Sampling

The principal activities in 1990 included maintenance of the trawl and trap catch and effort database, and biological sampling at commercial landings. The catch and effort database was modified to allow entry of catch and effort in a tow by tow format instead of the previous rolled-up version where each record represented groups of tows. The same conversion was made for trap fishing. To allow CPUE estimates from the new format to be

comparable to previous data, a roll-up program was developed to temporarily convert new format to old. An interactive data entry system was developed for the trap fishery data. Port samplers collected 253 biological samples in 1990.

An optimization study of port sampling effort was also initiated. Port samplers are recording the time taken to obtain a biological sample. The fixed and variable costs of sampling will be examined in conjunction with among sample variance in age composition to optimize sampling effort with respect to producing catch-at-age databases.

5. National Marine Fisheries Service - SWFC

Dr. MacCall reported on other related studies for SWFC. He said that as part of PacFIN, the Center will be asking other agencies about their procedures for species composition sampling. SWFC will try to help the agencies optimize sampling schemes. (Note: Following the TSC Meeting, ODFW has taken over the lead in designing optimum sampling schemes.)

VIII. OTHER TOPICS FOR DISCUSSION

A. Technology Sharing

Mr. Bracken suggested that TSC discuss technology sharing.

Mr. Wilkins said that NMFS staff have begun a yearly, nation wide stock assessment meeting. The first meeting was held in Florida, and they will be held each year at a different NMFC Fishery Center. The meetings are only for NMFS staff. The meeting this year was a show-and-tell instead of a workshop as planned. The next meeting will be held at LaJolla, CA.

Mr. Demory said that rockfish management is now a critical issue, because it is no longer working.

Mr. Bracken said that there is growing industry concern on the lack of good data for fishery management. Rockfish is a good example, since we do not have adequate information. Therefor, we must error in favor of the resource.

Dr. MacCall said that even with good information managers may not choose to use it.

Mr. Bracken said that wide confidence limits make data undefendable.

Mr. Wilkins said that there are now GIS systems at ODFW, PBS and WDF. AFSC now wants to get a GIS system on line.

Mr. Saunders said that Geographic Information Systems (GIS) have been in use for some time in forestry and terrestrial ecology. He suggested that the need to study the spatial component of populations is increasing and that affordable technology is now available. GIS systems range in price from hundreds of dollars to 100, 000 dollars. There are two fundamental approaches to manipulating data within a GIS, one is VECTOR and the other RASTER.

Digitized points and lines are typically handled by VECTOR systems. RASTER displays deal with polygons and address each pixel of your screen. Most spatial analysis is dealt with most efficiently in a RASTER format. Most inexpensive GIS are VECTOR products, and only a few very expensive products provide a combination of the two. An example of a VECTOR application is the display of points data of trawl haul catch locations from a survey. Should you want to use an objective function to generate an interpolated surface of fish distribution and calculate the area in sq. km of highest density then you are working with polygons and hence a RASTER application. GIS sales people usually come equipped with a slick slide show and promises that their system can do everything. Make sure the product can meet the analytical applications that you wish to employ.

The various agencies should maintain an open dialogue on the types of systems they are using and provide assistance to agencies that are considering implementing this technology. DFO at PBS is using a combination of a RASTER system called COMPUGRID and an in house program called CHARTGRAPH to handle VECTOR plotting.

Mr. Jagielo said that the WDF GIS system is PC Arc Info. The system requires a fast PC and has vector and rastor capability. It has an extensive capability, but takes a lot of setup time and requires a skilled programmer to set it up. The program is not user friendly. The GIS system costs $10,000 for software, and it uses a fast PC for hardware. It is best to have a 486 PC or faster machine.

Dr. MacCall said that the NMFS has a GIS system in Washington D.C.

Mr. Saunders said that the main point was to keep lines of communication open about the usefulness of this new technology.

Mr. Jagielo said that GIS is set up to use large data bases and to overlay information. Straight mapping packages are cheep at about $100, but they only produce maps.

Dr. MacCall asked if there was any use to exchange information on different agencies needs for input and output format for their GIS systems. The consensus seemed to be that it was not needed.

Dr. MacCall asked if or when there would be a another Groundfish Conference.

Mr. Demory said that Dr. Pikitch said that there would be a GF Conference held in Washington state in early 1992.

B. Conversion Factors

Mr. Zyblut requested information on conversion factors by species.

Mr. Bracken provided a source for information regarding changing fish portions to round weights.

C. Tagging and OTC Marking

AFSC will be cooperating with ODFW in planning the tagging of Dover sole and injection of OTC for age validation. This will occur during the NMFS 1992 flatfish survey.

A discussion of agency needs to validate age determinations concluded the following. Several flatfish species need age validation. Mr. Wilkins suggested that several flatfish species could be included in the OTC validation, and he will prepare a recommendation to that effect. TSC members wanted to include Dover sole, arrowtooth flounder and possibly other flatfish in the study. It was suggested that a single type of tag be used, possibly the Australian opercle tag, that a single clearing house be used for all tag returns, and that the whole fish be collected. Tag rewards were suggested as hats with the hat color changing yearly and a lottery.

D. The Future of TSC - Discussion with the Parent Group

The absence of CDFG at TSC was discussed. With budget and time problems CDFG has not attended this meeting. Mr. Thornburgh has talked with Mr.Henry (CDFG) who is concerned that trans boundary discussions are not critical for California, and the meeting time was poor for CDFG. Therefore CDFG gave TSC a low priority this year.

Mr. Demory suggested that since data reporting is now not an important portion of TSC, couldn't the timing of the meetings change.

Mr. Jagielo said that WDF was concerned with the lack of agreement on transboundary stock issues between U.S. and Canada. WDF involvement in TSC is in question because some think that their involvement in transboundary stock issues may be better spent elsewhere. WDF questions what the TSC focus is at this time.

Mr. Bracken stated that TSC is doing its assigned job and is doing a good job. Negotiations failures by the Parent Committee is not a failure of TSC.

Mr. Saunders said that TSC is meeting its assigned task of providing technical support. He suggested that there may be a need for a working group to support management.

Mr. Jagielo said that TSC was suppose to lend management advice and discussion.

Mr. Bracken stated that TSC makes management allocation recommendations.

Mr. Demory said that TSC cannot be responsible that its recommendations are not taken.

Mr. Six (PFMC) said that TSC recommendations were taken for the managers to meet and discuss hake allocations. They were unable to reach agreement.

Mr. Saunders said that Canada is very interested in TSC continuing the exchange of information. TSC assessments are very valuable as they benefit the coordination of research and lend weight to program funding and support.

Mr. Demory mentioned that CARE was formed under TSC. CARE was responsible for ODFW changing its method of aging marine fish. Age validation efforts are important and will go on in the 1992 survey. TSC has been helpful in our quest for fishery knowledge.

Mr. Thornburgh said that we get frustrated at slow progress, but in general, the job is getting done.

There was general agreement that TSC is useful there were some possible changes in the timing of meetings, etc., to better meet the needs of all participants including WDF and CDF&G. TSC is a forum for exchanging information and determining what is missing for future planning.

It was mentioned that about five years ago Jow and Westrheim summarized TSC accomplishments. Mr. Thornburgh will put their summary in his newsletter and include an update by Mr. Demory.

E. Data Tables and Catch Statistics

There was a general discussion of the usefulness of states data tables of catch statistics. It was concluded that year old landings for the coast should be included in the minutes.

F. Public Access to PacFIN Reports

Mr. Thornburgh said that the public can access PacFIN reports through his office via computer modems.

G. TSC Minutes

There was a general discussion on when TSC minutes should be available. It was felt that a time line was needed for the completion of the minutes. There also needs to be a distribution list for the TSC report. The report needs to include a map of INPFC areas.

Dr. MacCall recommended that the TSC report be made available formally to agency people that should be aware of the report.

H. Age Validation Studies

There was a general discussion on age validation; that is, which flatfish are now being aged and what species need vaildation.

Mr. Demory mentioned that rex sole and sanddabs do not tag well and die easily. Mr. Demory was assigned the task of writing a recommendation regarding age validation.

IX. PROGRESS ON 1990 RECOMMENDATIONS

A. From the TSC to Itself

1. Sablefish Symposium.

Mr. Wilkins and Mr. Saunders have a proposal for a 2 - 3 day sablefish symposium to be held in April 1992. (Subsequently, it was decided that the Symposium would be held in April 1993 to avoid conflict with the Western Groundfish Conference.) PSMFC can offer some support for the symposium. The tentative agenda and chairpersons are as follows:

Title - International Symposium on the Biology and Management of Sablefish.

Subjects	Chairperson
1. Early life history	Art Kendall
2. Age & growth	Sandy Mac Farlane
3. Migration	Jonathan Heifetz
4. Stock Assessment	Rick Methot
5. Management	Barry Bracken

Presenters would be required to submit copies (cleanly edited) of their presentations at the symposium for subsequent publishing in a Symposium Proceedings. The symposium will be co-chaired by Mark Wilkins and Mark Saunders, and a steering committee is suggested.

Dr. MacCall suggested that the proceedings be published in PISCES or by Scientific Publishing at AFSC .

2. Recommendations to CARE

There was a general discussion on recommendations to the CARE group. It was felt that CARE should encourage participation of La Jolla lab agers at CARE meetings. Some TSC members had special interest in thornyheads and Dover sole aging.

Dr. MacCall and Mr. Barss were assigned the task of writing recommendations to CARE for TSC. They were asked to comment on the CARE request for TSC input on the CARE Agenda for the May 1992 meeting.

Dr. MacCall suggested that CARE workshops include "hands on" look at otoliths during the last afternoon of the meeting for those who wish to attend.

Mr. Demory said TSC should encourage regional get workshops on species.

Mr. Saunders encouraged exchanges and dialogue on the aging of transboundry species and the establishment of comparable aging criteria and structure exchanges.

Dr. MacCall suggested that Dr. Methot could speak to the subject of statistical validation to CARE members.

B. From TSC to the Parent Committee

1. Historic Annotated landings (HAL) Database.

Guy Thornburgh did talk to Dr. Marasco about HAL, but work continues to be done on the system and the data is not readily available. The project now has a low priority. TSC questions if costs to complete the system is the problem, and if the project can be released to a working group to bring about its completion.

Mr. Thornburgh said that some PacFIN money is available to help complete the project. He will contact his staff to see how much money is available and if they can free up someone to finish the project.

Mr. Thornburgh contacted his staff and Dr. Marasco. He subsequently reported that PSMFC can offer $7,000 and a technician at PacFIN to clean up HAL. Dr. Marasco will meet with his staff and get back to Thornburgh on Monday.

Mr. Wilkins was assigned the task of writing a recommendation regarding the importance of HAL. This recommendation was to modify and resubmit the old

TSC recommendation on HAL by adding that without HAL analysis is more difficult.

2. Pacific Whiting (Hake) Allocation.

Technicians are agreeing on hake assessments. The yield estimate of 253,000 by Dorn for 1991 was acceptable. For 1992, he estimates a high risk ABC of 169,000 mt and a medium risk ABC of 135,000 mt. Dorn expects flat (stable) yields over the next few years.

Mr. Zyblut said that last years TSC recommendations were acted upon, but the deliberation for allocation of the resource's yield was not successful.

Dr. MacCall said that there was no problem with taking 120% of the ABC or some over harvest as long as the ABC was not set too aggressively.

A discussion of how much over harvest of hake is acceptable under what setting of ABC followed.

Dr. MacCall said that "Risk" is related to spawning biomass. High Risk is a higher possibility of falling under a critical spawning biomass level.

Mr. Zyblut said that the bi-national allocation question is now in the hands of Ottawa on the international level, and local managers will now aid Ottawa with advise only when asked.

Mr. Jagielo, Mr. Saunders and Mr. Bracken were assigned the task of writing TSC recommendations regarding Pacific whiting. They were to include the subject of over allocation and risk factors.

X. 1991 TECHNICAL SUBCOMMITTEE RECOMMENDATIONS

A. TSC to Itself

1. Age Validation Studies, prepared by Mr. Demory - approved

The TSC reviewed progress on the 1990 recommendations and noted that no progress had been made on the recommendation concerning Dover sole age validation. The TSC was made aware that a flatfish survey is planned for 1992 along the west coast and noted that the survey would provide an excellent opportunity to tag OTC injected Dover sole and other species as well, particularly arrowtooth flounder, English sole, and petrale sole. The TSC also noted that the planning effort for this venture could be included in the pre-survey planning phase that will take place during the fall of 1991. The TSC recommends that appropriate agency staff be appointed to assist in the planning and implementation of the validation studies.

2. CARE Recommendations, prepared by Dr. MacCall and Mr. Barss - approved.

   a. The issues and technologies involved in age determination are best treated by a combination of focused local consultations and interagency coastwide workshops comparing approaches across species and methodologies. Therefore we encourage participation of new members (e.g., La Jolla scientists) in CARE as well as frequent "one-on-one" consultations among the individual agencies and laboratories.

   b. The TSC recommends exchange of ageing structures and/or photographs in advance of the May 1992 CARE meeting. Also, a separate portion of the CARE meeting should address interpretation of these structures in a workshop environment. Species of particular concern are sablefish, the thornyheads and Dover sole.

   c. CARE should attempt to establish a systematic program for investigation of otolith edge formation for all species, with initial emphasis on a few key species (including flatfish).

   d. Validation of ageing methods continues to be important. TSC supports CARE exchange of information, active participation in ongoing studies, and continuation of a strong research program by member agencies. In addition to the OTC/tagging approach addressed in another TSC recommendation, we advocate investigation of independent age-related indicators (e.g., Pb-210, lipofuscin) and biostatistical methods for tracking strong year classes. For example, the maximum likelihood technology used in the stock synthesis model should be applied to this problem.

B. From the TSC to the Parent Committee

1. TSC recommendation to the Parent Committee on Hake, prepared by Mr. Jagielo, Mr. Saunders and Mr. Bracken - approved.

   The TSC expressed disappointment that the transboundary allocation of Pacific whiting (hake) was not resolved during

management meetings held in 1990. The current management already resulted in a reduction in the recommended yield for 1992 and places the total 1991 harvest in the "high-risk" area of exploitation despite adoption of a "moderate risk" policy. In the event that both countries independently adopt "high risk" policies the combined harvest would result in over-exploitation of the stock.

The TSC reiterates the need for rapid resolution of this issue to avoid the potential over-harvest of this valuable resource. We recommend that the Parent Committee work to find a solution to the current allocation conflict.

2. TSC Recommendation to the Parent Committee on HAL, prepared by Mr. Wilkins - approved.

The Technical Subcommittee discussed the status of the Historic Annotated Landings (HAL) coastwide groundfish database. In 1990, the TSC recommended that this important data set be submitted to contributing agencies for final review and, subsequent to review, be made available upon request. Delays in finalizing a standardized data set have resulted in scientists involved in stock assessments needing to refer to old TSC reports and PSMFC Data Series reports to complete their assessments. This has resulted in a reliance on a non-standard data set and an inefficient use of assessment scientists' time. The TSC reiterates its recommendation that the HAL data set be finalized as soon as possible and be made available to all users upon request. PSMFC funds are available to assist in this project.

XI. SCHEDULE OF NEXT MEETING

WDF will host the next meeting of TSC if their participation continues. It will be held in Seattle, Washington on the first week in May, which is May 5, 6 and 7, 1992. The meeting was moved up to May, so that it might be easier for the State of California TSC member to attend.

It was suggested that TSC speed up the meeting by just emphasizing new studies on important subjects.

XII. ELECTION OF CHAIRPERSON

Each agency contributes a chairperson for two years. NMFS now is beginning its second year. The rotation for agency chairperson contribution is as follows:

1991-1992 NMFS
1993-1994 California
1995-1996 Canada
1997-1998 Alaska
1999-2000 Oregon
2001-2002 Washington

Mr. Wilkins, NMFS, AFSC will continue as chairperson for his second year

XIII. ADJOURNMENT

The meeting adjourned at about 1000 hours, June 6, 1991.

Mr. Saunders stated that TSC recognizes Mr. Demory's many years of contributions to TSC, and wished him well in his coming retirement.

Appendix A

List of Attendees, TSC Meeting, June 4-6, 1991, Newport, Oregon

NAME	AGENCY	ADDRESS	TELEPHONE NO.
Barss, Bill	ODFW	Marine Science Dr., Bldg 3 Newport, OR 97365	(503) 867-4741
Blood, Calvin	IPHC	P.O. Box 95009 Seattle, WA 98145-2009	(206) 634-1838
Bracken, Barry E.	ADF&G	P.O. Box 667 Petersburg, AK 99833	(907) 772-3801
Clausen, Dave	NMFS	Auke Bay Laboratory 11305 Glacier Hwy., Juneau, AK 99801	
Demory, Bob	ODFW	Marine Science Dr., Bldg 3 Newport, OR 97365	(503) 867-4741
Glock, Jim	PFMC	2000 SW First Ave., Ste 420 Portland, OR 97201	(503) 326-6352
Jagielo, Tom	WDF	7600 Sand Point Way NE Bin C 15400, Bldg 4, Rm 2129 Seattle, WA 98115	(206) 545-6594
MacCall, Alec	NMFS/SWFSC	3150 Paradise Dr. Tiburon, CA 94920	(415) 435-3149
Pearce, Julie	NMFS/REFM	7600 Sand Point Way NE Bin C, 15700, Bldg 4, F/AKC2 Seattle, WA 98115-0070	(206) 526-6547
Saelens, Mark	ODFW	Marine Science Dr., Bldg 3 Newport, OR 97365	(503) 867-4741
Saunders, Mark	DFO	Pacific Biological Station Nanaimo, B.C. V9R 5K6	(604) 756-7154

Six, Lawrence D.	PFMC	Metro Center, Suite 420 2000 SW First Avenue Portland, OR 97201	(503) 326-6352
Thornburgh, Guy	PSMFC	2501 SW First Avenue Suite 200 Portland, OR 97201	(503) 326-7025
Wilkins, Mark	NMFS/RACE	7600 Sand Point Way NE Bin C\ 15700, Bldg 4, F/AKC1 Seattle, WA 98115-0070	(206) 526-4104
Wood, Claire	ODFW	Marine Science Dr., Bldg 3 Newport, OR 97365	(503) 867-4741
Zyblut, Ed	DFO	555 West Hastings St. Vancouver, B.C. V6B 5G3	(604) 666-3167

Appendix B

Agenda for the 32nd Annual Meeting of the Technical Subcommittee of the Canada-USA Groundfish Committee
Newport, Oregon
June 4-6, 1991

I. CALL TO ORDER
II. APPOINTMENT OF SECRETARY
III. INTRODUCTIONS
IV. APPROVAL OF THE 1990 REPORT AND 1991 AGENDA
V. TERMS OF REFERENCE
VI. WORKING GROUP REPORTS
  A. CARE
  B. PacFIN-PSMFC DATA Series Project
  C. Stock Assessment Groups
    1. Yellowtail Rockfish
    2. Pacific Whiting (Hake)
    3. Dover sole (particularly with regard to age validation)
  D. Other
VII. REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENTS, MANAGEMENT, AND FISHERIES
  A. Agency Overwiew
  B. Review of Milti Species, By Agency
  C. By Species, By Agency
    1. Pacific Cod
    2. Rockfish
      a. Shelf Rockfish
      b. Slope Rockfish
      c. Thornyheads
    3. Sablefish
    4. Flatfish (Dover, English, arrowtooth, petrale)
    5. Pacific Whiting
    6. Dogfish
    7. Lingcod
    8. Other
  D. Other related studies
VIII. OTHER TOPICS FOR DISCUSSION
IX. PROGRESS ON 1991 RECOMMENDATIONS
  A. From the TSC to Itself
  B. From the TSC to the Parent Committee
X. 1991 TECHNICAL SUBCOMMITTEE RECOMMENDATIONS
XI. SCHEDULE OF NEXT MEETING
XII. ELECTION OF CHAIRPERSON - Mark Wilkins serving through 1992
XIII. ADJOURNMENT

Appendix C

Committee of Age Reading Experts
Report to the T.S.C.
June 4, 1991

The Committee of Age Reading Experts (C.A.R.E.) has not held a major meeting within the last year. Various C.A.R.E. members have recently engaged in calibration exchanges and/or other activities which include the following:

1. A calibration exchange between NMFS/AFSC and NMFS/Tiburon with sablefish occurred, sample size n = 100.

2. An exchange between NMFS/AFSC and Canadian Dept. of Fisheries and Oceans, Pacific Biological Station (PBS) with sablefish was done as part of an age validation study, sample size n = 270.

3. Two meetings for Dover sole ageing calibration took place in 1990 involving California Fish and Game and Oregon Dept. of Fish and Wildlife personnel, sample size n = 50 in February and n = 50 in December.

4. A meeting took place between staff from PBS and NMFS/AFSC to demonstrate the precision testing and associated data base used by the Age and Growth Task at the AFSC.

Continuing with a two year schedule suggests that C.A.R.E. hold its next meeting in May of 1992, just prior to the T.S.C. meeting. A list of possible topics for a May 1992 meeting of C.A.R.E. includes the following:

1. Any species/topics of special interest or concern as recommended by the T.S.C. This might involve the use of some time at the next C.A.R.E. meeting for viewing otolith samples either under microscopes or in photographs. If photographs are available, they would be preferred to using microscopes. If an exchange is suggested by the T.S.C., samples should be passed between the appropriate agencies will in advance of the meeting. The results of the recent sablefish exchanges suggest this as a species of concern for age calibration.

2. Documentation/validation for the seasonality/timing of fish growth and the associated timing of annulus formation on the otoliths. This continues to be a major problem area in age determination, and has been suggested by members as the key topic for the next C.A.R.E. meeting. This meeting would be a good forum for presenting and in-house, less-published, validation studies on this topic.

3. Presentation of any other validation studies. This would be a good general goal for all future C.A.R.E. meetings; the area of validation is often neglected. The

C.A.R.E. meetings could be made a good forum for discussion and presenting smaller less publishable information as well as major research.

I look forward to receiving the TSC's recommendations on the list of proposed topics. Now is the time to start planning for C.A.R.E.'s next meeting, especially if an otolith exchange is to be done prior to such a meeting.

Respectfully,

Craig R. Kastelle
Chairperson, C.A.R.E.

Appendix D

Working Group Report on the Yellowtail Rockfish Fisheries

Jack V. Tagart
and
R. D. Stanley

June 1991

Submitted to the Technical Subcommittee of the Canada/United States Groundfish Committee

This document follows the earlier progress reports (June 89, September 89, and June 90) of the Yellowtail Rockfish Working Group. It summarizes progress made from June 1991 and outlines the objectives through June 1992.

