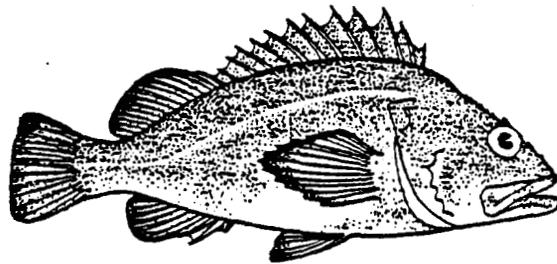


*Report of the Technical
Subcommittee of the
Canada - United States
Groundfish Committee*



*Thirty-First
Annual Meeting*

*June 5-7, 1990
Sitka, Alaska*



*Prepared by
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P.O. Box 667, Petersburg, Alaska 99833*

**REPORT OF THE TECHNICAL SUBCOMMITTEE
OF THE
CANADA - UNITED STATES
GROUND FISH COMMITTEE**

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

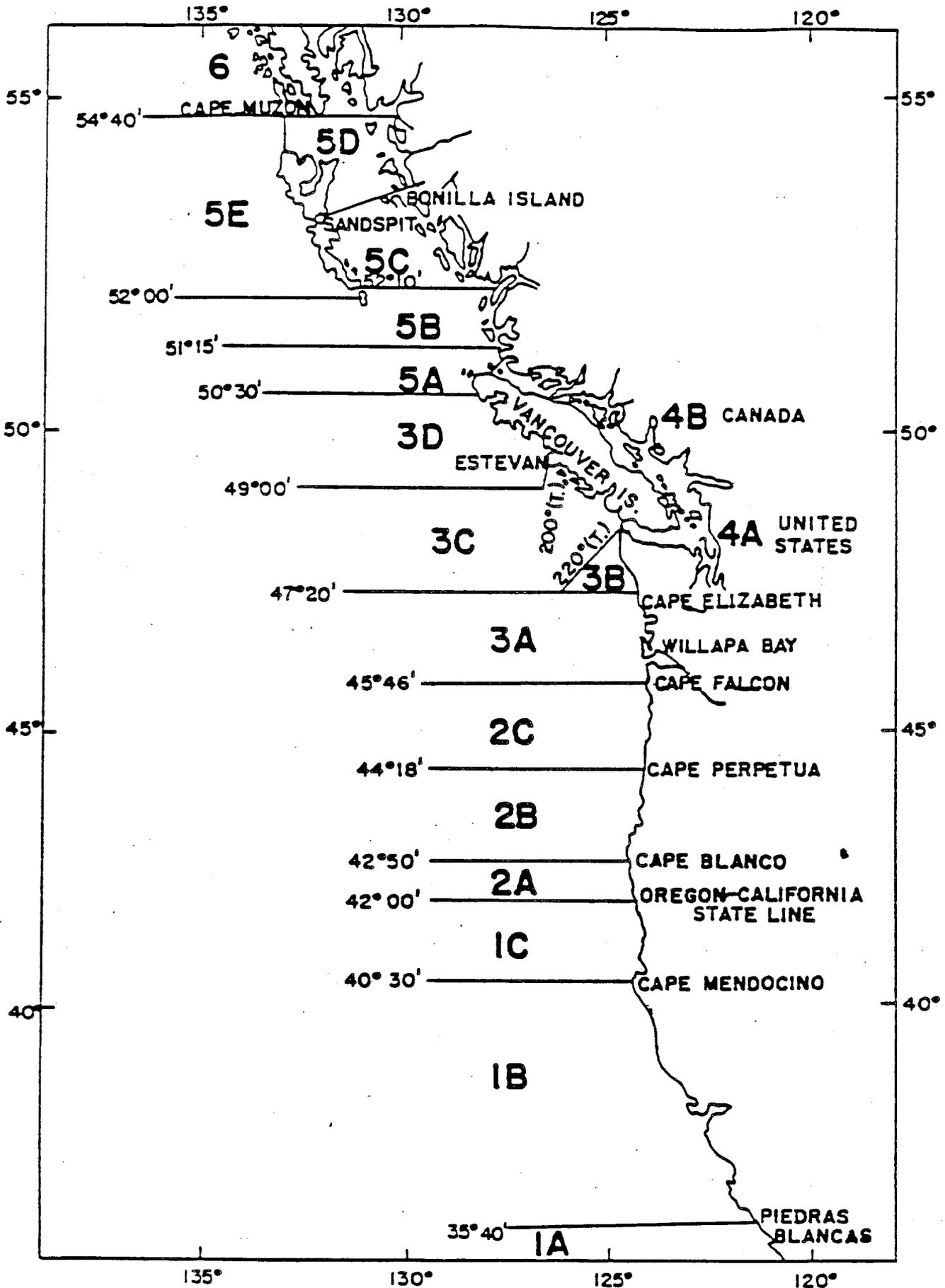
**Thirty-First Annual Meeting
June 5 - 7, 1990
Sitka, Alaska**

**Prepared by:
Barry Bracken
Alaska Department of Fish and Game
Division of Commercial Fisheries
Petersburg, Alaska**

Regional Information Report¹ No. 1J91-09

July 1991

¹ The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.



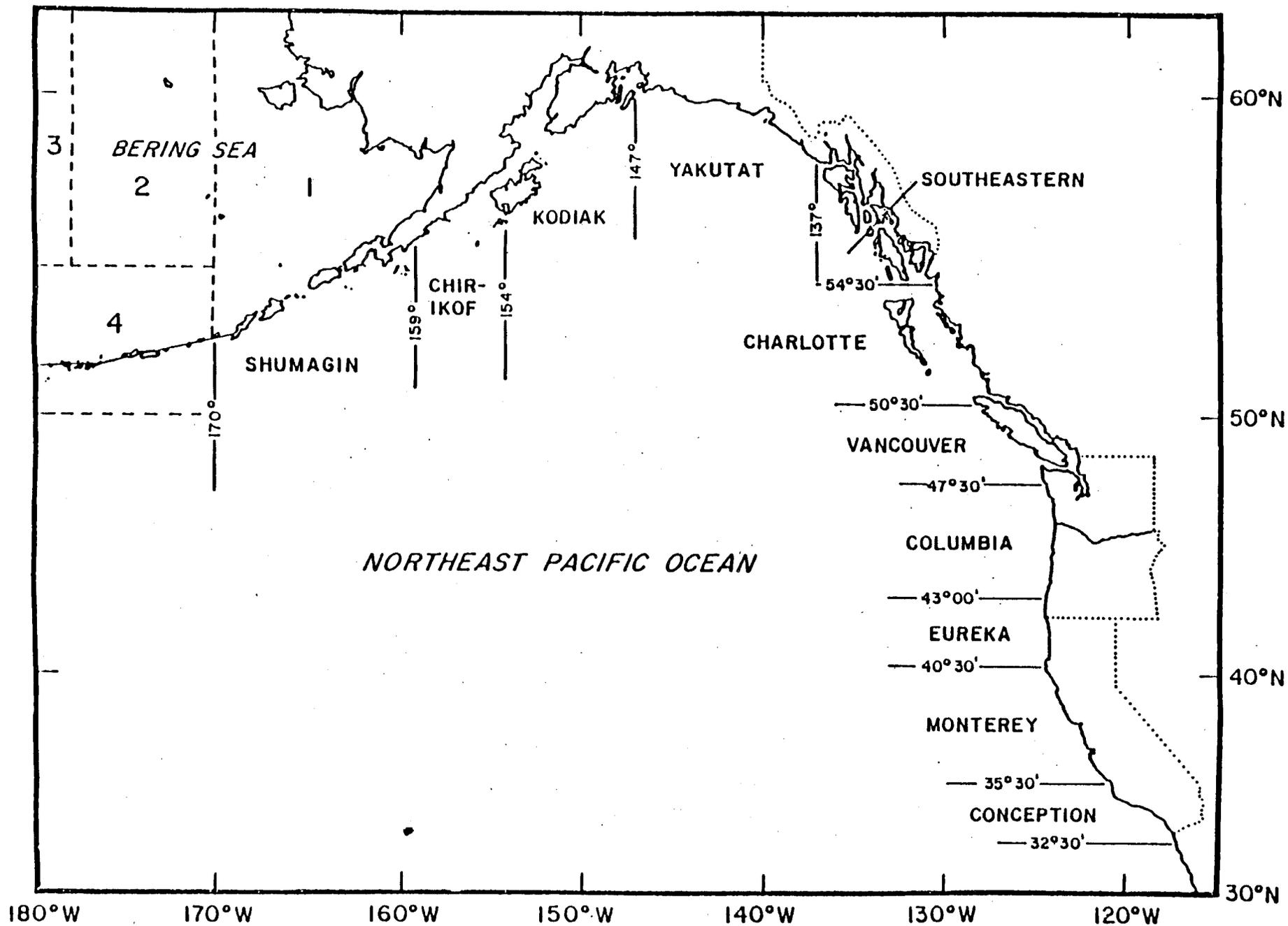


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I. CALL TO ORDER

Chairman, Mr. Tom Jagielo called to order the 31st Annual Meeting of the Technical Subcommittee at 0823 hours on June 5, 1990, at the Centennial Hall in Sitka, Alaska.

II. APPOINTMENT OF THE SECRETARY

Mr. Barry Bracken of the Alaska Department of Fish and Game, Petersburg, Alaska, 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 attendees is include as Appendix A.