At the 1988 Annual Meeting of the Canada/U.S. Groundfish Committee, the Technical Subcommittee recommended to the Parent Committee that a yellowtail rockfish working be appointed. They stated that this working group should

1. Review the status of the yellowtail rockfish stocks;
2. Study management strategies for yellowtail rockfish;
3. Review the implications of the various management strategies on the yellowtail rockfish stock;
4. Report to the TSC and Parent Committee on their progress.

The working group first met July 1988. At this meeting it was decided that in addition to updating and coordinating stock assessments, even more pressing needs included collation of a coastwide biological database and initiation of studies into stock identification.

1. Biological database

The initial compilation of the yellowtail rockfish biological database was completed in April 1989. The working group planned to update the dbase annually, but this has not been possible. A full dbase update, including data through 1990, is now scheduled for February 1992.

1.1. Canada (DFO)

The 1992 update will include ageing data for Canadian samples from 1989-91. Current ageing support of DFO material permits ageing of approximately 1000 pieces per year. This update will also include, for the first time, length frequency data of yellowtail rockfish from the bycatch of the offshore Canadian hake fishery.

1.2. California (CFG)

Earlier progress reports noted the lack of individual fish records from samples of California landings. In July 1989, Don Pearson, NMFS/SFC, provided 11 files with individual yellowtail rockfish biological data. These were obtained from samples of landings from the California commercial trawl fishery (1978-1988). These data were made available to the working group in a multi-record format which is incompatible with the Master biological database. Because they were received after the Master database had been compiled and because of other time commitments by the compilers, these data have not yet been prepared for inclusion. We expect that these data as well as data for 1989 and 1990 will be added to the Master database for the 1992 update.

1.3. Oregon (ODFW)

We have not yet requested additional data from ODFW. At the present time, none of ODFW's 1990 yellowtail rockfish otolith samples have been aged.

1.4. Washington (WDF)

Age reading is complete for all samples collected from commercial trawl landings between 1988 and 1990.

1.5. NMFS

The NMFS/AFSC collected additional length, weight, and age samples from yellowtail rockfish during their 1989 triennial groundfish survey. Mark Wilkins (NMFS) advises us that otoliths were collected from 464 yellowtail rockfish during the survey, but these otoliths have not yet been aged. There is not, at present, any available age reader time to age these structures.

WDF was able to age approximately 600 otoliths collected in 1989 from the yellowtail rockfish caught during the U.S. whiting fishery. These data will be available for the 1992 update.

1.6. Data report

We continue with our plans to prepare a user's guide to the database for publication in the WDF progress report series (Tagart and Stanley, in prep). Report preparation has been delayed owing to other work commitments by working group members. We now expect to finish the guide in conjunction with the 1992 update.

2. Stock delineation

2.1 Genetics

Steve Phelps (WDF) has completed an electrophoretic and statistical analysis of yellowtail rockfish samples. Tissue samples from 500 specimens (100 fish from each of 5 areas) were collected during the fall of 1990. Sample sites included Heceta Bank, Astoria Canyon, Cape Flattery, the west coast of Vancouver Island, and Queen Charlotte Sound. He observed significant heterogeneity among these area collections indicating the existence of discrete stocks.

To examine intra-annual persistence of the observed fall patterns, we initiated a second sampling during the spring of 1991. As of 29 April 1991, spring samples had been collected from all sites except Queen Charlotte Sound. Electrophoretic analysis has been completed

for a portion of these samples already. When the remainder of the samples have been received, Mr. Phelps will complete the analysis including tests for within and among site genetic diversity. Mr. Phelps and Dr. Tagart will provide a final report on this experiment by the end of 1991.

2.2. Parasites

Two coastwide collections of yellowtail rockfish were coordinated by the working group in 1988 and 1989. DFO have analyzed 238 specimens. An initial report (Lee et al 1991), documented the full body screening of 20 B.C. and 10 Washington specimens. These results indicated 4 parasite species which showed promise as biological tags for stock identification. Two species of parasite were also found which had not previously been observed in yellowtail rockfish.

The remaining 218 specimens were then examined with a restricted necropsy protocol for the selected parasites. Results have been analysed and submitted to the Canadian Journal of Zoology (Stanley et al, in prep). The conclusions are summarized below (Section 2.4).

2.3. Tagging

Results of two tagging experiments of yellowtail rockfish are being jointly summarized (Stanley, Leaman, Haldorson and O'Connell, in prep). The report documents 42 tag returns from studies conducted by the Alaska Department of Fish and Game, and DFO, Canada. The limited returns indicate that while some adult yellowtail rockfish travelled long-distances (>500 km), most were caught near the point of release.

2.4. Summary of stocks

We have recognized for some time that yellowtail rockfish may be separable into discrete operational stocks. This conclusion is supported by observations of their life history. For example, mating and parturition occur at roughly the same time of year across a broad geographic zone from California to British Columbia. Therefore, at least once per year, there must be discrete isolated

aggregations of yellowtail rockfish engaged in these spawning activities. Furthermore, to reinforce the notion that these local aggregations persist at other times of the year, we observe consistent differences among stocks in the annual size and age distribution and sex ratio of the landed catch. These differences could not reasonably persist if, following mating and/or parturition, there was significant movement of individuals among stocks. This circumstantial evidence of stock structure is enhanced by our recent experiments on the genetics and parasites of yellowtail rockfish.

In their investigation of yellowtail rockfish parasites as potential biological tags, Stanley et al. (1991) found a monogenean (Microcotyle sebastis) which followed a decreasing trend in frequency of occurrence and absolute abundance on fishes from southern Oregon to Queen Charlotte Sound. The apparent cline in the distribution of this parasite is consistent with the preliminary results from our genetic analysis where we find clear distinctions in the electrophoretic patterns of Oregon and Queen Charlotte Sound samples and more overlap in these patterns for the intervening samples.

It is our conclusion that the life history data in concert with the parasite and genetic data provide sufficient evidence to suggest that yellowtail rockfish are separable into operational stocks. At a minimum it appears that yellowtail rockfish from Oregon are distinct from those in Queen Charlotte Sound. There is greater difficulty separating the stocks from northern Washington and the west coast of Vancouver Island. It is unequivocal, however, that the S. Vancouver area stock is transboundary.

The limited tagging results have shown that some individuals were recovered after moving long distances which ostensibly contradicts the hypothesis of discrete stocks. However, after accounting for differential fishing pressure, a much higher proportion of tagged fish were shown to be captured in the vicinity of the release site than would have been demonstrated from non-standardized data (Stanley 1990) . While we continue to propose a discrete stock approach to assessment, we acknowledge that there is mixing among stocks.

We suggest that there is little more to be determined from analysis of yellowtail rockfish enzyme polymorphism using standard electrophoretic techniques. We could obtain additional samples from the central and northern California coast and/or from southeast Alaska. The California samples would be helpful for U.S. managers, while the Alaskan samples would merely serve to complete a coast-wide analysis of genetic similarity. One question we have not addressed is whether or not there is inter-annual variability in genetic patterns. The logistical difficulties of collecting coast-wide samples in a constrained period of time and the cost of analysis of those samples is substantive. At this point we do not think it is necessary to test for inter-annual variability, however, if others felt a compelling need for this test, we would need a supplementary budget to fund the collection and analysis of samples.

For similar reasons, we do not recommend additional tagging or parasite work for purposes of stock discrimination. Additional work would not significantly improve the knowledge base unless they could provide quantitative estimates of mixing. Such studies would be far more extensive and require a much larger dedication of supplemental resources.

3. Stock Assessments 1991

3.1. Canada

The Canadian yellowtail rockfish assessment was accepted by the Pacific Stock Assessment Review Committee (PSARC) of DFO, September 1991 (Stanley 1991). The recommended yield for Q.C.Sd was 1400-1300t based on use of the Stock Synthesis model (Methot 1990). An experimental yield of 500-1000 t was proposed for the west coast of Vancouver Island (PMFC Area 3D). The DFO recommended yield also endorsed the U.S. assessment of 1000-2000 t for northern Washington and southern B.C. combined (PMFC Area 3B/3C). The DFO assessment did not include discussion of the allocation of the 1000-2000 t.

3.2. U.S.

The U.S. yellowtail rockfish stock assessment was completed in March of 1991 and accepted by the University of Washington as Dr. Tagart's doctoral dissertation. Copies of the dissertation have been mailed to a select group of state and federal agency representatives.

Dr. Tagart's dissertation contains a description of the yellowtail rockfish fishery from northern California to British Columbia including a review of historical landings and life history, an analysis of growth, and an analysis of maturity for fish from the Washington coast. Estimates of stock abundance, recruitment and potential yield, were obtained from the stock synthesis model using the method of maximum likelihood estimation.

The coast-wide yellowtail rockfish population was separated into four operational stocks, three of which are accessible to U.S. fisherman. All stocks have experienced significant exploitation over the past 15 years with resultant declines in stock abundance. Of the stocks accessible to U.S. fishermen, one (the southern Columbia stock) appears healthy while two (northern Columbia and southern Vancouver) are overfished. There are no statistically significant spawner/recruit relationships for any stock. Preferred harvest strategies were determined using equilibrium models and an algorithm which preserves a fixed fraction of the unfished spawning biomass.

Yellowtail rockfish from the Washington coast mate between October and December. Parturition peaks in February. Estimated size at 50% maturity is 38-40 cm for males, 44-46 cm for females. Yellowtail rockfish of both sexes share a common length/weight relationship coast-wide. There were statistically significant differences in growth functions among stocks but not over time. There is weak evidence for a cline in sex ratios with males more dominant in northern latitudes. Males display a more protracted age distribution than females. It is hypothesized that females experience an increasing age specific natural mortality. For all stocks and both sexes, exploitation has caused a noticeable loss of older age classes.

The stock synthesis model proved to be a versatile analytical tool. It was particularly useful in the analysis of apparent ageing error and the evaluation of spawner/recruit relationships. It also proved effective in the evaluation of alternative hypotheses regarding the availability of older females. Despite quantitative estimates of total likelihood for various parameterizations of the model, difficulties remained with respect to estimation of absolute abundance. Flat response surfaces for objective functions often caused equivocal results under different parameterizations.

4. Future catch-at-age assessments

4.1. Canada

The catch-at-age analysis of the Canadian fishery will be updated for August of 1992 using the stock synthesis model. It will include three additional years of ageing data. An update of catch and effort statistics will be provided for PSARC review for August 1991.

4.2. U.S.

The U.S. stock assessment will be revised following the update of the coast-wide master database, February 1992. The revision will again rely on stock synthesis analysis. The analysis will be updated to include estimates of hypothesized values for discarded catch.

4.3. Joint work

Depending on the genetics results, joint assessment activities could include use of the Stock Synthesis model to explore various groupings of the stocks including transboundary combinations.

5. Additional research

5.1 DFO

DFO plans to conduct a hydroacoustic study of yellowtail rockfish in November 1991. The focus of the cruise will be to assess yellowtail biomass in one discrete area as a test of the repeatability of biomass assessments. DFO will not be attempting to estimate total

stock biomass in this cruise. Additional work will includes an examination of juvenile rockfish distribution, including yellowtail rockfish, and ecology on the west coast of Vancouver Island.

5.2 WDF

WDF has no immediate plans for auxiliary yellowtail rockfish assessment research.

6. Management options

The TSC asked that the working group examine various management strategies related to the trans-boundary allocation of yellowtail rockfish harvest. Available evidence suggests that the population in the trans-boundary area mixes freely in the vicinity of the boundary, thus there is no biological basis for an allocation. Consequently, recommendations for allocation of the harvestable resource must rely on social, political, and economic factors which the current working group is unprepared to address without explicit guidance from the managers of both countries.

The working group recommends that any bilateral discussion on the trans-boundary nature of these fisheries treat PMFC areas 3C and 3B as an operational stock (the southern Vancouver stock) and exclude from consideration the fisheries to the north and south. We acknowledge that the stock affiliation of the central Vancouver Island remains unclear.

Managers are reminded that the offshore hake fishery results in a significant harvest from the southern Vancouver stock. They are also advised that the working group does not perceive any differences in the harvest selectivities between the two domestic fleets. The impact of harvesting a fixed amount will be equal regardless of which nation does the harvesting.

Literature Cited

Lee, D. L., D. J. Whitaker, and R. D. Stanley. 1991. A preliminary examination of the parasite fauna of yellowtail rockfish, Sebastes flavidus. Can. Tech. Rept. Fish. Aquat. Sci. No. 1777. 21 p.

Methot, R. D. 1990. Synthesis Modelan adaptable framework for analysis of diverse stock assessment data. In L. Low [ed.] 1990. Proceedings of the symposium on application of stock assessment techniques to gadids. International North Pacific Fisheries Commission Bulletin No. 50.

Stanley, R. D. 1990. Shelf rockfish. InA. V. Tyler and J. Fargo [eds.] 1990. Groundfish stock assessments for the west coast of Canada in 1989 and recommended yield options for 1990. Can. Tech. Rep. Fish. Aquat. Sci. 1732

Stanley, R. D. 1991. Shelf rockfish. InJ. Fargo and B. M. Leaman [eds.] 1991. Groundfish stock assessments for the west coast of Canada in 1990 and recommended yield options for 1991. Can. Tech. Rep. Fish. Aquat. Sci. 1778

Stanley, R. D., D. L. Lee, and D. J. Whitaker. (in prep). An assessment of parasites of yellowtail rockfish, Sebastes flavidus (Ayres 1862) (PiscesTeleostei) from the Pacific coast of North America as potential biological tags for stock identification (Can. J. Zool.)

Tagart, J.V. 1990. Population dynamics of yellowtail rockfish with recommendations for acceptable biological catch in 1990. WDF Draft Manuscript Report, 104 p.

Appendix E

Working Group Report of Pacific Whiting

Pacific Whiting (Hake) Stock Assessment Working Group Report

Meetings

The Pacific whiting working group met in Seattle on January 15, 1991.

At this meeting, M. Saunders presented additional details of a DFO acoustic survey of Pacific whiting in Canadian zone in August 1990. Most of the aggregations of Pacific whiting were located along the shelf break at 200 m. La Perouse Bank and the Brooks Peninsula region were exceptions to this general pattern. In these areas fish tended to aggregate in basins and canyons. Samples of Pacific whiting obtained near Triangle Island displayed the same pattern of strong year classes as samples from the region of the fishery off southwest Vancouver Island, suggesting that these northern fish are part of the migratory coastal stock.

M. Saunders also discussed DFO plans for a survey of Pacific whiting spawning aggregations in spring of 1991. The Canadian research vessel W. E. Ricker will run transects in a zigzag pattern south along the coast from British Columbia to the U.S.-Mexico border. If any spawning aggregations of Pacific whiting are encountered, their geographic extent will be mapped, and mid-water trawls will be used to obtain samples for determining the age composition, the size frequency, the sex ratio, and the maturity of the fish in the aggregations.

M. Wilkins discussed Soviet plans for a research cruise off the west coast of the U.S.. The current schedule calls for the Soviet vessel to be engaged in Pacific whiting research from April 20 to June 1. The research objectives of the cruise are still being developed.

E. Nunnallee talked about some of the problems with adding together the biomass estimates from the bottom trawl survey and the acoustic survey to estimate total abundance. His field work has focused on the Puget Sound stock of Pacific whiting, and uses bottom trawls and acoustic arrays to study how fish aggregations respond to the passage of sampling gear. Some of his preliminary results suggest that 1) Pacific whiting dive down as bottom trawl gear passes, so that bottom trawls could

potentially sample fish that are in mid-water aggregations, and 2) there is a potential for bias in the age composition estimates from mid-trawls because larger fish may be able to dive further than the younger fish, and thus avoid capture.

M. Dorn presented the preliminary results of a fishery sampling project to estimate the maturity of Pacific whiting. Results from deck grading Pacific whiting using a 7-stage maturity table indicated that most fish are mature at age four. The study will be continued for several more years to follow the 1987 year class as it matures.Summary of 1990 Pacific whiting stock assessment

The combined U.S. and Canadian harvest of Pacific whiting in 1990 was 257,000 metric tons (t), down from a high of 309,000 t in 1989. The fishery continues to be supported by the strong 1980 and 1984 year classes. Assessment surveys in 1989 estimated the population biomass as 1.637 million t, a decline of 24% from estimates made in 1986.

The stock synthesis model was used to estimate age-structured population abundance, past levels of female spawning biomass, and recruitment for the 1959-87 year classes. The assessment model was revised to include geographic structure; the parameters of a curve defining the annual migration of fish across the U.S.-Canada border were also estimated. Estimated age 2+ biomass at the start of 1990 was 2,018,000 t, 12% below the mean 1960-89 biomass of 2,298,000 t.

An age-structured population simulation model was used to estimate sustainable yield under different harvest strategies and levels of risk. Risk is associated with the probability that spawning biomass falls below levels that would occur due to the natural variability of an unexploited population. Average annual yield ranged between 168,000 t and 247,000 t depending on the harvest strategy and the level of risk.

The recommended acceptable biological catch (ABC) for 1991 was 253,000 t, a 3% increase in the ABC from 1990. Difficulties in resolving allocation issues between the U.S. and Canada resulted in a combined fishery quota that was 29% in excess of the ABC. The prospects in the immediate future for the Pacific whiting resource are for stable or declining yields depending on the timing of the next strong year class.

Appendix F

Reports Published by the Member Agencies During 1990

UNITED STATES

Alaska Department of Fish & Game

1. Bracken, B. E. 1989. Southeast Alaska and Yakutat area groundfish investigations, final report for the period July 1989 through June 30, 1990. AK. Dept. of Fish and Game Regional Info. Rpt. 1J90-17. ADF&G, Box 667, Petersburg, AK. 99833. 25p.

2. Bracken, B. E. 1990. Report to the Board of Fisheries, 1989 Southeast-Yakutat groundfish fisheries. In Paul Larson editor, Southeast Alaska-Yakutat Region Alaska Department of Fish and Game finfish report to the Board of Fisheries. AK. Dept. of Fish and Game Regional Info. Rpt. 1J90-02 ADF&G, Juneau, AK. 99833. pp 6.1-6.31.

3. Bracken, B. E., V. M. O'Connell, and D. A. Gordon, 1990. Report to the Board of Fisheries, 1990. Southeast Alaska-Yakutat groundfish fisheries. In Doug Mecum editor, Southeast Alaska-Yakutat Region Alaska Department of Fish and Game finfish report to the Board of Fisheries. AK. Dept. of Fish and Game Regional Info. Rpt. 1J91-01 ADF&G, Juneau, AK. 99833. pp 6.1-6.39.

Washington Department of Fisheries

1. Bargmann, G., C. Schmitt, W. Palsson, S. Hoffmann, G. Lippert and G. Davis. In Press Recommended recreational management plan for bottomfish in Puget Sound. State of Washington Department of Fisheries Progress Report, Olympia, Washington.

2. Boettner, J.F., and S. F. Burton. 1990. Hydroacoustic stock assessment study of coastal black rockfish off Washington State. State of Washington Department of Fisheries Technical Report No. 108. Olympia, Washington.

3. Hoffmann, S. and W.A. Palsson. 1990. The recreational fishery of smelt in LaConner, 1986-1987. State of Washington Department of Fisheries Technical Report No. 109. Olympia, Washington.

4. Jagielo, T.H. 1991. In Press. Synthesis of tagging and fishery data to estimate open population parameters. American Fisheries Society Symposium Series.

5. Jagielo, T.H. 1991. Movement of tagged lingcod Ophiodon elongatus at Neah Bay, Washington. Fishery Bulletin, U.S. 88:815-820.

6. Kautsky, G.A., Lemberg, N.A., and E. Ona. 1990. In situ target strength measurements of Pacific herring Clupea harengus pallasi in the eastern Strait of Georgia using dual-beam and split-beam sonar. Lowel Wakefield International Herring Symposium. October 1990, Anchorage, Alaska.

7. Lai, H.L. and BN. Culver. 1991. Estimation of tag loss rate of black rockfish Sebastes Melanops off Washington Coast with a review of double tagging models. State of Washington Department of Fisheries Technical Report No. 113. Olympia, Washington.

8. Lippert, G., W.A. Palsson, S.G. Hulsman and S. Hoffmann. 1991. The Puget Sound charter fishery from bottomfish, 1986 and 1987. State of Washington Department of Fisheries Technical Report No. 114. Olympia, Washington. 72p.

9. Lemberg, N. AS., S.F. Burton and W.A Palsson. 1990. Hydroacoustic assessment of Puget Sound herring, whiting, and Pacific cod surveys, 1988 and 1989. State of Washington Department of Fisheries Progress Report No. 281. Olympia, Washington. 76p.

10. O'Neill, S.M. and C. Schnitt. In Press. What contaminates are in our fish? Proceedings from the 1991 Research in Puget Sound Conference. Puget Sound Water Quality Authority, Seattle, Washington.

11. Palsson, W.A. 1990. Pacific cod (Gadus marcrocephalus) in Puget Sound and adjacent waters: biology and stock assessment. State of Washington Department of Fisheries Technical Report No. 112. Olympia, Washington. 137p.

12. Palsson, W.A. In Press. Using creel surveys to evaluate angler success in discrete fisheries. American Fisheries Society Symposium Series.

13. Quinnell, S., and C. Schmitt. 1991. Abundance of Puget Sound demersal fishes: 1987 research trawl results. State of Washington Department of Fisheries Progress Report No. 286. Olympia, Washington. 267p.

14. Rickey, M.H. and H.L. Lai. 1990. The deep water complex species mix in the Washington and Oregon trawl fishery. State of Washington Department of Fisheries Technical Report No. 111. Olympia, Washington.

15. Richey, M.H. 1991. Geographical distribution of trawl caught groundfish in the INPFC Columbia and Vancouver areas from 1984 through 1988. State of Washington Department of Fisheries Progress Report No. 287. Olympia, Washington.

16. Schmitt, C. and S. Quinnell. 1991. Groundfish statistics from commercial fisheries in Puget Sound, 1970-1988. State of Washington Department of Fisheries Progress Report No. 285. Olympia, Washington. 315p.

17. Schmitt, C., H. Lai and G. Bargmann. In Press. Angler preference for bottomfish management in Puget Sound. Proceedings of the 1991 Puget Sound Research Conference. Puget Sound Water Quality Authority.

18. Tagart, J.T. 1991. Population dynamics of yellowtail rockfish Sebastes flavidus stocks in the northern California to southwest Vancouver Island region. Phd Thesis. University of Washington, Seattle, Washington.