Canada - Department of Fisheries and Oceans (DFO)

Biological Sciences Branch

- * Mr. Mark Saunders
- * Dr. Laura Richards

Fisheries Branch

Mr. Edward Zyblut
Mr. Barry Ackerman

United States

National Marine Fisheries Service

Auke Bay Laboratory

Mr. Dave Clausen

Alaska Fisheries Science Center (AFSC)

- * Mr. Mark Wilkins
- * Dr. Richard Methot

Southwest Fisheries Center (SWFC)

- * Dr. Bill Lenarz

Alaska Department of Fish & Game (ADFG)

- * Mr. Barry Bracken (Secretary)
- Mr. Gary Gunstrom
- Mr. Dave Carlile
- Ms. Victoria O'Connell
- Mr. Dave Gordon
- Ms. Joan Ried Brodie

Washington Department of Fisheries (WDF)

- * Mr. Tom Jagielo (Chairman)
- * Mr. Al Millikan

Oregon Department of Fish and Wildlife (ODFW)

- * Mr. Bob Demory

California Department of Fish & Game (CDFG)

Not Represented

Pacific Fishery Management Council (PFMC)

Mr. Larry Six

North Pacific Fisheries Management Council

Mr. Hal Weeks

Pacific States Marine Fisheries Commission (PSMFC)

Mr. Guy Thornburgh

International Pacific Halibut Commission

Mr. Bob Trumble

IV. APPROVAL OF THE 1989 REPORT AND THE 1990 AGENDA

At the request of Mr. Bracken, approval of the 1989 report was delayed until later in the meeting pending review by all members. The 1989 report was subsequently approved as written and the TSC commended Mr. Saunders for a job well done.

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 and none have occurred since 1981. Following are the Terms of Reference of the Technical Subcommittee:

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

C.A.R.E. (Committee of Age Reading Experts) met May 16 - 18 in Seattle, WA. There were 15 participants from Alaska, Canada, Washington, Oregon, and California fisheries agencies. Joan Ried Brodie presented the report from that meeting. The full report is included as Appendix C.

The minutes include detailed information and recommendations on the following topics: agency species status and validation updates, the fish ageing support system, precision systems, new age validation work, training methods, edge growth interpretation, age designation and flatfish ageing methods, criteria and problems.

Dr. Methot stated that he thought that many of the CARE recommendations were better directed to themselves rather than to the TSC.

Mr. Demory stated that precision needs to be better defined and that it varies by species as a function of age differences.

Dr. Methot suggested the need to account for aging error in modeling to avoid bias and the appearance that recruitment is stronger than it really is because of "bleed over".

Ms. Brody indicated that, as a technician, her interpretation of precision has more to do with accuracy between readers.

Mr. Jagielo suggested that some of the recommendations need agency endorsement to be implemented.

There was a general discussion on the merits of providing full information ie. season, size, sex, etc. as opposed to aging the structures without access to supplemental information. There was no consensus, but it was agreed that specific recommendations would be discussed further under agenda item XI. *1990 TSC Recommendations*.

Mr. Jagielo summarized his notes from the CARE meeting as follows:

- * The number of structures read is often based more on budget considerations than on sample design.
- * There needs to be better communication between the age reading technicians and the biologists who use the data.
- * The process would benefit if the technicians were more directly involved in all aspects of the research including collection, data entry, documentation and possibly even publishing the findings.

Mr. Wilkins suggested a pre-reading meeting between the reader and the end user.

Dr. Methot stated that age readers need to be more involved in studies regarding growth, ie. edge growth timing, stock identification, etc.

Dr. Richards asked a question regarding the problem with different notations used by the various agencies.

Dr. Methot agreed that interpretation is very important and that "age+" can be misleading. This notation should be standardized.

Mr. Clausen asked about the extent of formalized exchange of age structures among the agencies. A discussion followed which indicated that there is quite a bit of exchange occurring, but that consistency, which is an important aspect of an exchange program, is somewhat lacking.

Dr. Lenarz stated that it is important to know the year class as well as the age for modeling.

Mr. Saunders and Dr. Methot agreed to review the written CARE report and draft recommendations to the TSC.

B. PACFIN - PSMFC Data Series Project

It was reported that Data Series redefinition project is on track and scheduled for completion during the second half of 1990. The revised series will incorporate new sources of information including effort, logbook adjustments, and better species composition. It will include aspects of research as well as management and will incorporate fish ticket as well as logbook records.

C. Stock Assessment Groups

1. Yellowtail Rockfish

The full working group report on the yellowtail rockfish fisheries which was compiled by Mr. Jack Tagart and Mr. Rick Stanley is attached as Appendix D.

Mr. Saunders presented a summary of the report to the TSC during the meeting. A brief synopsis follows.

It was reported that tagging data suggests extensive trans-boundary movement. Most of the work was concentrated in the Vancouver INPFC area. The report indicates that the PSMFC area 3C and 3B area populations should be managed as a single stock. A joint assessment using more recent data will be completed for September 1990.

There have been few additions to the biological database since June 1989. New data has been requested from most agencies and should be on line by early 1991.

A data report/users guide to the database is being prepared and will be published in the WDF data report series.

Two separate papers on yellowtail stock assessment are being prepared. The Canadian yellowtail stock assessment, which was written by Mr. Rick Stanley, was accepted by the Pacific Stock Assessment Review Committee of DFO in September 1989 and was published in their 1990 west coast groundfish stock assessment report. A draft manuscript on population dynamics and acceptable biological catch of yellowtail rockfish in U.S. waters which was written by Mr. Jack Tagart has been submitted for publication.

There will be no new assessment of yellowtail stock condition for the 1991 fishing year. The 1990 assessment will be used to project recommended ABC's and harvest quotas. A 1991 PSMFC Area 3B-3C assessment will be conducted jointly by WDF and DFO staff. The assessments will rely heavily on the Stock Synthesis model of Dr. Rick Methot (NMFS).

A full scale genetic experiment is planned during the fall of 1990 and spring of 1991 using larger sample sizes and more sample units. The current recommended sample size is 100 fish.

A screening of 20 B.C. and 10 Washington specimens indicated 4 parasite species which showed promise as biological tags for stock identification. Two species of parasite were found which had not previously been observed in yellowtail rockfish. The report is in press:

There were significant differences between the maturity curves for each INPFC area. The rate of maturation is similar for females in the Columbia and U.S. Vancouver areas but maturation occurs at an earlier size for the Columbia area. The immediate implication of these observations is that we may be witnessing compensatory changes in maturation as a consequence of declining yellowtail rockfish stock biomass. It also supports the contention of two different stocks.

2. Pacific Whiting (Hake)

Dr. Methot presented the report of the "hake" working group consisting of R. Methot, M. Dom, L. Richards, A. Tyler, and M. Saunders.

Models for trans-boundary movement were compared. In one model, high exploitation in one zone impacts the other zone. In the other, remixing occurs annually. A proposal was made to allocate yield on the basis of mature biomass in each national zone. A discussion paper (Appendix E) was prepared for review.

Dr. Methot also reported that significant work on growth including size at age and density dependent growth had occurred over the past year.

Mr. Six questioned the accuracy of the survey and whether or not Canada accepted the U.S. biomass estimate in the Canadian zone.

Mr. Saunders responded that Canadian scientists suspect that the survey under samples whiting in two areas of B.C.

Mr. Wilkins stated that the triennial trawl survey is actually designed to assess slope rockfish. Regardless, he feels that the bottom trawl survey coupled with the hydroacoustic survey adequately assesses the whiting biomass in the U.S. zone.

Action on the report was deferred until later in the meeting. The TSC deliberation and action on the discussion paper is covered in more detail in the section on Pacific whiting research and management.

3. Dover Sole

No report.

D. Others

No report

VII. REVIEW OF GROUND FISH FISHERIES

This agenda item was deferred until later in the meeting, but is presented here to be consistent with the original agenda and the outline of the individual contributions from the member agencies.

A. Domestic Commercial Fisheries

1. Canada

Canadian landings of groundfish (excluding halibut) in 1989 were 62,707 t (Table 1), a decrease of 6 % below the 1988 level. Trawlers landed 53,744 t, 3 % less than in 1988 and 40 % above the 1979-1988 mean (Table 2). The major species in the trawl landings were Pacific cod (17 %), Pacific hake (16 %), Pacific ocean perch (11 %), yellowtail rockfish (8 %), lingcod (6 %) and silvergray rockfish (5 %). Principal areas of trawl production were 3C (19 %), 5B (18 %), 4B (16 %), 3D (12 %) and 5D (11 %).

Canadian landings of groundfish caught by gear other than trawl in 1989 totalled 8,477 t (Table 1). Trap gear accounted for 3,902 t (88 % sablefish) and longline, handline and troll gear for 5,060 t (33 % dogfish, 32 % rockfish, 17 % lingcod and 15 % sablefish).

2. National Marine Fisheries Service

Domestic fisheries in Alaska that are not managed by the State of Alaska (e.g. factory trawlers in the Bering Sea and Gulf of Alaska which deliver outside the state) are monitored by the NMFS Alaska Regional Office. Catch statistics for this segment of the groundfish fishery will be reported in a document prepared by the Pacific Fisheries Information Network (PACFIN) which is presented in Appendix G.