19. Wildermuth, D.A., H.L. Lai, P.T. Clark and L.E. Edinger. 1991. Estimating the recreational catch of halibut in Puget Sound using the mandatory halibut catch record and a summary of the 1990 South and North Coast recreational halibut fisheries. State of Washington Department of Fisheries Progress Report No. 290. Olympia, Washington. 60p.

National Marine Fisheries Center - AFSC

1990 publications dealing with groundfish and shellfish authored by scientists of the Resource Assessment and Conservation Engineering Division, Resource Ecology and Fishery Management Division, and the Auke Bay Laboratory of the Alaska Fisheries Science Center of the National Marine Fisheries Service.

1. ARMISTEAD, CLAIRE E. 1990. Report to the fishing industry on results of the 1990 eastern Bering Sea groundfish survey. NWAFC Processed Rep. 90-11, 52 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

2. BAKKALA, R. G. 1990. Squid and other species. In: stock assessment and fishery evaluation document for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 1991, p. 205-209. North Pac. Fish. Management Council, P.O. Box 103136, Anchorage AK 99510.

3. BAKKALA, R. G. and T.K. WILDERBUER. 1990. Yellowfin sole. In: stock assessment and fishery evaluation document for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 1991, p. 76-94. North Pac. Fish. Management Council., P.O. Box 103136, Anchorage, AK 99510.

4. BAKKALA, RICHARD G., and THOMAS K. WILDERBUER. 1990. Greenland turbot. In Loh-Lee Low and Renold E. Narita (editors), Condition of

groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 86-101. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

5. BAKKALA, RICHARD G., and VIDAR G. WESPESTAD. 1990. Yellowfin sole. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 67-85. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

6. BAKKALA, RICHARD G., and THOMAS K. WILDERBUER. 1990. Arrowtooth flounder. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 102-111. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

7. BAKKALA, RICHARD G. 1990. Squid and other species. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 217-224. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.BATES, RICHARD D. 1990. Estimation of seasonal egg production and daily egg mortality for walleye pollock (Theragra chalcogramma) in Shelikof Strait, AK, during the years 1981, 1985, and 1986. NWAFC Processed Rep. 90-08, 114 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

8. BAX, NICHOLAS, and JENS-ERIC ELIASSEN. 1990. Multispecies analysis in Balsfjord, northern Norway: Solution and sensitivity analysis of a simple ecosystem model. J. Cons. Int. Explor. Mer 47(2):175-204.

9. BERGER, JERALD, SUETO MURAI, and MICHAEL GUTTORMSEN. 1990. Summaries of foreign and joint venture groundfish catches (metric tons) in the Northeast Pacific Ocean and Bering Sea, 1989. NWAFC Processed Rep. 90-04, 81 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

10. BOHLE, MICHAEL S. 1990. Report to industry on results of the 1989 eastern Bering Sea groundfish survey. NWAFC Processed Rep. 90-02, 54 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

11. BRODERSEN, CHRISTINE C., PATRICIA M. ROUNDS, and MALIN M. BABCOCK. 1990. Diet influences cannibalism in laboratory-held juvenile red king crabs (Paralithodes camtschatica), p. 377-382. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

12. BRODEUR, RICHARD D., and WILLIAM G. PEARCY. 1990. Trophic relations of juvenile Pacific salmon off the Oregon and Washington coast. Fish. Bull., U.S. 88:617-636.

13. CARLS, MARK G., and CHARLES E. O'CLAIR. 1990. Influence of cold air exposures on ovigerous red king crabs (Paralithodes camtschatica) and Tanner crabs (Chionoecetes bairdi) and their offspring, p. 329-343. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

14. CARLS, MARK G., and STANLEY D. RICE. 1990. Abnormal development and growth reductions of pollock Theragra chalcogramma embryos exposed to water-soluble fractions of oil. Fish. Bull., U.S. 88:29-37.

15. CLAUSEN, DAVID M., and JONATHAN HEIFETZ. 1990. Pelagic shelf rockfish. Pages 162-168 in Gulf of Alaska Groundfish Plan Team (eds.), Stock assessment and fishery evaluation report for the 1991 Gulf of Alaska groundfish fishery. N. Pacific Fish. Manage. Council, P. O. Box 103136, Anchorage, AK 99510.

16. DAHLBERG, MICHAEL L. 1990. The high seas salmon fisheries of Japan, 1989. Alaska's Wildl. 22(4):25-26, 40-41.

17. DEW, C. BRAXTON. 1990. Behavioral ecology of podding red king crab, Paralithodes camtschatica. Can. J. Fish. Aquat. Sci. 47:1944-1958.

18. DORN, MARTIN, and RICHARD D. METHOT. 1990. Status of the Pacific whiting resource in 1989 and recommendation to management in 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-182, 84 p.

19. DORN, MARTIN W. and RICHARD D. METHOT. 1990. Status of the Pacific whiting resource in 1990. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for

1991, p. A1-A77. Pacific Fishery Management Council, Portland Oregon 97201.

20. FREESE, J. LINCOLN, and MALIN M. BABCOCK. 1990. The utility of artificial substrate collection devices to determine time and location of red king crab (Paralithodes camtschatica) glaucothoe settling in Auke Bay, Alaska, p. 119-130. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

21. FUJIOKA, JEFFREY T. 1990. Sablefish. Pages 125-139 in Gulf of Alaska Groundfish Plan Team (eds.), Stock assessment and fishery evaluation report for the 1991 Gulf of Alaska groundfish fishery. N. Pacific Fish. Manage. Council, P. O. Box 103136, Anchorage, AK 99510.

22. GUTTORMSEN, MICHAEL A. 1990. Provisional summary of U.S. observer activities and foreign and joint venture fisheries in the Northeast Pacific Ocean and eastern Bering Sea, 1989. NWAFC Processed Rep. 90-07, 24 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

23. HEIFETZ, JONATHAN, and DAVID M. CLAUSEN. 1990. Slope rockfish. Pages 140-161 in Gulf of Alaska Groundfish Plan Team (eds.), Stock assessment and fishery evaluation report for the 1991 Gulf of Alaska groundfish fishery. N. Pacific Fish. Manage. Council, P. O. Box 103136, Anchorage, AK 99510.

24. HERRMANN, MARK, BIING-HWAN LIN, RON MITTELHAMMER, and JOE TERRY. 1990. World salmon trade: Export/import statistics. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-181, 207 p.

25. HINCKLEY, SARAH. 1990. Variation of egg size of walleye pollock Theragra chalcogramma with a preliminary examination of the effect of egg size on larval size. Fish. Bull., U.S. 88:471-483.

26. IGNELL, STEVE. 1990. The North Pacific: Common ground for flying squid, salmonids, and squid driftnet fishermen. Alaska's Wildl. 22(4):27-29, 40.

27. ITO, DANIEL H. 1990. Other rockfish. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 184-188. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

28. ITO, DANIEL H. 1990. Pacific ocean perch. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 164-183. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

29. KENDALL, ARTHUR W., JR., and SUSAN J. PICQUELLE. 1990. Egg and larval distributions of walleye pollock, Theragra chalcogramma, in Shelikof Strait, Gulf of Alaska. Fish Bull, U.S. 88:133-154.

30. KIMURA, DANIEL K., and JULAINE J. LYONS. 1990. Choosing a structure for the production ageing of Pacific cod (Gadus macrocephalus). p. 9-23. In Loh-Lee Low (editor,) Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids, Oct. 31-Nov. 1, 1989, Seattle, Washington. Int. N. Pac. Fish. Comm. Bull. 50.

31. KIMURA, DANIEL K. 1990. Testing nonlinear regression parameters under heteroscedastic, normally distributed errors. Biometrics 46:697-708.

32. KIMURA, DANIEL K., and LAEL L. RONHOLT. 1990. Atka mackerel. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 189-216. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

33. KIMURA, DANIEL K. 1990. Approaches to age-structured separable sequential population analysis. Can. J. Fish. Aquat. Sci. 47(12):2364-2374.

34. KINOSHITA, RICHARD K., and JOSEPH M. TERRY. 1990. Pacific Northwest and Alaska exports of edible fishery products, 1989. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-185, 45 p.

35. KORSON, CHARLES S., and RICHARD K. KINOSHITA. 1990. Economic status of the Washington, Oregon, and California groundfish fishery in 1988. U.S. Dep. Commer., NOAA Tech. Memo NMFS-SWR-023, 51 p.KRIEGER, KENNETH J. 1990. Relationship between prey abundance and usage of

Glacier Bay by humpback whales. In A. M. Milner and J. D. Wood, Jr. (editors), Proceedings of the Second Glacier Bay Science Symposium, Sept. 19-22, 1988, Glacier Bay Lodge, Alaska, p. 74-77 or 90-95??. U.S. Dep. Inter., Natl. Park Serv., Alaska Regional Office, 2525 Gambell Street, Anchorage, AK 99503.

36. LIVINGSTON, PATRICIA A. 1990. Interannual trends in Pacific cod, Gadus macrocephalus, Predation on three commercially important crab species in the eastern Bering Sea. Fish. Bull., U.S. 87:807-827.

37. LOW, LOH-LEE (editor). 1990. Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids, Oct. 31-Nov. 1, 1989, Seattle, Washington. Int. N. Pac. Fish. Comm. Bull. 50.

38. LOW, LOH-LEE, and RENOLD E. NARITA (editors). 1990. Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/NWC-178, 224 p.

39. MCDEVITT, SANDRA A. 1990. Growth analysis of sablefish (Anoplopoma fimbria) from mark-recapture data from the Northeast Pacific. M.S. Thesis, Univ. Washington, Seattle, 87 p.

40. MCDEVITT, SANDRA A. 1990. Sablefish. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 140-163. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

41. MEADOR, JAMES P., B. D. ROSS, PAUL A. DINNEL, and SUSAN J. PICQUELLE. 1990. An analysis of the relationship between a sand-dollar embryo elutriate assay and sediment contaminants from stations in an urban embayment of Puget Sound, Washington. Mar. Environ. Res. 30:251-272.

42. MEGREY, BERNARD A., ANNE B. HOLLOWED, and RICHARD D. METHOT. 1990. Integrated analysis of Gulf of Alaska walleye pollock catch-at-age data and research survey data using two different stock assessment procedures. In Loh-Lee Low (editor), Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids, Oct. 31-Nov. 1, 1989, Seattle, Washington. Int. N. Pac. Fish. Comm., Bull. 50, p. 279-302.

43. MEGREY, BERNARD A., and VIDAR G. WESPESTAD. 1990. The Alaskan groundfish resources: Ten years of management under the Magnuson Fishery Conservation and Management Act. N. Am. J. Fish. Manage. 10(2):125-143.

44. METHOT, RICHARD D. 1990. Synthesis model: An adaptable framework for analysis of diverse stock assessment data. In Loh-Lee Low (editor), Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids, Oct. 31-Nov. 1, 1989, Seattle, Washington. Int. N. Pac. Fish. Comm. Bull. 50, p. 259-277.

45. METHOT, RICHARD D. and JOSEPH HIGHTOWER. 1990. Assessment of west coast sablefish stock in 1990 and recommendations to management in 1991. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991, p. B1-B67. Pacific Fishery Management Council, Portland Oregon 97201.

46. METHOT, RICHARD D., ROBERT DEMORY, FRANCIS HENRY, and JACK TURNOCK. 1990. Assessment of west coast Dover sole in 1990 and recommendations to management in 1991. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991, p. C1-C68. Pacific Fishery Management Council, Portland Oregon 97201.

47. MEYERS, T. R., B. EATON, S. SHORT, C. BOTELHO, T. KOENEMAN, ALBERT K. SPARKS, and J. FRANK MORADO. 1990. Bitter crab dinoflagellate disease: Overview of the causative agent and its importance and distribution in the Alaskan Tanner crab (Chionoecetes bairdi, C. opilio) fisheries, p. 405. In Proceedings of the International Symposium on King and Tanner Crabs, Nov. 28-30, 1989, Anchorage, AK. Alaska Sea Grant Col. Prog., Univ. Alaska Fairbanks, 138 Irving II, Fairbanks, AK 99775-5040.

48. MOLES, ADAM, PATRICIA ROUNDS, and CHRISTINE KONDZELA. 1990. Use of the brain parasite Myxobolus neurobius in separating mixed stocks of sockeye salmon. In Nick C. Parker, Albert E. Giorgi, Roy C. Heidinger, Douglas B. Jester, Jr., Eric D. Prince, and Gary A. Winans (editors), Fish-marking techniques, Proceedings International Symposium and Workshop on Fish-Marking Techniques, Univ. Washington, Seattle, June 27-July 1, 1988. American Fisheries Society Symposium 7:224-231.

49. MORADO,J., FRANK and ALBERT K. SPARKS. 1990. Preliminary report on the diseases and parasites of juvenile walleye pollock, Theragra chalcogramma, from the Gulf of Alaska, p. 201-213. In Frank O. Perkins and Thomas C. Cheng (editors), Pathology in marine science, Academic Press, Inc., San Diego.MORTENSEN, DONALD G. 1990. Use of staple sutures to close surgical incisions for transmitter implants. In Nick C. Parker, Albert E. Giorgi, Roy C. Heidinger, Douglas B. Jester, Jr., Eric D. Prince, and Gary A. Winans (editors), Fish-marking techniques, Proceedings International Symposium and Workshop on Fish-Marking Techniques, Univ. Washington, Seattle, June 27-July 1, 1988. American Fisheries Society Symposium 7:380-393.

50. MURPHY, MICHAEL L., and K V. KOSKI. 1989. Input and depletion of woody debris in Alaska streams and implications for streamside management. N. Am. J. Fish. Manage. 9:427-436.

51. O'CLAIR, CHARLES E., ROBERT P. STONE, and J. LINCOLN FREESE. 1990. Movements and habitat use of Dungeness crabs and the Glacier Bay fishery. In A. M. Milner and J. D. Wood, Jr. (editors), Proceedings of the Second Glacier Bay Science Symposium, Sept. 19-22, 1988, Glacier Bay Lodge, Alaska, p. 74-77. U.S. Dep. Inter., Natl. Park Serv., Alaska Regional Office, 2525 Gambell Street, Anchorage, AK 99503.

52. OLLA BORI L., and MICHAEL W. DAVIS. 1990. Effects of physical factors on the vertical distribution of larval walleye pollock Theragra chalcogramma under controlled laboratory conditions. Mar. Ecol. Prog. Ser. 63:105-112.

53. ONA, EGIL, and JIMMIE J. TRAYNOR. 1990. Hull mounted, protruding transducer for improving echo integration in bad weather. Int. Counc. Explor. Sea C.M. 1990/B:31.

54. OTTO, ROBERT S., RICHARD A. MACINTOSH, and PETER A. CUMMISKEY. 1990. Fecundity and other reproductive parameters of female red king crab (Paralithodes camtschatica) in Bristol Bay and Norton Sound, Alaska, p. 65-90. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

55. OTTO, ROBERT S., and PETER A. CUMMISKEY. 1990. Growth of adult male blue king crab (Paralithodes platypus), p. 245-257. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

56. OTTO, ROBERT S. 1990. An overview of eastern Bering Sea king and Tanner crab fisheries, p. 9-26. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

57. PACUNSKI, ROBERT. 1990. Food habits of flathead sole, Hippoglossoides elassodon, in the eastern Bering Sea. M.S. thesis, Univ. Washington, Seattle, 106 p.

58. PARKS, NORMAN B., and FRANKLIN R. SHAW. 1990. Changes in relative abundance and size composition of sablefish in coastal waters of Washington and Oregon, 1979-89. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-188, 38 p.

59. QUEIROLO, LEWIS E., and RICHARD S. JOHNSTON. 1990. Some economic consequences of extended jurisdiction for cooperative fishery arrangements, p. 763-777. In Hans Frost (editor), Vol. I, Proceedings of Fourth Biennial Conference of Institute for International Fisheries Economics and Trade, Aug. 7-12, 1988, Esbjerg. Danish Institute of Fisheries Economics Research, Univ. S. Jutland, Glentevej 7-DK-6705, Esbjerg, Denmark.

60. RAYMORE, PAUL A., JR., and KENNETH L. WEINBERG. 1990. 1984 Spring and autumn surveys of Pacific west coast upper continental slope groundfish resources. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-179, 196 p.

61. REEVES, JERRY E. 1990. Evaluation of some errors in estimating recruitment for the Bristol Bay red king crab stock-recruit relationship, p. 447-468. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

62. ROSE, CRAIG S., and GARY E. WALTERS. 1990. Trawl width variation during bottom trawl surveys: Causes and consequences. In Loh-Lee Low

(editor), Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids, Oct. 31-Nov. 1, 1989, Seattle, Washington. Int. N. Pac. Fish. Comm., Bull. 50, p. 57-67.

63. ROUNDS, PATRICIA M., CHRISTINE BRODERSEN, and MALIN M. BABCOCK. 1990. Effects of cohort density and habitat on survival and growth of juvenile red king crab, Paralithodes camtschatica, p. 209-217. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

64. RUGEN, WILLIAM C. 1990. Spatial and temporal distribution of larval fish in the western Gulf of Alaska, with emphasis on the period of peak abundance of walleye pollock (Theragra chalcogramma) larvae. NWAFC Processed Rep. 90-01, 162 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

65. SAMPLE, TERRANCE M. and THOMAS K. WILDERBUER. 1990. Arrowtooth flounder. In: Stock assessment and fishery evaluation document for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 1991. p. 108-117. North Pac. Management Council., P.O. Box 103136, Anchorage, AK 99510.

66. SHIRLEY, T. C., S. M. SHIRLEY, and SIDNEY KORN. 1990. Incubation period, molting and growth of female red king crabs: Effects of temperature, p. 52-63. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

67. SIEFERT, DEBORAH L., LEWIS S. INCZE, and PETER B. ORTNER. 1990. Vertical distribution of zooplankton, including ichthyoplankton, in Shelikof Strait, Alaska: Data from Fisheries-Oceanography Coordinated Investigations (FOCI) cruise in May 1987. NWAFC Processed Rep. 90-05,. 129 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

68. SPARKS, ALBERT K. (editor). 1990. Marine farming and enhancement. Proceedings of the Fifteenth U.S.-Japan Meeting on Aquaculture, Kyoto, Japan, Oct. 22-23, 1986. NOAA Tech. Rep. NMFS-85, 127 p.

69. STEVENS, BRADLEY G., and RICHARD A. MACINTOSH. 1990. Report to industry on the 1990 eastern Bering Sea crab survey. NWAFC Processed Rep. 90-09, 50 p. Alaska Fish. Sci. Center, Kodiak Facility, P. O. Box 1638, Kodiak, AK 99615.

70. STEVENS, BRADLEY G., and J. ERIC MUNK. 1990. A temperature-dependent growth model for juvenile red king crab, Paralithodes camtschatica, in Kodiak, Alaska, p. 293-304. In Proceedings of International Symposium on King and Tanner Crabs, Anchorage, Alaska, Nov. 28-30, 1989. Alaska Sea Grant College Program Rep. 90-04.

71. STEVENS, BRADLEY G. 1990. Temperature-dependent growth of juvenile red king crab (Paralithodes camtschatica) and its effects on size-at-age and subsequent recruitment in the eastern Bering Sea. Can. J. Fish. Aquat. Sci. 47:1307-1317.

72. STONE, ROBERT P., and CHARLES E. O'CLAIR. 1990. Seasonal migration of primiparous and multiparous female red king crabs (Paralithodes camtschatica), p. 189-191. In Proceedings of the International Symposium on King and Tanner Crabs, Nov. 28-30, 1989, Anchorage, AK. Alaska Sea Grant Col. Prog., Univ. Alaska Fairbanks, 138 Irving II, Fairbanks, AK.

73. THOMPSON, GRANT G., and RICHARD G. BAKKALA. 1990. Assessment of the eastern Bering Sea Pacific cod stock using a catch-at-age model and trawl survey, p. 215-236. In Loh-Lee Low (editor), Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids, Oct. 31-Nov. 1, 1989, Seattle, Washington. Int. N. Pac. Fish. Comm. Bull. 50.

74. THOMPSON, GRANT G., and ALLEN M. SHIMADA. 1990. Pacific cod. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 44-66. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

75. TRAYNOR, JIMMIE J., WILLIAM A. KARP, TERRANCE M. SAMPLE, MASAHIKO FURUSAWA, TAKASHI SASAKI, KAZUYUKI TESHIMA, NEAL J. WILLIAMSON, and TAKU YOSHIMURA. 1990. Methodology and biological results from surveys of walleye pollock (Theragra chalcogramma) in the eastern Bering Sea and Aleutian Basin in 1988. In Loh-Lee Low (editor), Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids, Oct. 31-Nov. 1, 1989, Seattle, Washington. Int. N.

Pac. Fish. Comm. Bull. 50, p. 69-99.

76. WALTERS, GARY E., and THOMAS K. WILDERBUER. 1990. Other flatfish. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 123-139. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

77. WALTERS, GARY E., and THOMAS K. WILDERBUER. 1990. Rock sole. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 112-122. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

78. WALTERS, GARY E. and THOMAS K. WILDERBUER. 1990. Other flatfish. In: stock assessment and fishery evaluation document for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 1991, p. 129-141. North. Pac. Fish. Management Council., P.O. Box 103136, Anchorage, AK 99510.

79. WALTERS, GARY E. and THOMAS K. WILDERBUER. 1990. Rock sole. In: Stock assessment and fishery evaluation documents for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 1991, p. 129-141. North. Pac. Fish. Management Council, P.O. Box 103136, Anchorage, AK 99510.

80. WESPESTAD, VIDAR G., RICHARD G. BAKKALA, and PIERRE DAWSON. 1990. Walleye pollock. In: Stock assessment and fishery evaluation document for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 1991, p. 27-50. North Pac. Fish. Management Council, P.O. Box 103136, Anchorage, AK 99510.

81. WESPESTAD, VIDAR G., and JIMMIE J. TRAYNOR. 1990. Walleye pollock. In Loh-Lee Low and Renold E. Narita (editors), Condition of groundfish resources in the Bering Sea-Aleutian Islands Region as assessed in 1988, p. 19-43. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-178.

82. WILDERBUER, THOMAS K. and TERRANCE M. SAMPLE. 1990. Greenland turbot. In: stock assessment and fishery evaluation document for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 1991, p. 94-107. North Pac. Fish. Management Council, P.O. Box 103136, Anchorage, AK 99510.