3. Alaska

The Alaska Department of Fish and Game (ADF&G) has management jurisdiction over 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.

With the exception of a small sablefish fishery in Prince William Sound, all state-managed groundfish fisheries occur in Southeast Alaska (east of 137° W longitude) and virtually all trans-boundary groundfish stocks in Alaskan waters occur in that area.

State-managed groundfish fisheries in Southeast Alaska include target fisheries for sablefish, rockfish, lingcod, pacific cod, and flatfish in order of economic importance. Rockfish are separated into three assemblages for management. Demersal shelf rockfish are the most important component of the state-managed rockfish fisheries.

Besides a very small flatfish trawl fishery in the Southeast inside area, hook and line gear is the primary means of harvest in state-managed groundfish fisheries. Set lines are the predominant hook-and-line gear type.

The harvest of all groundfish in the state-managed fisheries during 1989 totalled nearly 6 million pounds (2,680 t) landed weight worth an estimated ex-vessel value of over \$5 million. Sablefish dominated the harvest and value again during 1989 accounting for 55% of the landings and 76% of the value of all species landed. The commercial harvest is included in the PACFIN table in Appendix G.

4. Washington

As per discussions at the 1988 TSC meeting, Washington did not submit a detailed discussion of this section in its report. The reader is instead referred to the annual Pacific Fisheries Management Council (PFMC) Status of Stocks report for a description of Washington groundfish fisheries, management, and regulations in 1989.

5. Oregon

a. Monitoring

Monitoring the commercial fishery is a major component of program activities. In addition to numerous ad hoc activities we collected 944 samples over one-half of which were rockfish species composition samples. Biological samples collected for age, size, sex and maturity comprised the remainder.

b. Landed Catch

Total landed catch of groundfish by all gear types in 1989 was 36,782 mt, a 14% increase over the landed catch of 1988.

Trawl landings in 1989 were 34,220 mt, a 19% increase over landings in 1988. Trawl landings accounted for 93% of all commercial landings. Major species or

species groups were rockfish, flatfish and sablefish which accounted to 51%, 36% and 8% respectively (Appendix G).

Of the rockfish group widow rockfish was the most important species with landings of nearly 7,000 mt followed by yellowtail rockfish and canary rockfish at 1,924 mt and 1,419 mt respectively (Appendix G).

Landings of groundfish by gear types other than trawl were 2,562 mt, a reduction of 18% from 1988. Major species were sablefish, rockfish and lingcod (Appendix G).

c. Regulation Changes

During the year in-season regulation changes occurred in response to action taken by the Pacific Fishery Management Council. These amounted to changes in trip limits and are detailed in "Status of the Pacific Coast Groundfish Fishery through 1989 and Recommended Acceptable Biological Catches for 1990." There were no independent actions taken by the Oregon Fish and Wildlife Commission on groundfish.

6. California

California did not submit a report to the 1989 TSC meeting and was not represented at the meeting.

B. Recreational Fisheries

1. Canada

Each year, Fisheries Branch (DFO) conducts creel surveys of the recreational angling fishery in the Strait of Georgia. Principal target species are chinook and coho salmon. Provisional estimates of 1989 catches were 52,329 fish for lingcod, 199,898 fish for all rockfish species and 3,672 fish for dogfish.

2. National Marine Fisheries Service

No report

3. Alaska

a. Harvest

Estimates of recreational groundfish harvests are not yet available for 1989. The state-wide angler survey indicated that 56,839 rockfish were landed by recreational anglers in Southeast Alaska during 1988. That is up considerably from 42,261 reported from the same area during 1987, and substantially higher than the long-term average for the region. Assuming a five pound average for rockfish, this indicates that approximately 129 t of rockfish were taken. Creel census data in Southeast ports shows that discard of rockfish exceeds the retained portion of the catch suggesting that the total recreational rockfish harvest may

have exceeded 250 t. There is currently no species composition data available from the recreational rockfish fishery.

The survey shows that a total of 32,181 marine finfish of other species were landed in Southeast Alaska during 1988. This is substantially lower than the 53,650 fish reported in 1987. Better accounting of rockfish landings and the placement of those species in the appropriate category may account for some of this difference. No species composition data is available for the other groundfish category. Lingcod, Pacific cod, and flatfish are presumed to be the predominant species taken. The unreported discard of other groundfish also likely exceeds the retained portion of the total harvest.

b. Management

Beginning in mid-1989 bag limits were implemented for rockfish within Southeast Alaska. The limits are lower for yelloweye rockfish (*Sebastes ruberrimus*) than for other rockfish species. Also, there are two areas of the region, Sitka Sound and the immediate Ketchikan area where the harvest limits are even more restrictive because of indications of severe declines in the rockfish populations within those areas. There are currently no other regulations for recreational groundfish fisheries in Southeast Alaska.