83. WILDERBUER, THOMAS K., G. E. WALTERS, and R. G. BAKKALA. 1990. Yellowfin sole (Limanda aspera) of the eastern Bering Sea: Biological characteristics, history of exploitation, and current management of the resource. In Proceedings of the International Symposium on Flatfish Ecology, Texel, The Netherlands, Nov. 18-23, 1990. Netherlands J. Sea Res.

84. WING, BRUCE L., and ROGER W. MERCER. 1990. Temporary northern range extension of the squid Loligo opalescens in southeast Alaska. The Veliger 33(3):238-240.

85. WOLOTIRA, ROBERT J., JR., M. JAMES ALLEN, TERRANCE M. SAMPLE, RICK L. HENRY, CONSTANCE R. ITEN, and SANDRA F. NOEL. 1990. Life history and harvest summaries for selected invertebrate species occurring off the west coast of North America, Volume 2: Cephalopods and crustacea. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-183, 191 p.

86. YOKLAVICH, MARY M., and KEVIN M. BAILEY. 1990. Hatching period, growth and survival of young walleye pollock Theragra chalcogramma as determined from otolith analysis. Mar. Ecol. Prog. Ser. 64:13-23.

87. ZENGER, HAROLD H. and GRANT G. THOMPSON. 1990. Pacific cod. In Groundfish Plan Team (editor). Stock assessment and fishery evaluation document for 1991 Gulf of Alaska groundfish fishery.p. 90-105. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK 99510.

88. ZHANG, CHANG-IK, and DONALD R. GUNDERSON. 1990. Yield per recruit and management recommendations for Alaska plaice in the eastern Bering Sea. N. Am. J. Fish. Manage. 10(1):1-10.

NAATIONAL MARINE FISHERIES SERVICE - SWFSC

GROUNDFISH PUBLICATIONS OF THE SWFSC-NMFS,1989 TO 1991

1. Bakun, A. 1989. L'ocean et la variabilité des populations marines. In Troadec, J. P. (ed.), L'homme et les écosystems halieutiques, p. 155-187. Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Paris.

2. Bakun, A. 1990. Global climate change and intensification of coastal ocean upwelling. Science 247:198-201.

3. Bence, J. R., and J. E. Hightower. 1990. Status of bocaccio in the Conception/Monterey/Eureka INPFC areas in 1990. Appendix J, 65 p. In Status of the Pacific Coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Pacific Fishery Management Council, Portland, Oregon.

4. Butler, J. L., C. A. Kimbrell, W. C. Flerx, and R. D. Methot.1989. The 1987-88 demersal fish surveys off central California (34 30'N to 36 30'N). U. S. Dep. Commer., NOAA Tech. Memo, NOAA-TM-NMFS-SWFC-133, 44 p.

5. Eldridge, M. B., J. A. Whipple, M. J. Bowers, B. M. Jarvis, and J. Gold. 1991. Reproductive performance of yellowtail rockfish,Sebastes flavidus. Environ. Biol. Fishes 30:91-102.

6. Gordoa, A., and J. E. Hightower. In Press. Changes in catchability in a bottom-trawl fishery for Cape hake (Merluccius capensis). Can. Fish. Aquat. Sc.

7. Herrick, S, and D. Squires. 1990. On measuring fishing fleet productivity: development and demonstration of an analytical framework. Fish. Bull. 88:85-94.

8. Hightower, J. E. 1990. Multispecies harvesting policies for Washington-Oregon-California rockfish trawl fisheries. Fish. Bull., U.S. 88: 645-656.

9. Hightower, J. E., and W. H. Lenarz. 1990. Status of the widow rockfish fishery in 1990. Appendix F, 48 p. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Stock assessment and fishery evaluation. Appendix Volume 2. Pacific Fishery Management Council, Portland.
Hightower, J. E.

10. Hightower, J. E., and W. H. Lenarz. 1990. Biomass-based models and harvesting policies for Washington-Oregon-California rockfish stocks with correlated recruitment patterns. U. S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-137, 39 p.

11. Hightower, J. E., and W. H. Lenarz. 1989. Optimal harvesting policies for the widow rockfish fishery. In Edwards, E. F., and B. A. Megrey (eds.), Mathematical analysis of fish stock dynamics, p. 83-91. Amer. Fish. Soc. Symp. 6.

12. Hightower, J. E., and W. H. Lenarz. 1989. Status of widow rockfish fishery. Appendix C, 51 p. In Status of the Pacific Coast groundfish fishery through 1989 and recommended acceptable biological catches for 1990. Pacific Fishery Management Council, Portland, Oregon.

13. Hightower, J. E., and W. H. Lenarz. 1989. Using GENMOD to develop harvesting policies for multiaged fish stocks. In E. F. Edwards and B. A. Megrey (eds), Mathematical analysis of fish stock dynamics, p. 209-210. Amer. Fish. Soc. Symp. 6.

14. Hobson, E. S. 1989. Predation on ocean krill. Science 243:237-238.

15. Hobson, E. S., and D. F. Howard. 1989. Mass strandings of juvenile shortbelly rockfish and Pacific hake along the coast of northern California. Calif. Fish Game 75:169-172.

16. Hunter, J. R., J. L. Butler, C. Kimbrell, and E. A. Lynn. 1990. Bathymetric patterns in size, age, sexual maturity, water content, and caloric density of Dover sole, Microstomus pacificus. Calif. Coop. Oceanic Fish. Invest. Rep. 31:124-131.

17. Hunter, J. R., B. J. Macewicz, and C. A. Kimbrell. 1989. Fecundity and other aspects of the reproduction of sablefish, Anoplopoma fimbria, in central California waters. Calif. Coop. Oceanic Fish. Invest. Rep. 30:61-62.

18. Jacobson, L. D. 1990. Thornyheads--stock assessment for 1990. Appendix D. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Pacific Fishery Management Council. Portland, Oregon.

19. Laidig, T. E., S. Ralston and J. R. Bence. In press. Dynamics of growth in the early life history of shortbelly rockfish, Sebastes jordani. Fish. Bull., U.S.

20. Lapointe, M. F., R. M. Peterman, and A. D. MacCall. 1989. Trends in fishing mortality rate along with errors in natural mortality can cause spurious time trends in fish stock abundances estimated by virtual population analysis (VPA). Can. J. Fish. Aquat. Sci. 46:2129-2139.

21. Lenarz, W. H., R. J. Larson and S. Ralston. In press. An in-depth review of the depth distributions of early life history stages of important fishes of the CaliforniaCurrent. Calif. Coop. Oceanic Fish. Invest. Rep.

22. Lenarz, W. H., and T. Wyllie Echeverria. 1991. Sexual dimorphism in Sebastes. Environ. Biol. ofFishes 30:71-80.

23. MacCall, A. D. 1990. Dynamic geography of marine fish populations. Univ. Wash. Press, Seattle, 153 p.

24. Methot, R., and J. Hightower. 1990. Status of the West Coast sablefish stock in 1990 and recommendations to management in 1991. Appendix B, 67 p. In Status of the Pacific Coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Pacific Fishery Management Council, Portland, Oregon.

25. Methot, R., and J. Hightower. 1989. Status of the Washington-Oregon-California sablefish stock in 1989. Appendix B, 51 p. Status of the Pacific Coast groundfish fishery through 1989 and recommended acceptable biological catches for 1990. Pacific Fishery Management Council, Portland, Oregon.

26. Pearson, D. E. and S. Ralston. 1990. Trends in landings, species composition, length-frequency distributions, and sex ratios of 11 rockfish species (genus Sebastes) from central and northern California ports (1978-88). U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-145, 65p.

27. Pearson, D. E. and S. Ralston. 1990. Trends in length composition and landings in the California commercial rockfish fishery from 1978-1988. Appendix K, 9 p. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Stock assessment and fishery evaluation. Appendix Volume 2. Pacific Fishery Management Council, Portland.

28. Pearson, D. E., J. E. Hightower and J. T. H. Chan. 1989. Age, growth, year class strength, and potential yield for shortbelly rockfish. Appendix D, 32 p. In Status of the Pacific coast groundfish fishery through 1989 and recommended acceptable biological catches for 1990. Pacific Fishery Management Council, Portland, Oregon.

29. Pearson, D. E. 1989. A survey of the fishes and water properties of the South San Francisco Bay, California 1973-1982. NOAA Tech. Rep. NMFS-78, 21 p.

30. Pearson, D. E., J. E. Hightower and J. T. H. Chan. In press. Age, growth, and potential yield for shortbelly rockfish (Sebastes jordani). Fish. Bull., U.S.

31. Ralston, S., A. D. MacCall and D. E. Pearson. 1990. Reduction in mean length and exploitation of central and northern California rockfish. Appendix L, 4 p. In Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Stock assessment and fishery evaluation. Appendix Volume 2. Pacific Fishery Management Council, Portland.

32. Ralston, S. V. In press. Effect of seasonal recruitment on bias in the Beverton-Holt length-based mortality estimator. Amer. Fish. Soc. Symp. Ser.

33. Reilly, C. A., T. Wyllie Echeverria and S. Ralston. In press. Interannual variation and overlap in the diets of pelagic juvenile rockfish (genus: Sebastes) off central California. Fish. Bull., U.S.

34. Schwing, F. B., D. M. Husby and D. E. Tracy. 1991. In press. Mesoscale response of coastal waters off central California to wind events following the spring 1989 transition: analysis of CTD and surveys AVHRR imagery. Calif. Coop. Oceanic Fish. Invest. Rep. 32.

35. Schwing, F. B., J. G. Norton and C. H. Pilskaln. 1990. Earthquake and bay: response of Monterey Bay to the Loma Prieta earthquake. EOS, Trans. Amer. Geophys. Un. 71(6):250-251,262.

36. Schwing, F. B., S. V. Ralston, D. M. Husby and W. H. Lenarz. 1990. The nearshore physical oceanography off the central California coast during

May-June 1989: a summary of CTD data from juvenile rockfish surveys. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-153. La Jolla, CA. 142pp.

37. Schwing, F. B., D. M. Husby, D. E. Tracy, S. V. Ralston, and W. H. Lenarz. 1990. Hydrographic conditions in the Gulf of the Farallones following the spring transition. Trans. Am. Geophys. Union 71:1350.

38. Squires, D. 1990. On the estimation of economic capacity utilization in multiproduct industries. J. Econometrics 44:347-361.

39. Squires, D., S. F. Herrick, Jr., and J. Hastie. 1989. Integration of Japanese and United States sablefish markets. Fish. Bull., U.S. 87:341-351.

40. Tracy, D. E., L. K. Rosenfeld, N. Garfield and F. B. Schwing. 1990. Advection of upwelled water into Monterey Bay as observed by AVHRR imagery. Trans. Am. Geophys. Union 71:1350-1351.

41. Ueber, E. 1989. Xanthic, gigantic, china rockfish. Calif. Fish Game 75:47-48.

42. Woodbury, D., and S. Ralston. In press. Interannual variation in growth rates and back-calculated birthdate distributions of pelagic juvenile rockfishes (Sebastes spp.) off the central California coast. Fish. Bull., U.S.

43. Wyllie Echeverria, T., W. H. Lenarz and C. A. Reilly. 1990. Survey of the abundance and distribution of pelagic young-of-the-year rockfishes, Sebastes, off central California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-147, 125 p.

CANADA REPORTS PUBLISHED BY THE GROUNDFISH PROGRAM DURING THE PERIOD MAY 1, 1990 TO April 30, 1991 ARE LISTED BELOW:

1. Beamish, R. J., G. A. McFarlane and A. V. Tyler. 1990. Acomparison of the length frequency and fin-ray methods of estimating the age of Pacific cod. INPFC Bull. 50: 25-36.

2. Cass, A. J., R. J. Beamish and G. A. McFarlane. 1990. Lingcod(Ophiodon elongatus). Can. Spec. Bull. Fish. Aquat. Sci. 109: 40 p.

3. Crawford, W. R., A. V. Tyler and R. E. Thomson. 1990. Apossible eddy retention mechanism for ichthyoplankton in Hecate Strait. Can. J. Fish. Aquat. Sci. 47(7): 1356-1363.

4. Fargo, J., A.V. Tyler, and R.P. Foucher. 1990. Distribution ofdemersal fishes in Hecate Strait, British Columbia, based on systematic trawl surveys conducted from 1984-87. Can. Fish. Aquat. Sci. Tech. Rep. 1745: 115 p.

5. Foucher, R. P. and A. V. Tyler. 1990a. Length-at-age by sex forPacific cod in British Columbia. Can. MS Rep. Fish. Aquat. Sci. 2086: 39 p.

6. Foucher, R. P. and A. V. Tyler. 1990b. Estimation of thefecundity of Pacific cod. Can. MS Rep. Fish. Aquat. Sci. 2088: 49 p.

7. Hand, C. M., J. R. Candy and L. J. Richards. 1990. Results ofthe 1986-88 inshore rockfish harvest log program. Can. MS Rep. Fish. Aquat. Sci. 2069: 41 p.

8. Kieser, R. and J. E. Ehrenberg. 1990. An unbiased, stochasticecho-counting model. In: Developments in Fisheries Acoustics. A Symposium held in Seattle 22-26 June 1987. Rapports et proces verbaux des reunions. Rapp. p.-v. Reun. int. Explor. Mer. Vol. 189.

9. Leaman, B. M. 1991. Reproductive styles and life historyvariables relative to exploitation and management of Sebastes stocks. Environ. Bio. Fish. 30: 253-271.

10. Leaman, B. M., R. Kieser, P. Withler, and R. D. Stanley. 1990.W. E. RICKER hydroacoustic cruise to study rockfish behaviour off northern Vancouver Island, March 14-23, 1990. Can. MS. Rep. Fish. Aquat. Sci. 2091: 63 p.

11. Lee, D. L., D. J. Whitaker, and R. D. Stanley. 1990. Apreliminary examination of the parasite fauna of yellowtail rockfish, Sebastes flavidus. Can. Tech. Rep. Fish. Aquat. Sci. 1777: 21 p.
McFarlane, G. A., R. S. Wydoski and E. D. Prince. 1990.Historical review of the development of external tags and marks. Amer. Fish. Soc. Sym. 7: 9-29.

12. McFarlane, G. A. and R. J. Beamish. 1990a. Effect of anexternal tag on growth of sablefish (Anoplopoma fimbria), and consequences to mortality and age at maturity. Can. J. Fish. Aquat. Sci. 47: 1551-1557.

13. McFarlane, G. A. and R. J. Beamish. 1990b. An examination ofage determination structures of Walleye Pollock (Theragra chalcogramma) from five stocks in the Northeast Pacific Ocean. INPFC Bull. 50: 37-56.

14. Richards, L. J. and M. W. Saunders. 1990. Problems in yieldallocation of Pacific Hake (Merluccius productus). INPFC Bull. No. 50: 135-144.

15. Richards, L. J. and J. T. Schnute. 1990. Use of a general dose-response model for rockfish fecundity-length relationships. Can. J. Fish. Aquat. Sci. 47(6): 1148-1156.

16. Richards, L. J., J. T. Schnute, and C. M. Hand. 1990. Amultivariate maturity model with a comparative analysis of three lingcod (Ophiodon elongatus stocks. Can. J. Fish. Aquat. Sci. 47(5): 948-959.

17. Rutherford, K. L. 1991. Catch and effort statistics of theCanadian groundfish fishery on the Pacific Coast in 1989. Can. Tech. Rep. Fish. Aquat. Sci. No. 1979: 88 p.

18. Saunders, M. W., G. A. McFarlane and R. J. Beamish. 1990.Factors that affect the recapture of tagged Sablefish off the West Coast of Canada. Amer. Fish. Soc. Sym. 7: 708-713.

19. Shaw, W., G. A. McFarlane, and R. Kieser. 1990. Distribution and abundance of the Pacific Hake (Merluccius productus) spawning stocks in the Strait of Georgia, British Columbia, based on trawl and acoustic surveys in 1981 and 1988. INPFC Bull. No. 50: 121-134.

20. Smith, B. D., G. A. McFarlane and A. J. Cass. 1990. Movementand mortality of tagged male and female lingcod in the Strait of Georgia, British Columbia. Trans. Amer. Fish. Soc. 119: 802-812.

21. Smith, B. D., G. A. McFarlane and M. W. Saunders. 1990.Variation in Pacific Hake (Merluccius productus) summer length-at-age near southern Vancouver Island and its relationship to fishing and oceanography. Can. J. Fish. Aquat. Sci. 47: 2195-2211.

22. Smith, B. D. and G. A. McFarlane. 1990. Growth analysis ofStrait of Georgia lingcod by use of length frequency and length increment data in combination. Trans. Amer. Fish. Soc. 119: 813-824.

23. Stanley, R. D. 1990a. The effect of joint catches on themanagement of the British Columbia trawl rockfish (Sebastes) fisheries. pp. 23-25 in: Dewees, C. M. and E. Ueber (eds.). Effects of different fishery management schemes on bycatch, joint catch, and discards. California Sea Grant College Program, Rep. No. T-CSGCP-019.

24. Stanley, R. D. 1990b. Sample size versus sample number:Sampling optimization for trawl caught rockfish. Can. Man. Rep. of Fish. Aquat. Sci. 2080: 20 p.

25. Stocker, M. and B. M. Leaman. 1990. Effects of extendedjurisdiction on conservation of Canada's Pacific coast fisheries. N. Am. J. Fish. Mgmt. 10: 144-153.

26. Tyler, A.V. 1990a (Editor). Hecate Strait Project: Results fromfour years of multispecies research. Can. Tech. Rep. Fish. Aquat. Sci. 1675: 60 p.

27. Tyler, A. V. 1990b. Estimation of yield in a high turn-overstock of groundfish: an application to Pacific cod on the west coast of Canada. INPFC Bull 50: 237-242.

28. Westrheim, S. J., J. Fargo and R. P. Foucher. 1990. Stockassessments of individual species in a mixed-species trawl fishery: some hazards. INPFC Bull. No. 50: 145-155.

Appendix G

PacFIN Coast-Wide Groundfish Catch Report.

NOTE: It was agreed during the 1990 meting that the Coast-wide PacFIN Data Report would take the place of individual agency reports in future TSC Annual Minutes. For more specific catch and or effort information contact the individual agencies.

US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR ALL AREAS

SPECIES	HAND LINE	JIG	LONGLINE	OTH HK&LN	POLE(COM)	OTH-KNOWN	UNKN-GEAR	DIP NET	GILL NET	OTHER NETS
ARROWTOOTH FLOUNDER	_	_	38.6	TR	_	0.5	29.5	_	_	_
UNSPECIFIED TURBOTS	_	_	55.1	_	_	_	_	_	_	_
ALASKA PLAICE	_	_								
DOVER SOLE	_	_	1.3	TR	14.0	0.1	212.0	_	_	16.3
ENGLISH SOLE	_	TR	0.9	TR	7.4	0.8	70.9	_	_	42.2
GREENLAND TURBOT			843.6							
PETRALE SOLE	TR	_	0.6	TR	4.4	0.2	44.7	_	_	27.8
REX SOLE	_	_	0.4	_	1.8	0.1	22.6	_	_	4.1
ROCK SOLE		TR	9.7		0.2	0.4	2.4	_		TR
STARRY FLOUNDER	TR	TR	0.2	TR	TR	0.7	5.8	_	1.9	0.7
YELLOWFIN SOLE	_		TR					_	_	
OTHER FLATFISH		TR	6.3	TR	19.2	TR	96.2	_	_	136.3
UNSP. FLATFISH	0.1		22.0		2.0	TR	3.4	_		12.1
___ALL FLATFISH	0.1	0.1	1016.5	TR	49.0	2.9	495.4	_	1.9	239.5
BLACK ROCKFISH	_	_	10.7	6.8		_	0.3	_	_	_
BOCACCIO	_	_	0.4	0.2	38.8	_		_	_	_
CANARY ROCKFISH	_	_	1.8	17.2	9.8	_	TR	_	_	_
CHILIPEPPER	_	_		_	12.6	_	_	_	_	_
DARKBLOTCHED ROCKFIS	_	_	0.2		0.8	_		_	_	_
DUSKY ROCKFISH	_	_	4.0	0.1	_	_	0.2	_	_	_
QUILLBACK ROCKFISH	_	_	86.0	4.4	_	_	1.0	_	_	_
REDBANDED ROCKFISH	_	_	8.6	TR	_	_	TR	_	_	_
REDSTRIPE ROCKFISH	_	_	0.3	TR	_	_		_	_	_
ROSETHORN ROCKFISH	_	_	1.5	0.1	_	_	TR	_	_	_
ROUGHEYE ROCKFISH	_	_	132.3	1.0	_	_	_	_	_	_
SHARPCHIN ROCKFISH	_	_			_	_	_	_	_	_
SHORTRAKER ROCKFISH	_	_	12.2	0.2	_	_	_	_	_	_
SILVERGREY ROCKFISH	_	_	4.6	0.3		_	_	_	_	_
SPLITNOSE ROCKFISH	_	_			0.2	_		_	_	_
YELLOWEYE ROCKFISH	_	_	338.5	14.2	0.2	_	2.9	_	_	_
YELLOWMOUTH ROCKFISH	0.3		1.4			_		_	_	_
YELLOWTAIL ROCKFISH	7.5	14.6	11.0	4.6	76.4	_	TR	_	_	_
OTHER ROCKFISH	706.6	_	1313.7		137.1	_	0.1	_	0.1	0.7
PACIFIC OCEAN PERCH	2.0	_	11.8	7.7	_	_	0.3	_	_	_
UNSP. POP GROUP	_	_	33.0	_	_	_	_	_	_	_
SHORTBELLY ROCKFISH	_	_						_	_	
THORNYHEADS	_	_	473.6	1.7	16.0	1.0	129.0	_	_	1.1
WIDOW ROCKFISH	_	0.3	7.2	3.8	27.8	0.7	19.8	_	_	140.2
OTHER DEMERSAL RKFSH	_	_	5.3	0.1	_	_	TR	_	_	_
OTHER SLOPE RKFSH	_	_	250.0	3.5	_	_	_	_	_	_
UNSP. DEMERSAL RKFSH	_	_	28.3	_	_	_	_	_	_	_
UNSP. PELAGIC RKFSH	_	_	7.0	_	_	_	_	_	_	_
UNSP. SLOPE RKFSH			58.4					_		
UNSP. ROCKFISH	0.1	138.9	687.7	335.6	2212.6	24.5	905.3	_	TR	1773.3
___ALL ROCKFISH	716.5	153.8	3489.4	401.6	2532.3	26.1	1059.0	_	0.1	1915.2
ATKA MACKEREL	_	_	_		_	_	_	_	_	_
JACK MACKEREL				TR						
LINGCOD	342.9	75.2	978.4	265.3	249.7	0.6	60.0	_	0.3	173.9

DATA SOURCE FOR AREAS CHARLOTTE, GEORGIA STRAIT, AND THE CANADIAN PORTION OF VANCOUVER IS DFO,CANADA
TR => LANDED CATCH LESS THAN 0.05 METRIC TONS, OR METRIC TONS PER UNIT OF EFFORT LESS THAN 0.005

US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR ALL AREAS

SPECIES	HAND LINE	JIG	LONGLINE	OTH HK&LN	POLE(COM)	OTH-KNOWN	UNKN-GEAR	DIP NET	GILL NET	OTHER NETS
PACIFIC COD	4.1	2.2	53974.4	206.8	_	44.2	286.3	_	_	TR
PACIFIC WHITING	0.2				2.6		242.4	_	_	0.4
SABLEFISH	129.1	0.2	30604.3	5.0	412.0	0.1	186.3	_	_	59.0
WALLEYE POLLOCK	_	_	1164.3	TR		0.1	222.4			_
OTHER ROUNDFISH	_	_			0.2	_	_	1262.5	2.9	_
UNSP. ROUNDFISH			TR	TR						
___ALL ROUNDFISH	476.3	77.6	86721.3	477.2	664.5	45.0	997.5	1262.5	3.2	233.3
SPINY DOGFISH	10.8	0.4	3402.1	0.3	_	_	_	_	13.9	
UNSPECIFIED SHARK		_	0.5	_	_	_	_	_	_	0.1
UNSPECIFIED SKATE	3.1	_	7.5	_	_	_	_	_	_	_
UNSPECIFIED SQUID	_		2.6							
OTHER GROUNDFISH		0.6	22.6	3.6	40.6	_	12.4	999.8	0.1	61.7
UNSP. GROUNDFISH	0.2		994.3	2.3	2.7	TR	12.3		8.5	12.0
___MISC. GROUNDFISH	14.1	1.0	4429.6	6.2	43.3	TR	24.7	999.8	22.5	73.9
ALL GROUNDFISH	1206.9	232.4	95656.9	884.9	3289.2	74.1	2576.6	2262.3	27.7	2461.9

DATA SOURCE FOR AREAS CHARLOTTE, GEORGIA STRAIT, AND THE CANADIAN PORTION OF VANCOUVER IS.DFO,CANADA
TR => LANDED CATCH LESS THAN 0.05 METRIC TONS, OR METRIC TONS PER UNIT OF EFFORT LESS THAN 0.005

US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR ALL AREAS

SPECIES	SEINE	SET NET	TRAMMEL	CRAB POT	FISH POT	OTHER POTS	TROLL	BEAM TRAWL	BTM-TRAWL	GFSH-TRAWL
ARROWTOOTH FLOUNDER	-	-	-	-	-	TR	TR	-	4910.3	8514.4
UNSPECIFIED TURBOTS	-	-	-	-	-	-	-	-	1852.9	
ALASKA PLAICE	-	-	-	-	-	-	-	-		24.6
DOVER SOLE	-	-	-	TR	TR	0.1	0.1	-	2404.1	11359.7
ENGLISH SOLE	-	0.1	-	-	-	0.3	TR	-	1277.1	1204.0
GREENLAND TURBOT	-	-	-	-	-	0.5		-	7671.4	1615.7
PETRALE SOLE	-	-	TR	-	-	0.4	0.1	-	1074.1	1381.9
REX SOLE	-	-	-	-	-	0.1		-	135.3	805.0
ROCK SOLE	-	TR	-	-	-	TR	TR	-	15237.3	3662.6
STARRY FLOUNDER	TR	0.2	-	TR	-	TR	TR	-	145.2	623.3
YELLOWFIN SOLE	-		-		-	0.1		-	8976.9	542.8
OTHER FLATFISH	-	TR	-	TR	-	2.7	TR	-	71.7	1745.3
UNSP. FLATFISH	TR		-		-	0.1	0.1	-	2404.1	908.1
___ALL FLATFISH	TR	0.3	TR	TR	TR	4.5	0.4	-	50078.6	32734.8
BLACK ROCKFISH	-	-	-	-	-	TR	-	-	3.7	51.6
BOCACCIO	-	-	-	-	-	-	-	-	977.0	304.4
CANARY ROCKFISH	-	-	-	-	-	-	-	-	1578.3	1213.7
CHILIPEPPER	-	-	-	-	-	-	-	-	10.6	2.4
DARKBLOTCHED ROCKFIS	-	-	-	-	-	-	-	-	56.1	742.3
DUSKY ROCKFISH	-	-	-	-	-	-	-	-		52.7
QUILLBACK ROCKFISH	-	-	-	-	-	-	-	-	-	TR
REDBANDED ROCKFISH	-	-	-	-	-	-	-	-	-	0.1
REDSTRIPE ROCKFISH	-	-	-	-	-	-	-	-	1843.5	282.0
ROSETHORN ROCKFISH	-	-	-	-	-	-	-	-		0.1
ROUGHEYE ROCKFISH	-	-	-	-	-	-	-	-	1206.3	111.9
SHARPCHIN ROCKFISH	-	-	-	-	-	-	-	-	158.3	93.0
SHORTRAKER ROCKFISH	-	-	-	-	-	-	-	-	104.2	6.8
SILVERGREY ROCKFISH	-	-	-	-	-	-	-	-	2158.5	94.7
SPLITNOSE ROCKFISH	-	-	-	-	-	-	-	-	105.4	140.2
YELLOWEYE ROCKFISH	-	-	-	-	-	-	-	-	48.3	62.0
YELLOWMOUTH ROCKFISH	-	-	-	-	-	-	-	-	1585.0	327.9
YELLOWTAIL ROCKFISH	-	-	-	-	-	-	5.3	-	2622.0	3543.8
OTHER ROCKFISH	-	-	-	-	2.6	-	20.0	-	780.2	573.4
PACIFIC OCEAN PERCH	-	-	-	-	-	-	TR	-	5718.5	7178.1
UNSP. POP GROUP	-	-	-	-	-	14.2		-	20074.9	
SHORTBELLY ROCKFISH	-	-	-	-	-	-	-	-		TR
THORNYHEADS	-	-	-	-	0.2	0.1	1.5	-	1399.2	4831.2
WIDOW ROCKFISH	-	-	-	-	-	-	1.1	-	1248.6	5188.7
OTHER DEMERSAL RKFSH	-	-	-	-	-		-	-	-	
OTHER SLOPE RKFSH	-	-	-	-	-	0.2	-	-		128.3
UNSP. DEMERSAL RKFSH	-	-	-	-	-	-	-	-	65.9	
UNSP. PELAGIC RKFSH	-	-	-	-	-	-	-	-	1194.2	0.7
UNSP. SLOPE RKFSH	-	-	-	-	-	-	-	-	15365.3	17.8
UNSP. ROCKFISH	-	TR	TR	0.3	1.0	30.9	184.3	-	467.5	6302.6
___ALL ROCKFISH	-	TR	TR	0.3	3.9	45.4	212.3	-	58771.6	31250.7
ATKA MACKEREL	-	-	-	-	-	-	-	-	20305.6	1204.6
JACK MACKEREL	-		-					-		
LINGCOD	-	0.1	-	0.1	TR	3.1	261.6	-	4012.4	1956.3

DATA SOURCE FOR AREAS CHARLOTTE, GEORGIA STRAIT, AND THE CANADIAN PORTION OF VANCOUVER IS DFO,CANADA
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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR ALL AREAS

SPECIES	SEINE	SET NET	TRAMMEL	CRAB POT	FISH POT	OTHER POTS	TROLL	BEAM TRAWL	BTM-TRAWL	GFSH-TRAWL
PACIFIC COD	7.9	–	–	–	–	8152.8	1.0	–	82965.2	86600.0
PACIFIC WHITING	–	–	–	–				–	2.7	1612.0
SABLEFISH		–	–	–	3845.4	589.4	70.4	–	4045.9	3334.2
WALLEYE POLLOCK	12.4	–	–	–	–	3.1	–	–	112009.3	15826.1
OTHER ROUNDFISH	24.5	–	–	–	–	–	–	–	–	–
UNSP. ROUNDFISH								–		
___ALL ROUNDFISH	44.8	0.1	–	0.1	3845.5	8748.4	333.0	–	223341.2	110533.2
SPINY DOGFISH	TR	108.5	–	–	–	–	0.1	–	1384.0	1091.1
UNSPECIFIED SHARK	–	–	–	–	–	–	–	–	–	–
UNSPECIFIED SKATE	–	–	–	–	–	–	–	–	7.1	7.0
UNSPECIFIED SQUID			–		–					
OTHER GROUNDFISH	26.6	0.4	–	0.9		13.1	1.2	17.5	101.2	227.7
UNSP. GROUNDFISH	11.4				TR	3.0	1.4		3606.9	1275.3
___MISC. GROUNDFISH	38.0	108.9	–	0.9	TR	16.1	2.6	17.5	5099.2	2601.2
ALL GROUNDFISH	82.8	109.3	TR	1.3	3849.3	8814.4	548.3	17.5	337290.6	177119.9

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR ALL AREAS

SPECIES	MID-TRAWL	OTH TRAWLS	DBL-SHRIMP	SHMP-TRAWL	SGL-SHRIMP	ALL GEARS
ARROWTOOTH FLOUNDER	175.9	52.7	8.4	23.4	1.0	13754.8
UNSPECIFIED TURBOTS	945.8	_	_	_	_	2853.7
ALASKA PLAICE						24.6
DOVER SOLE	0.9	6187.0	15.1	15.9	3.9	20230.7
ENGLISH SOLE	0.1	781.2	0.4	0.7	0.1	3386.2
GREENLAND TURBOT	26.5					10157.7
PETRALE SOLE	0.3	611.1	0.3	0.1	0.1	3146.1
REX SOLE	18.9	539.9	TR	0.7	TR	1528.8
ROCK SOLE	310.7	4.6	0.1	TR	_	19228.0
STARRY FLOUNDER		29.8	_	0.6	_	808.5
YELLOWFIN SOLE	1450.1		_		_	10969.8
OTHER FLATFISH	177.4	523.5	_	TR	0.1	2778.9
UNSP. FLATFISH	709.5	19.1		0.1		4080.9
___ALL FLATFISH	4192.3	8748.8	24.3	41.6	5.2	97636.4
BLACK ROCKFISH	0.3		_	_	_	73.3
BOCACCIO	34.7	369.4		_		1724.9
CANARY ROCKFISH	44.4	78.0	15.2		0.5	2958.9
CHILIPEPPER		640.0	_	_	_	665.6
DARKBLOTCHED ROCKFIS	13.6	178.7	_	_	_	991.7
DUSKY ROCKFISH	0.4	_	_	_	_	57.4
QUILLBACK ROCKFISH	_	_	_	_	_	91.5
REDBANDED ROCKFISH			_	_	_	8.7
REDSTRIPE ROCKFISH	91.2	0.6	_	_	_	2217.6
ROSETHORN ROCKFISH		_	_	_	_	1.8
ROUGHEYE ROCKFISH	1.5		_	_	_	1453.1
SHARPCHIN ROCKFISH	0.8	34.3	_	_	_	286.5
SHORTRAKER ROCKFISH	TR	_	_	_	_	123.4
SILVERGREY ROCKFISH	36.0		_	_	_	2294.2
SPLITNOSE ROCKFISH		26.8	_	_	_	272.6
YELLOWEYE ROCKFISH	0.1	4.3	_	_	_	470.4
YELLOWMOUTH ROCKFISH	58.5	2.7				1975.9
YELLOWTAIL ROCKFISH	2392.0	86.0	363.0	61.6	21.0	9208.8
OTHER ROCKFISH	10.5	229.8	0.4	0.4	TR	3775.6
PACIFIC OCEAN PERCH	182.0	5.1	0.6	0.1	TR	13106.2
UNSP. POP GROUP	112.6	_	_	_	_	20234.8
SHORTBELLY ROCKFISH						TR
THORNYHEADS	5.0	5265.6	0.2	0.1	TR	12125.6
WIDOW ROCKFISH	6575.6	1854.4	4.5	TR	0.7	15073.5
OTHER DEMERSAL RKFSH		_	_	_	_	5.4
OTHER SLOPE RKFSH	TR	_	_	_	_	382.1
UNSP. DEMERSAL RKFSH		_	_	_	_	94.2
UNSP. PELAGIC RKFSH	20.8	_	_	_	_	1222.7
UNSP. SLOPE RKFSH	127.0					15568.6
UNSP. ROCKFISH	19.0	3912.1	72.1	291.9	7.9	17367.9
___ALL ROCKFISH	9726.3	12688.0	456.0	354.2	30.1	123832.8
ATKA MACKEREL	752.9	_		_	_	22263.0
JACK MACKEREL			0.1			0.2
LINGCOD	13.6	586.9	13.9	11.7	4.5	9010.6

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR ALL AREAS

SPECIES	MID-TRAWL	OTH TRAWLS	DBL-SHRIMP	SHMP-TRAWL	SGL-SHRIMP	ALL GEARS
PACIFIC COD	13187.7	TR	0.8	3.2	TR	245436.7
PACIFIC WHITING	17600.5	5273.3		5.9	TR	24740.0
SABLEFISH	93.3	2201.1	7.3	9.6	1.2	45593.9
WALLEYE POLLOCK	1280434.5	-	-	-	-	1409672.2
OTHER ROUNDFISH	-	-	-	-	-	1290.1
UNSP. ROUNDFISH						TR
___ALL ROUNDFISH	1312082.5	8061.3	22.2	30.3	5.8	1758006.7
SPINY DOGFISH	46.2	-	TR	12.3	-	6069.7
UNSPECIFIED SHARK	-	-	-	-	-	0.7
UNSPECIFIED SKATE		-	-	-	-	10.5
UNSPECIFIED SQUID	456.9					473.7
OTHER GROUNDFISH		10.8	0.2	0.5	0.3	1541.6
UNSP. GROUNDFISH	378.9	121.0	TR	0.1	TR	6430.4
___MISC. GROUNDFISH	882.0	131.8	0.2	12.8	0.3	14526.6
ALL GROUNDFISH	1326883.1	29629.9	502.8	439.0	41.4	1994002.6

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR ALEUTIAN AREA

SPECIES	LONGLINE	OTHER POTS	BTM-TRAWL	GFSH-TRAWL	MID-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	_	_		352.2		352.2
UNSPECIFIED TURBOTS	_	_	1105.7	_	0.8	1106.5
DOVER SOLE	0.3	_				0.3
GREENLAND TURBOT	204.0	_	2048.8	98.4	0.2	2351.4
PETRALE SOLE	_	_	_	9.5	_	9.5
REX SOLE	_			1.1		1.1
ROCK SOLE	_	TR	360.6	45.6	17.3	423.5
YELLOWFIN SOLE	_	_	0.2		_	0.2
OTHER FLATFISH	_	_		0.7	_	0.7
UNSP. FLATFISH		_	34.0	87.1	5.1	126.1
___ALL FLATFISH	204.3	TR	3549.3	594.7	23.4	4371.7
DUSKY ROCKFISH	_	_	_	14.2	_	14.2
ROUGHEYE ROCKFISH	_	_	_	82.5	_	82.5
SHORTRAKER ROCKFISH	_	_	_	2.0	_	2.0
YELLOWEYE ROCKFISH	0.9	_	_		_	0.9
PACIFIC OCEAN PERCH	0.1	_	_	4332.3	1.1	4333.5
UNSP. POP GROUP	20.7	14.2	13232.2		21.9	13288.9
THORNYHEADS	27.3	_	12.0	10.5	_	49.8
OTHER SLOPE RKFSH	0.9	_		8.4		9.4
UNSP. PELAGIC RKFSH		_	0.9		0.1	0.9
UNSP. SLOPE RKFSH	5.6	_	253.0	2.9	_	261.5
UNSP. ROCKFISH	135.4	_	277.2	114.6	_	527.1
___ALL ROCKFISH	190.8	14.2	13775.2	4567.4	23.1	18570.7
ATKA MACKEREL		_	19855.0	1203.8	665.9	21724.7
LINGCOD	0.8					0.8
PACIFIC COD	585.2	6.8	6131.0	1287.1	71.2	8081.3
SABLEFISH	1784.2	_	360.5	61.8		2206.5
WALLEYE POLLOCK			370.0	1723.5	70776.6	72870.0
___ALL ROUNDFISH	2370.1	6.8	26716.5	4276.1	71513.7	104883.3
UNSPECIFIED SQUID	_		2.5	3.9	5.0	11.4
UNSP. GROUNDFISH	_	0.1	175.9	442.1	8.7	626.9
___MISC. GROUNDFISH	_	0.1	178.4	446.1	13.7	638.3
ALL GROUNDFISH	2765.3	21.1	44219.4	9884.3	71573.9	128464.0

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR AREA 2 AREA

SPECIES	LONGLINE	OTHER POTS	GFSH-TRAWL	MID-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	_	_	5.1	_	5.1
ENGLISH SOLE			TR		TR
GREENLAND TURBOT	138.7	0.5		3.8	462.3
REX SOLE		_	0.6	_	0.6
ROCK SOLE	3.5	_	5.9	10.4	166.7
STARRY FLOUNDER	_	_	0.1	_	0.1
OTHER FLATFISH		_	3.5	_	3.5
___ALL FLATFISH	194.2	0.6	15.2	131.7	1420.4
DUSKY ROCKFISH	_	_	TR	_	TR
PACIFIC OCEAN PERCH	_	_	0.5	_	0.5
THORNYHEADS	1.5	_	TR	_	1.5
OTHER SLOPE RKFSH	TR	_	TR	_	TR
UNSP. ROCKFISH	27.2	_	0.2	_	46.7
___ALL ROCKFISH	36.6	_	0.7	41.2	3910.6
ATKA MACKEREL			0.2		0.2
PACIFIC COD	40822.4	337.6	3915.7	4615.4	59501.1
SABLEFISH	198.7				284.2
WALLEYE POLLOCK	803.2	_	11.3	609194.0	644348.8
___ALL ROUNDFISH	41824.4	337.6	3927.3	613809.5	704134.2
UNSP. GROUNDFISH	638.0	_	154.3	77.5	945.9
___MISC. GROUNDFISH	640.1	_	154.3	77.5	948.0
ALL GROUNDFISH	42695.3	338.2	4097.5	614059.9	710413.3

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR AREA 1 AREA

SPECIES	LONGLINE	OTH HK&LN	UNKN-GEAR	OTHER POTS	GFSH-TRAWL	MID-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	0.9	_	TR	TR	320.9	38.6	360.4
ALASKA PLAICE	_	_	_	_	9.1		9.1
DOVER SOLE	_	_	_	_	7.1	0.1	7.1
ENGLISH SOLE		_	_	_	TR		TR
GREENLAND TURBOT	489.1	_	_	_	1309.0	22.4	6803.9
PETRALE SOLE	_	_		_	91.2		91.2
REX SOLE		_	TR	_	11.1	14.0	25.1
ROCK SOLE	2.7	_	_	_	484.1	265.8	12993.4
STARRY FLOUNDER	_	_	_	_	0.3		0.3
YELLOWFIN SOLE	_	_		_	480.7	1450.1	10827.9
OTHER FLATFISH		_	0.2	_	48.3	173.8	222.3
UNSP. FLATFISH	5.8	_			506.8	585.3	3192.8
___ALL FLATFISH	513.5	_	0.2	TR	3288.7	3822.1	36392.1
BLACK ROCKFISH		_	_	_	TR	0.3	0.3
BOCACCIO	_	_	_	_	49.5	_	49.5
DUSKY ROCKFISH		_	_	_	16.2	_	16.2
ROUGHEYE ROCKFISH	0.1	_	_	_	11.8	_	11.8
SHORTRAKER ROCKFISH	1.1	_	_	_	2.7	_	3.9
YELLOWEYE ROCKFISH	3.6	_	_	_		_	3.6
PACIFIC OCEAN PERCH	5.4	_	_	_	298.1	139.5	442.9
THORNYHEADS	29.8	_	_	_	9.7	0.1	58.3
OTHER SLOPE RKFSH	5.2	_	_	_	31.5	TR	36.8
UNSP. SLOPE RKFSH	0.8	_	_	_	10.5		11.3
UNSP. ROCKFISH	18.6	_	_	_	0.6	5.3	159.9
___ALL ROCKFISH	65.8	_	_	_	430.6	173.5	2714.3
ATKA MACKEREL					0.6	87.0	479.6
PACIFIC COD	6091.4	143.4	TR	1268.7	28273.6	8031.7	95348.8
SABLEFISH	1200.2			_	49.0	12.1	1971.0
WALLEYE POLLOCK	350.2	_	9.7		7909.7	532222.9	613261.7
___ALL ROUNDFISH	7641.7	143.4	9.7	1268.7	36232.9	540353.7	711061.1
UNSPECIFIED SQUID	0.5	_	_	_	2.0	451.9	458.0
UNSP. GROUNDFISH	226.4	_	_	_	367.0	254.2	1495.0
___MISC. GROUNDFISH	226.9	_	_	_	369.0	706.1	1952.9
ALL GROUNDFISH	8447.8	143.4	9.9	1268.7	40321.3	545055.4	752120.3