Bag limits for both rockfish and lingcod remain in effect for the Cook Inlet-Resurrection Bay salt water areas in the Central Region.

ADF&G is attempting to obtain better data on recreational fisheries and has requested supplemental funding to determine the landings from the steadily increasing charter boat fleet.

4. Washington

As per discussions at the 1988 TSC meeting, Washington did not submit a detailed section under this topic in its report. The reader is instead referred to the annual Pacific Fisheries Management Council (PFMC) Status of Stocks report for a description of Washington groundfish fisheries, management, and regulations in 1989.

5. Oregon

Bottomfish-directed ocean angler trips increased from 32,183 in 1988 to 50,114 in 1989; an increase of 56%. Charter boat anglers made 64% of these trips, with private boat anglers contributing the rest. These bottomfish-directed trips produced an overall season average of 5.5 fish per angler; this was down from the 1988 catch of 6.2 fish per angler trip. Most of this decrease in fish per trip is attributed to the large increase in halibut-directed trips, where the catch per trip was approximately one fish.

Oregon's 1989 ocean recreational fishery resulted in a bottomfish catch of 346,291 fish (Table 5), an increase of 33% over the catch in 1988. Table 5 also shows the sampling periods for each port.

Black rockfish was the most commonly seen species, comprising 65% of the total landings. Combined rockfish species comprised 87% of the catch, approximately the same as in 1988.

Pacific halibut comprised only 1.6% of the total catch by numbers, but 12% of the landed weight. Our estimate of the total recreational catch of halibut in Oregon for 1989 was 6,251 fish with a dressed weight of 135,413 pounds (180,069 pounds, round weight). Approximately 97% of this was landed into Newport. Charter boat anglers caught 69% of the statewide halibut catch, with private boat anglers contributing the remaining 31%.

PSMFC area 2C produced 437.1 mt of recreational-caught fish, 75% of the state total. This management area includes the ports of Newport, Garibaldi, and Depoe Bay that ranked first, third, and fourth, respectively, in total landings.

6. California

California did not submit a report to the 1989 TSC meeting and was not represented at the meeting.

C. Foreign Fisheries

1. Canada

The USSR and Poland conducted national fisheries for Pacific hake off southwest Vancouver Island (Area 3C) in 1989. Thirteen Polish and six Soviet vessels caught 31,577 t of Pacific hake. Sixteen of the 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 1,977 t is added to the national catch. A summary of foreign fishery quotas and catches is included in Appendix G.

2. United States

Foreign groundfish catches in the U.S. EEZ were eliminated completely in 1989. Foreign fishing effort in the Bering Sea/Aleutian area ended in 1987 and directed foreign fishing in the Gulf of Alaska ended in 1986. This is the first year that directed foreign Pacific whiting catches in the Washington-California region were completely eliminated, as joint ventures moved to harvest all of the OY.

D. Joint Venture Fisheries

1. Canada

In 1989, twenty-seven Canadian catcher vessels delivered Pacific hake and incidental species to twenty-two processing vessels in cooperative fishing arrangements. These fisheries take place off the southwest coast of Vancouver Island (Area 3C). A total of 66,102 t of Pacific hake was processed by 14 Polish vessels, 6 Soviet vessels and 2 Japanese vessels.

2. United States

U.S. joint venture fisheries have decreased dramatically in the Bering Sea and Gulf of Alaska. Following major increases in joint venture catches in the Bering Sea between 1985 and 1986 and a smaller increase (17%) in 1987, joint venture landings decreased slightly in the Bering Sea/Aleutians area in 1988 and then decreased by 60% in 1989 (Appendix G). The composition of the catches remained similar to that in 1988, reflecting the capacity of the domestic industry to more fully utilize most of the commercially important species under DAP allocation, leaving the remainder of available harvests to JVP allocation. The JV landings of the most important groundfish species in the Bering Sea/Aleutians showed decreases of from 11 to 99.7 percent. Herring was the only species which showed any increase in landings over 1988 harvests (+620%). Joint venture landings in the Gulf of Alaska were completely eliminated in 1989 from 3,771 t in 1988. Joint venture hake catches in the Washington-California region increased by 50% to 203,578 t.

Joint venture allocations in 1990 are 204,680 t (-69%) in the Bering Sea/Aleutians, 173,500 t (-21%) in the Washington-California area, and have been eliminated completely in the Gulf of Alaska since 1988.

VIII. REVIEW OF AGENCY GROUND FISH RESEARCH, ASSESSMENTS AND MANAGEMENT

A. Agency Overview

1. International Pacific Halibut Commission (IPHC)

Mr. Bob Trumble was in Sitka to monitor the June halibut opening. He participated in the first full day of the meetings and presented a brief report on the activities of his agency.

a. Research

The IPHC is exploring the effectiveness of bycatch reduction incentives. They are pursuing work on in-situ observations using underwater camera equipment to determine trawl-halibut interactions.