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR SHUMAGIN AREA

SPECIES	LONGLINE	OTH HK&LN	OTH-KNOWN	UNKN-GEAR	OTHER POTS	BTM-TRAWL	GFSH-TRAWL	MID-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	-	-	-	-	-	922.2	73.8	2.8	998.8
ALASKA PLAICE	-	-	-	-	-	-	2.2	-	2.2
ENGLISH SOLE	-	-	-	-	-	TR	-	-	TR
GREENLAND TURBOT	3.1	-	-	-	-	319.5	93.4	TR	416.0
PETRALE SOLE	-	-	-	-	-	-	15.3	-	15.3
REX SOLE	-	-	-	-	-	-	0.9	0.1	1.0
ROCK SOLE	-	-	-	-	-	53.7	89.3	TR	143.0
STARRY FLOUNDER	-	-	-	-	-	-	1.4	-	1.4
YELLOWFIN SOLE	-	-	-	-	-	-	32.1	-	32.1
OTHER FLATFISH	-	-	-	-	-	-	10.6	0.2	10.7
UNSP. FLATFISH	-	-	-	-	-	-	52.4	0.4	52.8
___ALL FLATFISH	3.1	-	-	-	-	1889.7	376.0	3.6	2272.4
BLACK ROCKFISH	-	-	-	-	-	-	TR	-	TR
DUSKY ROCKFISH	-	-	-	-	-	-	11.6	-	11.6
ROUGHEYE ROCKFISH	0.4	-	-	-	-	-	4.2	-	4.6
SHORTRAKER ROCKFISH	TR	-	-	-	-	-	1.1	-	1.2
YELLOWEYE ROCKFISH	0.3	-	-	-	-	-	-	-	0.3
PACIFIC OCEAN PERCH	0.2	-	-	-	-	-	326.0	2.7	328.9
UNSP. POP GROUP		-	-	-	-	360.1			360.1
THORNYHEADS	45.3	-	-	-	-	324.7	2.3	2.7	374.9
OTHER SLOPE RKFSH	0.7	-	-	-	-		13.2	-	13.9
UNSP. DEMERSAL RKFSH	9.1	-	-	-	-	6.4	-	-	15.5
UNSP. PELAGIC RKFSH		-	-	-	-	150.6		-	150.6
UNSP. SLOPE RKFSH	14.0	-	-	-	-	3319.4	4.5	-	3337.9
UNSP. ROCKFISH	14.1	-	-	-	0.1	7.5		0.1	21.8
___ALL ROCKFISH	84.2	-	-	-	0.1	4168.6	362.8	5.5	4621.2
ATKA MACKEREL						58.5			58.5
PACIFIC COD	2414.0	52.7	16.7	226.4	188.4	4096.7	25714.0	28.1	32736.9
SABLEFISH	1599.7	-	-	-	1.2	353.8	17.3	71.9	2043.9
WALLEYE POLLOCK						906.6	377.0	6117.2	7400.8
___ALL ROUNDFISH	4013.7	52.7	16.7	226.4	189.6	5415.6	26108.3	6217.2	42240.1
UNSPECIFIED SQUID		-	-	-	-			0.1	0.1
UNSP. GROUNDFISH	0.1	-	-	-	-	2473.6	74.2	TR	2547.9
___MISC. GROUNDFISH	0.1	-	-	-	-	2473.6	74.2	0.1	2548.0
ALL GROUNDFISH	4101.0	52.7	16.7	226.4	189.6	13947.5	26921.4	6226.3	51681.7

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR CHIRIKOF AREA

SPECIES	LONGLINE	UNKN-GEAR	SEINE	OTHER POTS	BTM-TRAWL	GFSH-TRAWL	MID-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	5.6	-	-	-	1090.4	384.5	0.1	1480.7
GREENLAND TURBOT	0.6	-	-	-	-	114.2	-	114.9
REX SOLE	-	-	-	-		19.6	-	19.6
ROCK SOLE	-	-	-	-	69.9	176.0	0.1	246.1
OTHER FLATFISH	-	-	-	-	-	67.5	-	67.5
UNSP. FLATFISH		-	TR	-		67.7	0.1	67.8
ALL FLATFISH	6.3	-	TR	-	3343.8	1117.4	0.4	4467.9
ROUGHEYE ROCKFISH	2.1	-	-	-	-	0.3	-	2.4
YELLOWEYE ROCKFISH	0.9	-	-	-	-		-	0.9
PACIFIC OCEAN PERCH	1.9	-	-	-		TR	-	1.9
UNSP. POP GROUP	0.3	-	-	-	109.5		-	109.8
THORNYHEADS	63.2	-	-	-	293.7	0.4	-	357.4
OTHER SLOPE RKFSH	0.5	-	-	-		0.1	-	0.6
UNSP. DEMERSAL RKFSH	0.7	-	-	-	15.0	-	-	15.6
UNSP. PELAGIC RKFSH		-	-	-	55.6	-	-	55.6
UNSP. SLOPE RKFSH	3.6	-	-	-	3350.6		-	3354.2
UNSP. ROCKFISH	0.6	-	-	-		1.8	TR	2.4
ALL ROCKFISH	73.9	-	-	-	3824.4	4.5	TR	3902.8
PACIFIC COD	253.3		7.9	1086.4	3756.9	7236.8	17.6	12358.9
SABLEFISH	2038.4	0.6			691.8	0.8		2731.6
WALLEYE POLLOCK			12.4	2.6	296.3	761.5	2634.5	3707.3
ALL ROUNDFISH	2291.7	0.6	20.2	1089.0	4745.0	7999.2	2652.1	18797.8
UNSP. GROUNDFISH	6.1	-	-	TR	148.4	65.3	3.4	223.3
MISC. GROUNDFISH	6.1	-	-	TR	148.4	65.3	3.4	223.3
ALL GROUNDFISH	2377.9	0.6	20.3	1089.0	12061.7	9186.3	2656.0	27391.8

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR KODIAK AREA

SPECIES	LONGLINE	OTH HK&LN	OTH-KNOWN	UNKN-GEAR	OTHER POTS	BTM-TRAWL	GFSH-TRAWL	MID-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	24.8	-	0.5	28.0	TR	232.8	1098.0	134.2	1518.4
ALASKA PLAICE	-	-	-	-	-	-	13.3	-	13.3
DOVER SOLE	-	-	-	12.8	-	-	1137.8	0.1	1150.7
ENGLISH SOLE	-	-	0.1	-	-	-	8.1	-	8.1
GREENLAND TURBOT	6.6	-	-	-	-	0.4	0.6	-	7.7
REX SOLE	0.1	-	-	-	-	-	450.8	4.7	455.6
ROCK SOLE	3.4	-	0.4	-	TR	76.6	2732.1	16.2	2828.7
STARRY FLOUNDER	-	-	0.7	-	-	-	36.9	-	37.5
YELLOWFIN SOLE	TR	-	-	-	-	-	26.7	-	26.7
OTHER FLATFISH	3.6	-	TR	0.6	-	-	1096.3	3.4	1103.9
UNSP. FLATFISH	3.8	-	-	-	-	-	194.1	7.7	205.6
___ALL FLATFISH	80.3	-	1.7	49.2	TR	1326.0	6835.0	208.7	8500.9
BLACK ROCKFISH	2.0	2.1	-	-	TR	-	27.6	-	31.7
BOCACCIO	0.1	-	-	-	-	-	-	-	0.1
CANARY ROCKFISH	0.1	-	-	-	-	-	-	-	0.1
DARKBLOTCHED ROCKFIS	0.1	-	-	-	-	-	-	-	0.1
DUSKY ROCKFISH	TR	-	-	-	-	-	9.0	0.4	9.4
QUILLBACK ROCKFISH	-	TR	-	-	-	-	-	-	TR
REDBANDED ROCKFISH	0.2	-	-	-	-	-	-	-	0.2
ROUGHEYE ROCKFISH	33.2	0.3	-	-	-	-	12.0	-	45.5
SHORTRAKER ROCKFISH	8.2	0.2	-	-	-	-	-	-	8.4
YELLOWEYE ROCKFISH	16.8	-	-	-	-	-	-	-	16.8
YELLOWTAIL ROCKFISH	-	-	-	-	-	-	TR	-	TR
PACIFIC OCEAN PERCH	2.4	7.7	-	0.3	-	-	1.2	-	11.6
UNSP. POP GROUP	2.7	-	-	-	-	129.4	-	-	132.1
THORNYHEADS	130.4	1.1	-	0.5	-	214.2	100.7	-	446.8
WIDOW ROCKFISH	-	-	-	-	-	-	0.5	-	0.5
OTHER DEMERSAL RKFSH	0.4	-	-	-	-	-	-	-	0.4
OTHER SLOPE RKFSH	201.0	3.5	-	-	0.2	-	74.9	TR	279.7
UNSP. DEMERSAL RKFSH	8.3	-	-	-	-	35.2	-	-	43.5
UNSP. PELAGIC RKFSH	-	-	-	-	-	544.6	-	0.2	544.8
UNSP. SLOPE RKFSH	21.3	-	-	-	-	4092.2	-	2.7	4116.2
UNSP. ROCKFISH	8.2	16.5	-	-	-	TR	129.4	0.3	154.4
___ALL ROCKFISH	435.5	31.5	-	0.8	0.2	5015.5	355.2	3.6	5842.3
LINGCOD	5.2	3.0			1.4		0.1		9.7
PACIFIC COD	3618.1	9.7	27.5	59.2	5265.0	1134.2	18825.7	421.9	29361.2
SABLEFISH	9041.7	4.0		2.9	TR	878.0	248.5	TR	10175.1
WALLEYE POLLOCK	5.9	TR	0.1	212.6	0.5	2873.3	4983.3	58587.6	66663.4
___ALL ROUNDFISH	12670.8	16.8	27.6	274.8	5266.9	4885.4	24057.6	59009.5	106209.4
UNSPECIFIED SQUID							0.9		0.9
UNSP. GROUNDFISH	85.0	-	-	3.2	2.8	28.5	164.7	35.0	319.4
___MISC. GROUNDFISH	85.0	-	-	3.2	2.8	28.5	165.7	35.0	320.3
ALL GROUNDFISH	13271.7	48.2	29.4	327.9	5269.9	11255.4	31413.5	59256.8	120872.8

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR YAKUTAT AREA

SPECIES	LONGLINE	OTH HK&LN	BTM-TRAWL	MID-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	2.6	_	38.6	_	41.2
GREENLAND TURBOT	TR	_		_	TR
ROCK SOLE		_	0.3	_	0.3
UNSP. FLATFISH	TR	_		_	TR
___ALL FLATFISH	2.6	_	99.6	_	102.2
BLACK ROCKFISH	TR	1.6	_	_	1.7
BOCACCIO	TR	_	_	_	TR
CANARY ROCKFISH	TR	_	_	_	TR
DUSKY ROCKFISH	0.7	_	_	_	0.7
QUILLBACK ROCKFISH	0.3	_	_	_	0.3
REDBANDED ROCKFISH	2.4	_	_	_	2.4
REDSTRIPE ROCKFISH	0.1	_	_	_	0.1
ROSETHORN ROCKFISH	0.1	_	_	_	0.1
ROUGHEYE ROCKFISH	43.1	0.4	_	_	43.5
SHORTRAKER ROCKFISH	1.0	_	_	_	1.0
SILVERGREY ROCKFISH	0.3	_	_	_	0.3
YELLOWEYE ROCKFISH	25.4	_	_	_	25.4
PACIFIC OCEAN PERCH	1.0	_	_	_	1.0
UNSP. POP GROUP	0.6	_	449.4	21.2	471.2
THORNYHEADS	74.1	0.5	234.3	1.7	310.7
OTHER DEMERSAL RKFSH	TR	_	_	_	TR
OTHER SLOPE RKFSH	16.4	_	_	_	16.4
UNSP. DEMERSAL RKFSH	9.8	_	9.4	_	19.2
UNSP. PELAGIC RKFSH	7.0	_	442.3	20.5	469.8
UNSP. SLOPE RKFSH	12.1	_	3283.6	124.3	3420.1
UNSP. ROCKFISH	7.0	2.8			9.8
___ALL ROCKFISH	201.7	5.3	4419.1	167.7	4793.9
LINGCOD	51.2	2.6			53.8
PACIFIC COD	18.1	_	10.8	0.3	29.2
SABLEFISH	5552.0		394.6	9.1	5955.8
___ALL ROUNDFISH	5621.3	2.6	405.5	9.4	6038.8
UNSP. GROUNDFISH	38.3	_	6.9	_	45.2
___MISC. GROUNDFISH	38.3	_	6.9	_	45.2
ALL GROUNDFISH	5863.9	8.0	4931.2	177.2	10980.2

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR S. EASTERN AREA

SPECIES	LONGLINE	OTH HK&LN	UNKN-GEAR	SEINE	OTHER POTS	BTM-TRAWL	GFSH-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	2.0	-	-	-	-	0.3	0.6	2.9
DOVER SOLE	TR	-	-	-	-	-	-	TR
ENGLISH SOLE	-	-	-	-	-	-	1.5	1.5
GREENLAND TURBOT	1.5	-	-	-	-	-	-	1.5
PETRALE SOLE	-	-	-	-	-	-	TR	TR
REX SOLE	-	-	-	-	-	-	TR	TR
ROCK SOLE	-	-	-	-	-	-	1.3	1.3
STARRY FLOUNDER	-	-	-	-	-	-	57.9	57.9
YELLOWFIN SOLE	-	-	-	-	-	-	0.1	0.1
OTHER FLATFISH	TR	-	-	-	-	-	2.3	2.3
UNSP. FLATFISH	0.3	-	-	-	-			0.3
___ALL FLATFISH	3.8	-	-	-	-	0.5	63.8	68.1
BLACK ROCKFISH	8.7	3.0	0.3	-	-	-	-	11.9
BOCACCIO	0.3	0.2	-	-	-	-	-	0.5
CANARY ROCKFISH	1.7	0.1	TR	-	-	-	0.3	2.1
DARKBLOTCHED ROCKFIS	TR	-	-	-	-	-	-	TR
DUSKY ROCKFISH	3.2	0.1	0.2	-	-	-	-	3.6
QUILLBACK ROCKFISH	85.7	4.4	1.0	-	-	-	TR	91.1
REDBANDED ROCKFISH	5.9	TR	TR	-	-	-	0.1	6.1
REDSTRIPE ROCKFISH	0.1	TR	-	-	-	-	1.3	1.4
ROSETHORN ROCKFISH	1.4	0.1	TR	-	-	-	0.1	1.7
ROUGHEYE ROCKFISH	53.4	0.3	-	-	-	-	1.2	54.9
SHORTRAKER ROCKFISH	1.8	-	-	-	-	-	0.9	2.7
SILVERGREY ROCKFISH	4.3	0.3	-	-	-	-	2.2	6.7
YELLOWEYE ROCKFISH	290.6	14.2	2.9	-	-	-	-	307.6
YELLOWTAIL ROCKFISH	0.2	0.1	TR	-	-	-	TR	0.3
PACIFIC OCEAN PERCH	0.3	TR	-	-	-	-	-	0.4
UNSP. POP GROUP		-	-	-	-	91.3	-	91.3
THORNYHEADS	68.6	0.1	-	-	-	87.4	0.3	156.4
WIDOW ROCKFISH	TR	TR	-	-	-	-	TR	TR
OTHER DEMERSAL RKFSH	4.9	0.1	TR	-	-	-	-	5.0
OTHER SLOPE RKFSH	25.2	-	-	-	-	-	0.2	25.4
UNSP. DEMERSAL RKFSH	0.3	-	-	-	-	-	-	0.3
UNSP. PELAGIC RKFSH		-	-	-	-	0.2	0.7	0.9
UNSP. SLOPE RKFSH	0.7	-	-	-	-	1066.5	-	1067.2
UNSP. ROCKFISH	63.2	0.8	0.5	-	-	-	-	64.4
___ALL ROCKFISH	620.5	23.8	4.9	-	-	1245.5	7.1	1901.9
LINGCOD	132.5	163.9	0.4	-	-	-	TR	296.9
PACIFIC COD	158.0	0.9	0.7	-	-	-	1.2	160.9
SABLEFISH	6317.4	-	-	-	-	106.9	0.1	6424.4
WALLEYE POLLOCK	5.0	-	-	-	-	-	3.5	8.5
UNSP. ROUNDFISH	TR	TR	-	-	-	-	-	TR
___ALL ROUNDFISH	6612.9	164.9	1.1	-	-	106.9	4.9	6890.7
SPINY DOGFISH	3.8	0.2	-	-	-	-	-	4.0
UNSP. GROUNDFISH	0.1	-	-	10.3	TR	-	5.6	16.0
___MISC. GROUNDFISH	3.9	0.2	-	10.3	TR	-	5.6	20.0

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR S. EASTERN AREA

SPECIES	LONGLINE	OTH HK&LN	UNKN-GEAR	SEINE	OTHER POTS	BTM-TRAWL	GFSH-TRAWL	ALL GEARS
ALL GROUNDFISH	7241.2	188.8	6.0	10.3	TR	1352.8	81.5	8880.6

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR UNK-ALASKA AREA

SPECIES	LONGLINE	GFSH-TRAWL	MID-TRAWL	ALL GEARS
ROCK SOLE	_	4.3	_	4.3
UNSP. FLATFISH	_	_	TR	TR
___ALL FLATFISH	_	4.3	TR	4.3
PACIFIC OCEAN PERCH	_	_	0.1	0.1
THORNYHEADS	1.4	_	_	1.4
UNSP. ROCKFISH	0.2	_	_	0.2
___ALL ROCKFISH	1.7	_	0.1	1.8
LINGCOD	0.1	_	_	0.1
PACIFIC COD	_	_	TR	TR
SABLEFISH	28.9	_	_	28.9
WALLEYE POLLOCK	_	_	393.9	393.9
___ALL ROUNDFISH	29.0	_	393.9	423.0
ALL GROUNDFISH	30.7	4.3	394.1	429.1

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR CHARLOTTE AREA

SPECIES	HAND LINE	LONGLINE	GILL NET	OTHER NETS	FISH POT	TROLL	BTM-TRAWL	GFSH-TRAWL	MID-TRAWL	SHMP-TRAWL
ARROWTOOTH FLOUNDER	-	-	-	-	-	-	1837.8	-	0.3	-
DOVER SOLE	-	-	-	-	-	-	931.9	-	0.5	-
ENGLISH SOLE	-	-	-	-	-	-	1083.3	-	-	-
PETRALE SOLE	-	-	-	-	-	-	338.6	-	TR	-
REX SOLE	-	-	-	-	-	-	130.5	-	-	-
ROCK SOLE	-	TR	-	-	-	-	2127.1	-	-	-
STARRY FLOUNDER	-	-	-	-	-	-	73.0	-	-	-
YELLOWFIN SOLE	-	-	-	-	-	-	0.9	-	-	-
OTHER FLATFISH	-	-	-	-	-	-	18.1	-	-	-
UNSP. FLATFISH	-	-	-	-	-	TR		-		TR
___ALL FLATFISH	-	TR	-	-	-	TR	6541.1	-	0.8	TR
BLACK ROCKFISH	-	-	-	-	-	-	3.2	-		-
BOCACCIO	-	-	-	-	-	-	729.5	-	15.4	-
CANARY ROCKFISH	-	-	-	-	-	-	832.0	-	6.5	-
DARKBLOTCHED ROCKFIS	-	-	-	-	-	-	25.8	-	13.6	-
REDSTRIPE ROCKFISH	-	-	-	-	-	-	1290.4	-	81.5	-
ROUGHEYE ROCKFISH	-	-	-	-	-	-	1087.6	-	1.5	-
SHARPCHIN ROCKFISH	-	-	-	-	-	-	122.6	-	-	-
SHORTRAKER ROCKFISH	-	-	-	-	-	-	76.8	-	TR	-
SILVERGREY ROCKFISH	-	-	-	-	-	-	1525.3	-	15.1	-
SPLITNOSE ROCKFISH	-	-	-	-	-	-	59.2	-		-
YELLOWEYE ROCKFISH	-	-	-	-	-	-	43.4	-	0.1	-
YELLOWMOUTH ROCKFISH	0.2	1.4	-	-	-	-	1252.7	-	58.5	-
YELLOWTAIL ROCKFISH	1.6	TR	-	-	-	-	1669.9	-	1163.1	-
OTHER ROCKFISH	185.8	854.4	TR	-	0.1	4.8	621.8	-	3.1	-
PACIFIC OCEAN PERCH	1.4	0.1	-	-	-	-	4574.6	-	14.9	-
THORNYHEADS	-	1.7	-	-	-	-	121.0	-	0.2	-
WIDOW ROCKFISH	-	-	-	-	-	-	726.6	-	1759.7	-
UNSP. ROCKFISH	-	-	-	-	-	-		-		-
___ALL ROCKFISH	189.0	857.6	TR	-	0.1	4.8	14762.5	-	3133.3	-
LINGCOD	106.1	448.1	0.2	-	-	68.4	2461.8	-	1.8	-
PACIFIC COD	1.5	2.2	-	-	-	-	4391.7	-	0.8	-
PACIFIC WHITING	0.2	-	-	-	-	-	1.1	-	-	-
SABLEFISH	-	425.9	-	-	2036.0	-	182.9	-	-	-
WALLEYE POLLOCK	-	-	-	-	-	-	432.6	-	31.6	-
___ALL ROUNDFISH	107.8	876.2	0.2	-	2036.0	68.4	7470.1	-	34.2	-
SPINY DOGFISH	TR	325.7	-	-	-	-	34.5	-	4.5	-
UNSPECIFIED SHARK	-	0.3	-	0.1	-	-	-	-	-	-
UNSPECIFIED SKATE	1.8	2.7	-	-	-	-		-	-	-
UNSPECIFIED SQUID	-	-	-	-	-	-	0.6	-	-	-
OTHER GROUNDFISH	-	-	-	-	-	-	87.7	-	-	-
UNSP. GROUNDFISH	-	-	-	-	-	-	49.8	-		-
___MISC. GROUNDFISH	1.8	328.6	-	0.1	-	-	172.5	-	4.5	-
ALL GROUNDFISH	298.6	2062.4	0.3	0.1	2036.1	73.3	28946.2	-	3172.8	TR

DATA SOURCE FOR AREAS CHARLOTTE, GEORGIA STRAIT, AND THE CANADIAN PORTION OF VANCOUVER IS DFO,CANADA
TR => LANDED CATCH LESS THAN 0.05 METRIC TONS, OR METRIC TONS PER UNIT OF EFFORT LESS THAN 0.005

US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR CHARLOTTE AREA

SPECIES	ALL GEARS
ARROWTOOTH FLOUNDER	1838.1
DOVER SOLE	932.4
ENGLISH SOLE	1083.3
PETRALE SOLE	338.6
REX SOLE	130.5
ROCK SOLE	2127.1
STARRY FLOUNDER	73.0
YELLOWFIN SOLE	0.9
OTHER FLATFISH	18.1
UNSP. FLATFISH	TR
___ALL FLATFISH	6542.0
BLACK ROCKFISH	3.2
BOCACCIO	744.9
CANARY ROCKFISH	838.6
DARKBLOTCHED ROCKFIS	39.5
REDSTRIPE ROCKFISH	1371.9
ROUGHEYE ROCKFISH	1089.0
SHARPCHIN ROCKFISH	122.6
SHORTRAKER ROCKFISH	76.8
SILVERGREY ROCKFISH	1540.4
SPLITNOSE ROCKFISH	59.2
YELLOWEYE ROCKFISH	43.5
YELLOWMOUTH ROCKFISH	1312.8
YELLOWTAIL ROCKFISH	2834.7
OTHER ROCKFISH	1670.0
PACIFIC OCEAN PERCH	4591.1
THORNYHEADS	122.9
WIDOW ROCKFISH	2486.3
UNSP. ROCKFISH	
___ALL ROCKFISH	18947.4
LINGCOD	3086.5
PACIFIC COD	4396.2
PACIFIC WHITING	1.3
SABLEFISH	2644.8
WALLEYE POLLOCK	464.1
___ALL ROUNDFISH	10592.9
SPINY DOGFISH	364.7
UNSPECIFIED SHARK	0.5
UNSPECIFIED SKATE	4.5
UNSPECIFIED SQUID	0.6
OTHER GROUNDFISH	87.7
UNSP. GROUNDFISH	49.8
___MISC. GROUNDFISH	507.7
ALL GROUNDFISH	36590.0

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR GRGIA STRT AREA

SPECIES	HAND LINE	LONGLINE	GILL NET	SEINE	FISH POT	TROLL	BTM-TRAWL	GFSH-TRAWL	MID-TRAWL	SHMP-TRAWL
ARROWTOOTH FLOUNDER	-	-	-	-	-	-	0.2	-	-	-
DOVER SOLE	-	-	-	-	-	-	15.4	-	-	-
ENGLISH SOLE	-	-	-	-	-	-	60.1	-	-	-
PETRALE SOLE	-	-	-	-	-	-	0.3	-	-	-
REX SOLE	-	-	-	-	-	-	0.6	-	-	-
ROCK SOLE	-	-	-	-	-	-	15.7	-	-	-
STARRY FLOUNDER	-	-	-	-	-	-	12.6	-	-	-
OTHER FLATFISH	-	-	-	-	-	-	11.0	-	-	-
UNSP. FLATFISH	0.1	-	-	-	-	-		-	-	TR
___ALL FLATFISH	0.1	-	-	-	-	-	115.9	-	-	TR
REDSTRIPE ROCKFISH	-	-	-	-	-	-	TR	-	-	-
SILVERGREY ROCKFISH	-	-	-	-	-	-	2.5	-	-	-
YELLOWTAIL ROCKFISH	0.2	0.1	-	-	-	-	36.2	-	0.4	-
OTHER ROCKFISH	353.1	103.9	-	-	-	1.4	1.0	-	-	TR
PACIFIC OCEAN PERCH	0.3	-	-	-	-	-	TR	-	-	-
UNSP. ROCKFISH			-	-	-			-		
___ALL ROCKFISH	353.6	104.0	-	-	-	1.4	39.7	-	0.4	TR
LINGCOD	40.2	8.0	TR	-	-	0.6	0.2	-		-
PACIFIC COD	2.6	1.3	-	-	-	0.1	122.7	-	0.2	-
PACIFIC WHITING	-	-	-	-	-	-	0.2	-	7189.0	-
SABLEFISH	-	-	-	-	0.5	-	0.1	-		-
WALLEYE POLLOCK				-			0.9	-	458.5	-
___ALL ROUNDFISH	42.8	9.2	TR	-	0.5	0.7	124.0	-	7647.7	-
SPINY DOGFISH	8.9	536.7	-	-	-	-	56.5	-	41.7	TR
UNSPECIFIED SHARK		TR	-	-	-	-	-	-	-	-
UNSPECIFIED SKATE	1.1	2.9	-	-	-	-		-	-	-
OTHER GROUNDFISH							7.3			
UNSP. GROUNDFISH	0.2	-	8.5	1.0	-	-	TR	-	-	-
___MISC. GROUNDFISH	10.2	539.7	8.5	1.0	-	-	63.9	-	41.7	TR
ALL GROUNDFISH	406.7	652.9	8.5	1.0	0.5	2.1	343.5	-	7689.8	0.1

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR GRGIA STRT AREA

SPECIES	ALL GEARS
ARROWTOOTH FLOUNDER	0.2
DOVER SOLE	15.4
ENGLISH SOLE	60.1
PETRALE SOLE	0.3
REX SOLE	0.6
ROCK SOLE	15.7
STARRY FLOUNDER	12.6
OTHER FLATFISH	11.0
UNSP. FLATFISH	0.1
___ALL FLATFISH	116.0
REDSTRIPE ROCKFISH	TR
SILVERGREY ROCKFISH	2.5
YELLOWTAIL ROCKFISH	36.9
OTHER ROCKFISH	459.4
PACIFIC OCEAN PERCH	0.3
UNSP. ROCKFISH	
___ALL ROCKFISH	499.1
LINGCOD	49.0
PACIFIC COD	126.8
PACIFIC WHITING	7189.2
SABLEFISH	0.6
WALLEYE POLLOCK	459.4
___ALL ROUNDFISH	7825.0
SPINY DOGFISH	643.8
UNSPECIFIED SHARK	TR
UNSPECIFIED SKATE	4.0
OTHER GROUNDFISH	7.3
UNSP. GROUNDFISH	9.8
___MISC. GROUNDFISH	665.0
ALL GROUNDFISH	9105.1

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR PUGET SND AREA

SPECIES	JIG	LONGLINE	DIP NET	GILL NET	OTHER NETS	SEINE	SET NET	OTHER POTS	TROLL	BEAM TRAWL
ARROWTOOTH FLOUNDER	-	TR	-	-	-	-	-	-	-	-
DOVER SOLE	TR	0.1	-	-	-	-	0.1	-	TR	-
ENGLISH SOLE	-	TR	-	-	-	-	-	-	-	-
PETRALE SOLE	-	TR	-	-	-	-	-	-	-	-
REX SOLE	TR	TR	-	-	-	-	TR	-	TR	-
ROCK SOLE	TR	-	-	-	-	TR	0.1	-	-	-
STARRY FLOUNDER	TR		-	-	-		TR	-	TR	-
OTHER FLATFISH	TR	0.2	-	-	-	TR	0.3	-	TR	-
ALL FLATFISH										
YELLOWTAIL ROCKFISH	5.2	TR	-	-	-	-	-	-	0.2	-
THORNYHEADS	-	0.2	-	-	-	-	-	-	-	-
WIDOW ROCKFISH	0.1		-	-	-	-	-	-	-	-
UNSP. ROCKFISH	16.0	6.3	-	TR	-	-	TR	-	1.4	-
ALL ROCKFISH	21.4	6.5	-	TR	-	-	TR	-	1.6	-
LINGCOD	3.8	0.4	-	-	-	-	0.1	-	0.5	-
PACIFIC COD	0.1	2.0	-	-	-	-	-	-	0.7	-
PACIFIC WHITING	-	-	-	-	-	-	-	-	-	-
SABLEFISH	-	16.7	-	-	-	-	-	-	TR	-
WALLEYE POLLOCK	-	-	-	-	-	-	-	-	-	-
OTHER ROUNDFISH	-	-	TR	-	-	7.7	-	-	-	-
ALL ROUNDFISH	3.9	19.2	TR	-	-	7.7	0.1	-	1.2	-
SPINY DOGFISH	0.4	353.2	-	13.7	-	TR	108.5	-	-	-
UNSPECIFIED SQUID										
OTHER GROUNDFISH	0.1	13.3	999.8	TR	0.5	26.6	0.2	11.4	0.2	17.5
MISC. GROUNDFISH	0.5	366.5	999.8	13.7	0.5	26.6	108.7	11.4	0.2	17.5
ALL GROUNDFISH	25.8	392.3	999.8	13.7	0.5	34.3	109.2	11.4	3.0	17.5

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR PUGET SND AREA

SPECIES	GFSH-TRAWL	ALL GEARS
ARROWTOOTH FLOUNDER	6.5	6.6
DOVER SOLE	10.0	10.1
ENGLISH SOLE	158.8	158.9
PETRALE SOLE	TR	0.1
REX SOLE	TR	TR
ROCK SOLE	26.8	26.8
STARRY FLOUNDER	235.1	235.3
OTHER FLATFISH	17.0	17.0
___ALL FLATFISH	454.3	454.8
YELLOWTAIL ROCKFISH	_	5.5
THORNYHEADS	_	0.2
WIDOW ROCKFISH	_	0.1
UNSP. ROCKFISH	84.4	108.3
___ALL ROCKFISH	84.4	114.0
LINGCOD	14.0	18.8
PACIFIC COD	128.7	131.5
PACIFIC WHITING	8.5	8.5
SABLEFISH	0.3	17.1
WALLEYE POLLOCK	0.4	0.4
OTHER ROUNDFISH		7.7
___ALL ROUNDFISH	151.9	184.0
SPINY DOGFISH	438.7	914.5
UNSPECIFIED SQUID	0.1	0.1
OTHER GROUNDFISH	100.2	1169.7
___MISC. GROUNDFISH	539.0	2084.3
ALL GROUNDFISH	1229.6	2837.1

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR VANCOUVER AREA

SPECIES	JIG	LONGLINE	DIP NET	GILL NET	SEINE	SET NET	FISH POT	TROLL	BTM-TRAWL	GFSH-TRAWL
ARROWTOOTH FLOUNDER	-	1.0	-	-	-	-	-	-	787.9	3736.6
DOVER SOLE	-	0.8	-	-	-	-	-	-	1449.5	1646.0
ENGLISH SOLE	-	TR	-	-	-	-	-	-	121.9	431.7
PETRALE SOLE	-	0.1	-	-	-	-	-	-	727.8	173.4
REX SOLE	-	TR	-	-	-	-	-	-	2.1	32.3
ROCK SOLE	TR	TR	-	-	-	TR	-	-	145.5	0.1
STARRY FLOUNDER	TR	-	-	-	-	TR	-	-	59.6	21.5
OTHER FLATFISH	TR	-	-	-	-	TR	-	-	29.1	28.1
___ALL FLATFISH	TR	2.1	-	-	-	TR	-	-	3323.6	6069.7
BOCACCIO	-	-	-	-	-	-	-	-	245.9	100.7
CANARY ROCKFISH	-	-	-	-	-	-	-	-	746.3	372.8
DARKBLOTCHED ROCKFIS	-	-	-	-	-	-	-	-	30.1	17.4
REDSTRIPE ROCKFISH	-	-	-	-	-	-	-	-	553.1	6.5
SHARPCHIN ROCKFISH	-	-	-	-	-	-	-	-	35.8	2.0
SILVERGREY ROCKFISH	-	-	-	-	-	-	-	-	630.8	18.8
SPLITNOSE ROCKFISH	-	-	-	-	-	-	-	-	46.1	2.4
YELLOWEYE ROCKFISH	-	-	-	-	-	-	-	-	4.9	2.1
YELLOWMOUTH ROCKFISH	-	-	-	-	-	-	-	-	332.3	0.7
YELLOWTAIL ROCKFISH	9.4	3.7	-	-	-	-	-	4.9	915.9	1356.9
OTHER ROCKFISH	-	355.4	-	TR	-	-	2.5	13.8	156.2	153.1
PACIFIC OCEAN PERCH	-	0.3	-	-	-	-	-	TR	1143.8	303.0
THORNYHEADS	-	22.4	-	-	-	-	TR	TR	83.5	171.2
WIDOW ROCKFISH	0.2	TR	-	-	-	-	-	TR	518.3	1081.7
UNSP. ROCKFISH	119.7	61.9	-	TR	-	-	TR	31.7	-	451.5
___ALL ROCKFISH	129.3	443.7	-	TR	-	-	2.6	50.5	5589.6	4040.6
LINGCOD	71.2	257.5	-	-	-	-	-	167.7	1546.5	620.4
PACIFIC COD	2.2	5.9	-	-	-	-	-	0.1	1971.5	712.7
SABLEFISH	0.2	1673.5	-	-	-	-	929.3	TR	279.8	349.8
WALLEYE POLLOCK	-	TR	-	-	-	-	-	-	20.2	2.9
OTHER ROUNDFISH			2.5	-	16.9	-				
___ALL ROUNDFISH	73.6	1936.8	2.5	-	16.9	-	929.3	167.8	3817.9	1685.7
SPINY DOGFISH	-	1229.1	-	-	-	-	-	0.1	1292.9	337.5
UNSPECIFIED SQUID			-	-	-		-		0.4	TR
OTHER GROUNDFISH	0.5	4.2	-	-	-	0.1	-	TR	5.3	23.4
UNSP. GROUNDFISH		TR	-	-	-		-	1.1		0.1
___MISC. GROUNDFISH	0.5	1235.3	-	-	-	0.1	-	1.2	1298.7	361.0
ALL GROUNDFISH	203.4	3617.9	2.5	TR	16.9	0.1	931.8	219.5	14029.7	12157.0

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR VANCOUVER AREA

SPECIES	MID-TRAWL	SHMP-TRAWL	SGL-SHRIMP	ALL GEARS
ARROWTOOTH FLOUNDER	TR	_	_	4525.5
DOVER SOLE	0.2	TR	_	3096.5
ENGLISH SOLE	0.1	_	_	553.7
PETRALE SOLE	0.2	_	_	901.5
REX SOLE	_	_	_	34.4
ROCK SOLE	0.9	_	_	146.6
STARRY FLOUNDER	_	_	_	81.1
OTHER FLATFISH	_	_	_	57.2
___ALL FLATFISH	1.4	0.1	_	9396.8
BOCACCIO	19.3	_	_	365.9
CANARY ROCKFISH	37.9	_	_	1156.9
DARKBLOTCHED ROCKFIS	_	_	_	47.5
REDSTRIPE ROCKFISH	9.7	_	_	569.3
SHARPCHIN ROCKFISH	_	_	_	37.7
SILVERGREY ROCKFISH	20.8	_	_	670.4
SPLITNOSE ROCKFISH	_	_	_	48.5
YELLOWEYE ROCKFISH	_	_	_	6.9
YELLOWMOUTH ROCKFISH	_	_	_	333.1
YELLOWTAIL ROCKFISH	1158.1	_	0.1	3454.7
OTHER ROCKFISH	7.4	0.4	_	856.7
PACIFIC OCEAN PERCH	3.6	_	_	1451.0
THORNYHEADS	0.2	_	_	277.4
WIDOW ROCKFISH	1574.0	_	_	3174.2
UNSP. ROCKFISH	_	3.8	_	668.6
___ALL ROCKFISH	2831.0	4.1	0.1	13265.3
LINGCOD	11.7	5.1	_	2876.4
PACIFIC COD	0.4	0.1	_	2692.9
SABLEFISH	0.2	_	_	3361.8
WALLEYE POLLOCK	17.7	_	_	40.7
OTHER ROUNDFISH	_	_	_	19.3
___ALL ROUNDFISH	3469.4	5.2	_	12430.6
SPINY DOGFISH	_	12.3	_	2873.8
UNSPECIFIED SQUID	_	_	_	0.5
OTHER GROUNDFISH	_	_	_	33.6
UNSP. GROUNDFISH	_	_	_	1.2
___MISC. GROUNDFISH	_	12.3	_	2911.1
ALL GROUNDFISH	6301.8	21.7	0.1	38003.9

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR COLUMBIA AREA

SPECIES	JIG	LONGLINE	OTH HK&LN	GILL NET	CRAB POT	FISH POT	OTHER POTS	TROLL	BTM-TRAWL	GFSH-TRAWL
ARROWTOOTH FLOUNDER	-	1.6	-	-	-	-	-	TR	-	1982.0
DOVER SOLE	-	TR	TR	-	TR	TR	-	-	-	6740.4
ENGLISH SOLE	-	-	TR	-	-	-	-	-	-	568.4
PETRALE SOLE	-	0.1	TR	-	-	-	-	TR	-	800.4
REX SOLE	-	-	-	-	-	-	-	-	-	269.9
ROCK SOLE	-	-	-	-	-	-	-	-	-	4.8
STARRY FLOUNDER	-	TR	TR	-	TR	-	-	TR	-	270.1
OTHER FLATFISH	-	-	TR	-	TR	-	-	TR	-	470.1
___ALL FLATFISH	-	1.7	TR	-	TR	TR	-	TR	-	11106.0
BLACK ROCKFISH	-	-	-	-	-	-	-	-	-	23.9
BOCACCIO	-	-	-	-	-	-	-	-	-	141.7
CANARY ROCKFISH	-	-	17.1	-	-	-	-	-	-	804.3
CHILIPEPPER	-	-	-	-	-	-	-	-	-	2.4
DARKBLOTCHED ROCKFIS	-	-	-	-	-	-	-	-	-	722.5
REDSTRIPE ROCKFISH	-	-	-	-	-	-	-	-	-	264.9
SHARPCHIN ROCKFISH	-	-	-	-	-	-	-	-	-	82.8
SILVERGREY ROCKFISH	-	-	-	-	-	-	-	-	-	73.8
SPLITNOSE ROCKFISH	-	-	-	-	-	-	-	-	-	84.6
YELLOWEYE ROCKFISH	-	-	-	-	-	-	-	-	-	59.3
YELLOWMOUTH ROCKFISH	-	-	-	-	-	-	-	-	-	327.2
YELLOWTAIL ROCKFISH	TR	6.0	3.4	-	-	-	-	0.1	-	2104.3
OTHER ROCKFISH	-	-	-	-	-	-	-	-	0.4	404.5
PACIFIC OCEAN PERCH	-	0.1	-	-	-	-	-	-	-	653.5
SHORTBELLY ROCKFISH	-	-	-	-	-	-	-	-	-	TR
THORNYHEADS	-	5.5	-	-	-	0.2	-	-	-	3572.0
WIDOW ROCKFISH	-	1.9	1.7	-	-	-	-	-	-	3987.1
UNSP. ROCKFISH	3.1	98.7	171.9	-	0.3	1.0	-	66.2	-	126.1
___ALL ROCKFISH	3.1	112.3	194.1	-	0.3	1.2	-	66.3	0.4	13435.0
JACK MACKEREL	-	-	TR	-	-	-	-	-	-	-
LINGCOD	0.1	9.3	52.8	-	0.1	TR	-	11.6	-	804.2
PACIFIC COD	-	0.2	-	-	-	-	-	TR	-	342.2
PACIFIC WHITING	-	-	-	-	-	-	-	-	1.4	330.0
SABLEFISH	-	539.8	0.8	-	-	869.0	-	0.1	-	2074.6
WALLEYE POLLOCK	-	-	-	-	-	-	-	-	-	0.5
UNSP. ROUNDFISH	-	-	TR	-	-	-	-	-	-	-
___ALL ROUNDFISH	0.1	549.3	53.6	-	0.1	869.0	-	11.8	1.4	3551.5
SPINY DOGFISH	-	2.6	0.1	0.2	-	-	-	TR	-	12.1
OTHER GROUNDFISH	-	0.4	3.4	TR	0.9	-	TR	0.1	-	68.9
UNSP. GROUNDFISH	-	0.1	1.1	-	-	TR	-	0.1	-	2.0
___MISC. GROUNDFISH	-	3.1	4.6	0.2	0.9	TR	TR	0.2	-	83.0
ALL GROUNDFISH	3.3	666.4	252.4	0.2	1.3	870.2	TR	78.3	1.8	28175.4

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR COLUMBIA AREA

SPECIES	MID-TRAWL	DBL-SHRIMP	SHMP-TRAWL	SGL-SHRIMP	ALL GEARS
ARROWTOOTH FLOUNDER	-	8.2	23.4	0.3	2015.5
DOVER SOLE	-	14.6	15.9	3.0	6774.0
ENGLISH SOLE	-	0.3	0.7	0.1	569.4
PETRALE SOLE	0.1	0.2	0.1	TR	801.0
REX SOLE	0.1	TR	0.7	TR	270.7
ROCK SOLE	-	0.1	TR	-	4.9
STARRY FLOUNDER	-	-	0.6	-	270.7
OTHER FLATFISH	TR	-	TR	TR	470.2
___ALL FLATFISH	0.2	23.4	41.5	3.5	11176.3
BLACK ROCKFISH	-	-	-	-	23.9
BOCACCIO	-	-	-	-	141.7
CANARY ROCKFISH	TR	15.2	-	0.5	837.1
CHILIPEPPER	-	-	-	-	2.4
DARKBLOTCHED ROCKFIS	-	-	-	-	722.5
REDSTRIPE ROCKFISH	-	-	-	-	264.9
SHARPCHIN ROCKFISH	0.8	-	-	-	83.6
SILVERGREY ROCKFISH	-	-	-	-	73.8
SPLITNOSE ROCKFISH	-	-	-	-	84.6
YELLOWEYE ROCKFISH	TR	-	-	-	59.3
YELLOWMOUTH ROCKFISH	-	-	-	-	327.2
YELLOWTAIL ROCKFISH	68.6	362.7	61.6	20.9	2627.6
OTHER ROCKFISH	TR	0.4	-	TR	405.3
PACIFIC OCEAN PERCH	20.2	0.6	0.1	TR	674.5
SHORTBELLY ROCKFISH	-	-	-	-	TR
THORNYHEADS	TR	0.2	0.1	-	3578.0
WIDOW ROCKFISH	3124.5	4.5	TR	0.7	7120.5
UNSP. ROCKFISH	13.2	69.9	288.2	3.4	842.0
___ALL ROCKFISH	3227.4	453.5	350.0	25.5	17869.1
JACK MACKEREL	-	0.1	-	-	0.2
LINGCOD	0.1	11.9	6.6	3.1	900.0
PACIFIC COD	-	0.8	3.1	TR	346.3
PACIFIC WHITING	6635.5	-	5.9	TR	6972.8
SABLEFISH	0.1	6.6	9.6	0.7	3501.2
WALLEYE POLLOCK	-	-	-	-	0.5
UNSP. ROUNDFISH	-	-	-	-	TR
___ALL ROUNDFISH	6635.7	19.5	25.1	3.9	11721.0
SPINY DOGFISH	-	TR	-	-	15.1
OTHER GROUNDFISH	-	0.2	0.5	TR	74.5
UNSP. GROUNDFISH	-	TR	0.1	TR	3.3
___MISC. GROUNDFISH	-	0.2	0.5	TR	92.9
ALL GROUNDFISH	9863.2	496.6	417.1	32.9	40859.3

DATA SOURCE FOR AREAS CHARLOTTE, GEORGIA STRAIT, AND THE CANADIAN PORTION OF VANCOUVER IS DFO,CANADA
TR => LANDED CATCH LESS THAN 0.05 METRIC TONS, OR METRIC TONS PER UNIT OF EFFORT LESS THAN 0.005

US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR COL RIVER AREA

SPECIES	DIP NET	GILL NET	TROLL	ALL GEARS
STARRY FLOUNDER	_	1.9	_	1.9
___ALL FLATFISH	_	1.9	_	1.9
UNSP. ROCKFISH	_	TR	TR	TR
___ALL ROCKFISH	_	TR	TR	TR
OTHER ROUNDFISH	1260.0	2.9	_	1262.9
___ALL ROUNDFISH	1260.0	2.9	_	1262.9
SPINY DOGFISH	_	TR	_	TR
OTHER GROUNDFISH	_	TR	_	TR
___MISC. GROUNDFISH	_	TR	_	TR
ALL GROUNDFISH	1260.0	4.8	TR	1264.9