Otoliths were collected from several thousand fish of known weight during 1989 and the halibut weight/otolith weight relationship was verified and updated.

b. Stock Assessment

Survey data and sampling analysis was used to make quota adjustments. Point estimates were improved using CAGEAN and alternative methods of stock size estimates were compared to CAGEAN. The current 35% exploitation rate is being evaluated. The otolith sampling goal for modeling is 2,000 otoliths per management area per year with attention paid to the contribution of each vessel participating in the fishery. Sex discrimination is being evaluated from otoliths.

c. Other Related Studies

Hook timers are being used to determine when certain species and what size of fish within species take the bait on longline gear.

Studies which compare the effectiveness coded wire tags compared to anchor tags are being conducted.

Age validation work is being done using OTC marks. Estimates of migration and mortality rates are also being determined from the tagging studies.

Data from the NMFS triennial trawl surveys is being examined to estimate abundance and determine age, sex, and size of halibut in the trawl catch. Observer data is also being analyzed for this purpose.

Observations of longline gear using underwater camera equipment is being pursued.

2. Canada Department of Fisheries and Oceans

NOTE: Canada reported their agency research by species or in "other related topics" in their 1989 TSC report.

3. National Marine Fisheries Service

NOTE: The following information was included under the "Agency overview" section of the 1989 NMFS TSC report even though much of the information contained in this section applies to research activities aimed at assessing the status of individual species or species groups.

a. Alaska Fisheries Science Center

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. This report will contain, for the first time, a report from the ABL relating groundfish research at that laboratory. Recent publications produced by RACE, REFM, and ABL scientists are presented in Appendix F.

(1) RACE Division

(a) Gulf of Alaska Groundfish Subtask

In 1989 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 six bottom trawl surveys, one trap survey, two longline surveys, and two hydroacoustic surveys conducted in 1989. Major emphasis was along the West Coast, in keeping with the rotation of comprehensive surveys among three major geographic areas on a triennial basis. The focus will be along in the Gulf of Alaska in 1990. A summary of the tasks' research activities for the past year are presented below.

i) Bering Sea Groundfish Subtask

a) Crab and Groundfish Survey

A standard annual survey was conducted in the eastern Bering Sea in 1989 to assess the abundance and biological condition of crab and groundfish. The 1989 survey was the eleventh consecutive year in which a standard survey area, encompassing a major portion of the eastern Bering Sea continental shelf, has been sampled in this time series. The survey was performed about the chartered vessels *Alaska* and *Ocean Hope 3*. The two vessels sampled 400 stations over an area of about 465,000 km². A cooperating U.S.S.R. research vessel, the *Mys Babushkina*, also sampled 169 stations in this area. In addition to the collection of catch data in weight and numbers of each species at each station, 154,700 length measurements and 4,390 age structures were collected. Other studies carried out during the survey were (1) an examination of halibut and crab bycatch rates at inshore trawling areas, (2) side-by-side comparative fishing experiments between the U.S. vessels and between the U.S. and Soviet vessels, (3) tagging of Pacific cod and red king crab, (4) collection of 7,470 fish stomachs for food habit studies, and (5) collection of specimens and tissues from crab and fish for disease and other studies.

ii) Gulf of Alaska Groundfish Subtask

The Gulf of Alaska Groundfish Subtask conducts assessments of groundfish stocks in the Gulf of Alaska and the Aleutian Islands. During 1989, these field research activities included a bottom trawl survey of the central Gulf of Alaska, a domestic longline survey of the Gulf of Alaska and a cooperative Japan- U.S. longline survey of the Aleutian Islands, Bering Sea and Gulf of Alaska.

a) Bottom Trawl Survey of the Central Gulf of Alaska

A 55-day bottom trawl survey aboard the chartered fishing vessel F/V *Pelagos*, ending 26 October 1989, in the central Gulf of Alaska was conducted to assess the impact of the

Exxon Valdez oil spill on offshore groundfish stocks. One-hundred and eight stations were sampled between 147° and 154°W longitude on the southeast side of Kodiak Island and southward to 57°30'N latitude in Shelikof Strait at bottom depths ranging from 33-293 m. This was approximately one-third of the area surveyed during triennial surveys completed in 1984 and 1987, due to fewer available vessel days in 1989. Also, in previous triennial surveys, this area has been allocated between 260 and 320 stations. Because of significant time lost principally to transit and bad weather, only 108 of the planned 158 tows were attempted. Of these, 100 were judged to be successful and included in the data analysis. The unsuccessful tows were generally due to excessive gear damage.