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR EUREKA AREA

SPECIES	LONGLINE	OTH HK&LN	POLE(COM)	UNKN-GEAR	OTHER NETS	CRAB POT	FISH POT	OTHER POTS	TROLL	BTM-TRAWL
ARROWTOOTH FLOUNDER	-	TR	-	1.5	-	-	-	-	-	0.3
DOVER SOLE	TR	-	0.8	54.1	-	-	-	0.1	-	TR
ENGLISH SOLE	0.9	-	3.0	6.3	-	-	-	0.1	-	0.3
PETRALE SOLE	0.2	-	0.7	2.5	-	-	-	TR	-	-
REX SOLE	0.3	-	0.2	3.6	-	-	-	-	-	TR
STARRY FLOUNDER	0.2	-	-	1.5	-	-	-	0.2	-	
OTHER FLATFISH	2.2	-	5.4	8.7	-	-	-	TR	TR	
UNSP. FLATFISH	TR	-	0.2	0.4	-	-	-	0.5	TR	0.7
ALL FLATFISH	3.8	TR	10.2	78.5	-	-	-			
BOCACCIO	-	-	0.1	-	-	-	-	-	-	TR
CANARY ROCKFISH	-	-	-	-	-	-	-	-	-	TR
CHILIPEPPER	-	-	TR	-	-	-	-	-	-	TR
DARKBLOTCHED ROCKFIS	-	-	TR	-	-	-	-	-	-	TR
REDSTRIPE ROCKFISH	-	-	-	-	-	-	-	-	-	-
SHARPCHIN ROCKFISH	-	-	-	-	-	-	-	-	-	TR
SPLITNOSE ROCKFISH	-	-	-	-	-	-	-	-	-	TR
YELLOWEYE ROCKFISH	-	-	-	-	-	-	-	-	-	-
YELLOWMOUTH ROCKFISH	-	-	-	-	-	-	-	-	-	TR
YELLOWTAIL ROCKFISH	1.0	1.1	0.1	-	-	-	-	-	-	TR
OTHER ROCKFISH	-	-	0.2	-	-	-	-	-	-	-
PACIFIC OCEAN PERCH	-	-	-	-	-	-	-	-	0.6	-
THORNYHEADS	0.5	-	2.1	40.8	-	-	-	-	-	TR
WIDOW ROCKFISH	1.7	2.1	9.4	0.4	-	-	TR	3.5	20.3	0.2
UNSP. ROCKFISH	82.3	143.7	646.8	49.3	0.1	-	TR	3.5	20.9	0.3
ALL ROCKFISH	85.4	146.9	658.7	90.5	0.1	-				
LINGCOD	25.9	43.0	104.0	8.6	TR	TR	-	0.3	4.1	0.4
PACIFIC COD	-	-	-	242.4	-	-	-	-	-	-
PACIFIC WHITING	-	-	-	-	-	-	-	-	-	-
SABLEFISH	136.0	0.2	60.8	28.6	-	-	10.7	16.1	24.7	TR
ALL ROUNDFISH	161.9	43.2	164.8	279.6	TR	TR	10.7	16.4	28.8	0.4
OTHER GROUNDFISH	0.2	0.2	7.1	0.6	0.4	-	-	TR	0.8	-
UNSP. GROUNDFISH	0.1	1.2	0.2	2.9	-	-	-	-	TR	-
MISC. GROUNDFISH	0.3	1.4	7.3	3.5	0.4	-	-	TR	0.9	-
ALL GROUNDFISH	251.4	191.4	841.1	452.1	0.6	TR	10.7	20.5	50.7	1.4

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR EUREKA AREA

SPECIES	GFSH-TRAWL	MID-TRAWL	OTH TRAWLS	DBL-SHRIMP	SGL-SHRIMP	ALL GEARS
ARROWTOOTH FLOUNDER	15.8	_	52.4	0.2	0.7	70.7
DOVER SOLE	955.4	_	2874.5	0.5	0.9	3886.5
ENGLISH SOLE	19.6	_	169.5	0.1	TR	199.5
PETRALE SOLE	111.6	_	167.3	0.1	TR	283.0
REX SOLE	18.7	_	158.4	TR	_	181.2
STARRY FLOUNDER	TR	_	18.6	_	_	20.2
OTHER FLATFISH	0.9	_	150.1	_	0.1	167.6
UNSP. FLATFISH	_	_	0.3	_	_	0.9
___ALL FLATFISH	1122.0	_	3591.2	1.0	1.8	4809.6
BOCACCIO	12.5	_	83.5	_	_	96.2
CANARY ROCKFISH	36.3	TR	46.8	_	_	83.2
CHILIPEPPER	_	_	56.5	_	_	56.5
DARKBLOTCHED ROCKFIS	2.4	_	92.8	_	_	95.3
REDSTRIPE ROCKFISH	9.4	_	0.3	_	_	9.7
SHARPCHIN ROCKFISH	8.3	_	28.6	_	_	36.9
SPLITNOSE ROCKFISH	53.3	_	8.0	_	_	61.3
YELLOWEYE ROCKFISH	0.6	TR	_	_	_	0.6
YELLOWMOUTH ROCKFISH	0.1	_	2.7	_	_	2.8
YELLOWTAIL ROCKFISH	82.6	1.8	63.6	0.4	TR	150.6
OTHER ROCKFISH	15.8	TR	44.4	_	_	60.4
PACIFIC OCEAN PERCH	0.8	_	4.3	_	_	5.2
THORNYHEADS	964.2	_	3134.0	TR	TR	4142.2
WIDOW ROCKFISH	118.1	117.4	902.6	TR	_	1151.8
UNSP. ROCKFISH	30.5	0.1	702.0	2.2	4.5	1685.5
___ALL ROCKFISH	1334.9	119.3	5170.2	2.6	4.5	7637.9
LINGCOD	56.7	TR	174.5	2.0	1.4	420.9
PACIFIC COD	0.1	_	TR	_	_	0.1
PACIFIC WHITING	_	336.4	5273.3	_	_	5852.1
SABLEFISH	443.5	_	1239.3	0.7	0.5	1961.2
___ALL ROUNDFISH	500.3	336.5	6687.1	2.7	1.9	8234.3
OTHER GROUNDFISH	35.0	_	1.2	TR	0.2	46.0
UNSP. GROUNDFISH	_	_	67.5	_	_	71.9
___MISC. GROUNDFISH	35.0	_	68.8	TR	0.2	117.9
ALL GROUNDFISH	2992.2	455.8	15517.1	6.2	8.5	20799.7

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR MONTEREY AREA

SPECIES	HAND LINE	LONGLINE	POLE(COM)	OTH-KNOWN	UNKN-GEAR	OTHER NETS	OTHER POTS	TROLL	BTM-TRAWL	OTH TRAWLS
ARROWTOOTH FLOUNDER										0.3
DOVER SOLE		–	13.2	TR	145.1	16.3	0.1	0.1	6.9	3299.5
ENGLISH SOLE		TR	4.4	0.5	64.6	42.0	0.2		11.7	610.5
PETRALE SOLE		0.1	3.6	0.1	42.0	27.0	0.3	0.1	7.0	440.8
REX SOLE			1.6		19.0	4.1	0.1		2.0	378.2
ROCK SOLE		TR	0.2	–	2.4	TR	–	TR	TR	4.6
STARRY FLOUNDER			TR	–	4.3	0.7				11.2
OTHER FLATFISH		0.4	12.7	–	85.5	136.2	2.5	TR	13.5	373.3
UNSP. FLATFISH		TR	1.5		1.8	8.9	TR	TR	0.8	13.3
___ALL FLATFISH		0.7	37.2	0.7	364.7	235.3	3.2	0.3	42.1	5131.8
BOCACCIO			38.3						1.6	285.8
CANARY ROCKFISH		–	9.2	–	–	–	–	–		31.1
CHILIPEPPER		–	12.5	–	–	–	–	–	10.6	583.4
DARKBLOTCHED ROCKFIS		–	0.8	–	–	–	–	–	TR	86.0
REDSTRIPE ROCKFISH		–	–	–	–	–	–	–	–	0.3
SHARPCHIN ROCKFISH		–		–	–	–	–	–		5.7
SPLITNOSE ROCKFISH		–	TR	–	–	–	–	–	TR	18.7
YELLOWEYE ROCKFISH		–	0.2	–	–	–	–	–		4.3
YELLOWTAIL ROCKFISH		–	75.3	–	–	–	–	–	TR	22.4
OTHER ROCKFISH		–	40.0	–	–	–	–	–	0.8	185.4
PACIFIC OCEAN PERCH										0.7
THORNYHEADS		1.5	11.5	–	87.8	0.9	0.1	0.9	9.8	2121.1
WIDOW ROCKFISH		3.6	18.4		19.0	139.9		1.0	3.7	950.9
UNSP. ROCKFISH	0.1	83.6	1076.0	6.0	718.3	1370.7	13.2	60.5	27.8	3178.6
___ALL ROCKFISH	0.1	88.8	1282.3	6.0	825.0	1511.4	13.3	62.5	54.3	7474.4
LINGCOD	0.1	22.8	143.0	0.2	49.8	156.4	1.3	8.6	3.5	411.5
PACIFIC WHITING			0.1		TR					TR
SABLEFISH		49.8	273.7	0.1	132.7	53.4	563.9	45.6	2.5	956.5
___ALL ROUNDFISH	0.1	72.6	416.7	0.2	182.4	209.8	565.2	54.2	6.0	1368.0
OTHER GROUNDFISH		0.1	3.4	–	2.4	10.9	0.1	TR	0.9	8.5
UNSP. GROUNDFISH		0.1	2.5	–	5.7	8.2	TR	0.2	0.3	53.5
___MISC. GROUNDFISH		0.2	5.9	–	8.1	19.2	0.2	0.2	1.2	62.0
ALL GROUNDFISH	0.2	162.3	1742.2	6.9	1380.2	1975.7	581.8	117.2	103.7	14036.2

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR MONTEREY AREA

SPECIES	ALL GEARS
ARROWTOOTH FLOUNDER	0.3
DOVER SOLE	3481.4
ENGLISH SOLE	734.0
PETRALE SOLE	521.1
REX SOLE	405.1
ROCK SOLE	7.3
STARRY FLOUNDER	16.2
OTHER FLATFISH	624.3
UNSP. FLATFISH	26.4
___ALL FLATFISH	5816.0
BOCACCIO	325.7
CANARY ROCKFISH	40.3
CHILIPEPPER	606.4
DARKBLOTCHED ROCKFIS	86.8
REDSTRIPE ROCKFISH	0.3
SHARPCHIN ROCKFISH	5.7
SPLITNOSE ROCKFISH	18.7
YELLOWEYE ROCKFISH	4.5
YELLOWTAIL ROCKFISH	97.7
OTHER ROCKFISH	226.2
PACIFIC OCEAN PERCH	0.7
THORNYHEADS	2233.5
WIDOW ROCKFISH	1136.5
UNSP. ROCKFISH	6534.7
___ALL ROCKFISH	11317.9
LINGCOD	797.2
PACIFIC WHITING	0.1
SABLEFISH	2078.0
___ALL ROUNDFISH	2875.4
OTHER GROUNDFISH	26.4
UNSP. GROUNDFISH	70.6
___MISC. GROUNDFISH	97.0
ALL GROUNDFISH	20106.3

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR CONCEPTION AREA

SPECIES	LONGLINE	POLE(COM)	OTH-KNOWN	UNKN-GEAR	OTHER NETS	TRAMMEL	OTHER POTS	TROLL	BTM-TRAWL	OTH TRAWLS
DOVER SOLE	–	–	0.1			–	–	–	–	8.3
ENGLISH SOLE	–	–	0.2	0.1	0.2	–	–	–	TR	1.2
PETRALE SOLE	–	0.1	0.1	0.2	0.7	TR	TR	–	TR	2.8
REX SOLE	–	–	0.1			–	–	–	–	3.2
STARRY FLOUNDER	–	–	–	TR	TR	–	–	–	–	–
OTHER FLATFISH	–	0.8	–	1.3	0.1	–	–	–	–	0.1
UNSP. FLATFISH	TR	0.3	TR	1.0	3.1	–	0.1	–	0.1	5.5
___ALL FLATFISH	TR	1.2	0.5	2.6	4.2	TR	0.1	–	0.1	21.2
BOCACCIO	–	0.2	–	–	–	–	–	–	–	0.1
CANARY ROCKFISH	–	0.6	–	–	–	–	–	–	–	–
CHILIPEPPER	–	0.1	–	–	–	–	–	–	–	0.1
SPLITNOSE ROCKFISH	–	0.2	–	–	–	–	–	–	–	–
YELLOWTAIL ROCKFISH	–	0.5	–	–	–	–	–	–	–	–
OTHER ROCKFISH	–	88.0	–	0.1	0.6	–	–	–	–	TR
THORNYHEADS	TR	0.2	1.0		0.2	–	–	–	–	4.3
WIDOW ROCKFISH		TR	0.7	0.4	0.3				–	1.0
UNSP. ROCKFISH	36.4	446.9	18.5	131.4	395.4	TR	14.0	4.1	–	30.9
___ALL ROCKFISH	36.4	536.7	20.2	131.9	396.5	TR	14.0	4.1	–	36.5
LINGCOD	0.1	1.2	0.4	1.2	17.5	–	TR	–	–	0.9
PACIFIC COD	–		–		TR	–	–	–	–	–
PACIFIC WHITING		TR	–	TR	0.3	–		–	–	–
SABLEFISH	1.5	9.6	0.1	21.2	3.3	–	0.1	–	–	2.7
___ALL ROUNDFISH	1.5	10.8	0.5	22.4	21.0	–	0.1	–	–	3.7
OTHER GROUNDFISH	TR	16.7		6.1	47.7	–	1.5	–	TR	1.0
UNSP. GROUNDFISH		TR	TR	0.5	3.8	–		–		TR
___MISC. GROUNDFISH	TR	16.8	TR	6.5	51.5	–	1.5	–	TR	1.0
ALL GROUNDFISH	38.0	565.5	21.1	163.5	473.2	TR	15.7	4.1	0.1	62.3

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR CONCEPTION AREA

SPECIES	ALL GEARS
DOVER SOLE	8.4
ENGLISH SOLE	1.7
PETRALE SOLE	3.9
REX SOLE	3.3
STARRY FLOUNDER	TR
OTHER FLATFISH	2.3
UNSP. FLATFISH	10.2
___ALL FLATFISH	29.9
BOCACCIO	0.3
CANARY ROCKFISH	0.6
CHILIPEPPER	0.2
SPLITNOSE ROCKFISH	0.2
YELLOWTAIL ROCKFISH	0.5
OTHER ROCKFISH	88.8
THORNYHEADS	5.7
WIDOW ROCKFISH	2.4
UNSP. ROCKFISH	1077.7
___ALL ROCKFISH	1176.4
LINGCOD	21.3
PACIFIC COD	TR
PACIFIC WHITING	0.3
SABLEFISH	38.4
___ALL ROUNDFISH	60.1
OTHER GROUNDFISH	73.1
UNSP. GROUNDFISH	4.3
___MISC. GROUNDFISH	77.4
ALL GROUNDFISH	1343.7

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US-CANADA DOMESTIC GEAR REPORT: COMM. GROUNDFISH LANDED CATCH (MTONS) FOR 1990 FOR UNKN INPFC AREA

SPECIES	LONGLINE	POLE(COM)	UNKN-GEAR	OTHER NETS	OTHER POTS	TROLL	OTH TRAWLS	ALL GEARS
DOVER SOLE	_	TR	_	_	_	_	4.6	4.6
PETRALE SOLE	_	TR	_	_	TR	_	0.1	0.1
STARRY FLOUNDER	_	TR	_	_	_	_	_	TR
OTHER FLATFISH	_	0.2	_	_	_	_	_	0.2
UNSP. FLATFISH	_	0.1	0.2	TR	TR	_	_	0.3
___ALL FLATFISH	_	0.3	0.2	TR	TR	_	4.7	5.3
BOCACCIO	_	0.2	_	_	_	_	TR	0.2
CANARY ROCKFISH	_	0.1	_	_	_	_	_	0.1
CHILIPEPPER	_	TR	_	_	_	_	TR	0.1
DARKBLOTCHED ROCKFIS	_	TR	_	_	_	_	_	TR
SPLITNOSE ROCKFISH	_	TR	_	_	_	_	_	TR
YELLOWTAIL ROCKFISH	_	0.4	_	_	_	_	_	0.4
OTHER ROCKFISH	_	8.8	TR	TR	_	_	TR	8.9
THORNYHEADS	_	2.2	_	_	_	_	6.3	8.5
WIDOW ROCKFISH	_	TR	_	_	_	_	TR	TR
UNSP. ROCKFISH	4.8	42.9	5.9	7.1	0.1	0.1	0.6	61.4
___ALL ROCKFISH	4.8	54.7	5.9	7.1	0.1	0.1	7.0	79.6
LINGCOD	1.7	1.6	0.1	TR	0.1	_	TR	3.4
PACIFIC WHITING	_	2.5	TR	0.1	_	_	_	2.6
SABLEFISH	_	67.9	0.3	2.3	8.1	_	2.5	81.2
OTHER ROUNDFISH	_	0.2	_	_	_	_	_	0.2
___ALL ROUNDFISH	1.7	72.2	0.4	2.5	8.2	_	2.5	87.5
OTHER GROUNDFISH	TR	13.3	3.3	2.2	TR	_	_	18.9
UNSP. GROUNDFISH	_	_	TR	TR	_	_	_	0.1
___MISC. GROUNDFISH	TR	13.3	3.4	2.2	TR	_	_	18.9
ALL GROUNDFISH	6.5	140.5	9.9	11.8	8.3	0.1	14.2	191.2

DATA SOURCE FOR AREAS CHARLOTTE, GEORGIA STRAIT, AND THE CANADIAN PORTION OF VANCOUVER IS DFO,CANADA
TR => LANDED CATCH LESS THAN 0.05 METRIC TONS, OR METRIC TONS PER UNIT OF EFFORT LESS THAN 0.005

Appendix H

Canadian Groundfish Catch Report

1. Commercial Fisheries

Canadian landings of groundfish (excluding halibut) in 1990 were 70,416 t (Table 1), an increase of 11% above the 1990 level. Trawlers landed 60,368 t, 13% more than in 1989 and 48% above the 1980-1989 mean (Table 2). The major species in the trawl landings were Pacific hake (17%), Pacific cod (11%), Pacific ocean perch (10%), yellowtail rockfish (8%), lingcod (7%) and widow rockfish (7%). Principal areas of trawl production were 3C-(19%), 5B (16%), 3D (14%), 4B (13%) and 5D (12%).

Table 1. British Columbia landings (t) of groundfish in 1990[a] by species and gear type (excluding dumped and discarded).

Species	Bottom trawl	Midwater trawl	Line[b]	Trap	Total
English sole	1,261.3	.2	tr.	-	1,261.5
Rock sole	2,284.7	.9	tr.	-	2,285.6
Petrale sole	1,066.4	.1	tr.	-	1,066.5
Dover sole	2,390.9	.7	-	-	2,391.6
Rex sole	132.7	-	-	-	132.7
Starry flounder	145.3	-	tr.	-	145.3
Turbot	2,624.5	.3	tr.	-	2,624.8
Other flatfish	56.6	-	.2	-	56.8
Pacific cod	6,482.8	1.3	10.1	-	6,494.2
Lingcod	4,006.1	13.4	1,133.1	.2	5,152.8
Sablefish	462.6	.1	1,767.5	2,961.2	5,191.4
Pollock	453.8	459.2	-	-	913.0
Hake	1.2	10,552.3	.2	-	10,553.7
Ocean perch	5,718.1	18.5	2.4	-	5,739.0
Other RF	14,659.3	5,833.2	2,037.9	4.2	22,534.6
Misc. species	100.8	-	14.8	160.8[c]	276.4
Dogfish	1,382.7	45.9	1,946.1	-	3,374.7
Animal food	7.6	-	9.5	-	17.1
Reduction	79.6	124.7	-	-	204.3
Total	43,317.0	17,050.8	6,921.8	3,126.4	70,416.0

[a]Preliminary data.

[b]Includes longline, handline, and troll.

[c]Catch is all hagfish, caught by small Korean-type traps.

Canadian landings of groundfish caught by gear other than trawl in 1990 totalled 10,048 t (Table 1). Trap gear accounted for 3,126 t (95% sablefish) and longline, handline and troll gear for 6,922 t (29% rockfish, 28% dogfish, 26% sablefish and 16% lingcod).

2. Recreational Fisheries

Each year, Fisheries Branch (DFO) conducts creel surveys of the recreational fishery in the Strait of Georgia. Principal target species are chinook and coho salmon. Provisional estimates of 1990 catches were 31,716 fish for lingcod, 154,858 fish for all rockfish species and 2,679 fish for dogfish.

3. Joint-Venture Fisheries

In 1990, thirty-three Canadian catcher vessels delivered Pacific hake and incidental species to eighteen processing vessels in cooperative fishing arrangements. These fisheries take place off the southwest coast of Vancouver Island (Area 3C). A total of 69,293 t of Pacific hake was processed by 12 Polish vessels, 4 Soviet vessels and 2 Japanese vessels. The quotas and catches are outlined below:

Nation	Species	Quota(t)	Catch(t)
Poland	Hake	32,500	32,527
	Pollock	incidental	402
	Rockfish	incidental	163
	Other	incidental	1
USSR	Hake	20,000	19,918
	Pollock	incidental	92
	Rockfish	incidental	84
	Other	incidental	-
Japan	Hake	17,000	16,848
	Pollock	incidental	43
	Rockfish	incidental	52
	Other	incidental	-
Total	Hake	69,500	69,293
	Pollock	incidental	537
	Rockfish	incidental	299
	Other	incidental	1

4. Foreign Fisheries

There were no national fisheries for Pacific hake off southwest Vancouver Island (Area 3C) in 1990. Seven of the Polish processing vessels involved in the joint-venture fishery occasionally fished directly (supplemental fishing) when domestic vessels could not supply sufficient quantities of hake. This supplemental catch of 3,976 t is considered to be the national catch. A summary of foreign fishery quotas and catches follows:

Nation	Species	Quota(t)	Supplemental catch(t)
Poland	Hake	4,000	3,976
	Pollock	incidental	1
	Rockfish	incidental	128
	Other	incidental	-