Biomass was calculated for each species encountered during the survey and compared to the same areas and depths assessed during the 1987 triennial bottom trawl survey. Of the nine most abundant species encountered during the 1989 survey, six had higher biomass estimates than observed during 1987. Walleye pollock increased 131% to 825,904 t, arrowtooth flounder increased 98% to 839,528 t, Pacific halibut increased 27% to 309,570 t, flathead sole increased 69% to 164,586 t, and Dover sole increased 13% to 44,843 t. Species with apparent decreases in biomass included Pacific cod (-33% to 138,512 t), sablefish (-6% to 103,607 t, and rock sole (-38% to 46,356 t).

b) Domestic Longline Survey

The third annual U.S. longline survey of the upper continental slope and deep gullies of the Gulf of Alaska was conducted aboard the U.S. longliner *Ocean Prowler* from 26 June to 12 September 1989. This research was a cooperative effort between RACE and ABL.

The primary objective was to determine the relative abundance and size composition of slope-resident groundfish species: sablefish, shortspine thornyhead, and shortraker and roughey rockfish, and secondarily to determine the relative abundance and size compositions of other species such as Pacific cod, grenadiers, arrowtooth flounder, and Pacific halibut.

One hundred twenty-six longline sets were completed at 63 pre-established stations. Forty-seven of those stations were sampled at the same sites, distributed from the Islands of Four Mountains (long. 170°W) to Dixon Entrance, that have been fished annually since 1978 by the Japan-U.S. cooperative longline survey. Sixteen kilometers of groundline are set each

day, containing 7,200 hooks baited with squid. The U.S. sampling gear was identical to that used during the Japan-U.S. cooperative survey with respect to the number of hooks, bait, and length of each groundline, but differed in hook type, gangion length and thickness, and anchoring arrangement. Once again sampling was performed in deep gullies to assess the abundance and size composition of sablefish in those areas.

Previously, certain assumptions had been made in extrapolating CPUE's and size compositions from the upper slope stations to deep, large gullies that were not actually sampled. The results of this and the 1988 U.S. survey show that extrapolated relative population numbers and size compositions may not have been appropriate. Comparisons between the CPUE's realized by the U.S. and Japanese longline gears are being made to relate the two data series.

The domestic survey results were very similar to results of the 1989 Japan-U.S. cooperative longline survey in the Gulf of Alaska. Sablefish relative population numbers (RPN) on the upper continental slope decreased 18% from 1988-89, and this change was statistically significant. Most of the decrease was observed in the western and central areas of the Gulf of Alaska; the RPN remained about the same in the eastern areas. The possibly strong 1984 year class expected to recruit in 1989 was not apparent in the survey results, and there also was no evidence for later strong year classes.

c) Cooperative Japan-U.S. Longline Survey

The twelfth annual Japan-U.S. cooperative longline survey was conducted in the Aleutian Islands, Bering Sea and Gulf of Alaska from 17 May through 13 September 1989. U.S. participation in this research is a cooperative effort between RACE and ABL. Formerly (1978-88), the Japanese government's Fishery Agency of Japan was the Japanese agency responsible for the survey. In 1989, however, the survey was conducted by a private Japanese organization, the North Pacific Cooperative Fisheries of Japan, using the *Tsunemaru No. 31*, a commercial Japanese longline vessel. The vessel sampled 107 stations, setting 7,200 hooks (8.6 nmi. of groundline) at each station. The depths sampled by each set ranged between approximately 100 and 1,000 m.

The primary objective was to obtain indices of sablefish and Pacific cod abundance; assessment of other major catch components such as halibut, arrowtooth flounder, Greenland turbot, rockfish, thornyheads, and grenadiers; and tagging and collecting biological information from sablefish. Survey results showed that sablefish relative population number

(RPN) declined 17.5% in the Gulf of Alaska from 1988 to 1989, a decrease that was statistically significant. RPN, however, was still relatively high compared to the early years of the survey. Most of the decrease occurred in the Chirikof and Shumagin areas in the central and western Gulf of Alaska. There was no evidence of any strong year classes recruiting to the survey area.

iii) West Coast Groundfish Subtask

Four surveys were conducted off the Washington, Oregon, and California coasts by the AFSC in 1989. They included the fifth in a series of coastwide triennial groundfish surveys which extends back to 1977, a trap survey to obtain indices of sablefish relative abundance off Washington and Oregon, and two replications of a bottom trawl survey of the continental slope waters (100-700 fm) off central Oregon in cooperation with the NMFS Southwest Fisheries Science Center.

a) 1989 Triennial Survey of West Coast Groundfish Stocks

The fifth in a series of triennial comprehensive surveys of west coast continental shelf groundfish resources was conducted in July -September. The triennial groundfish survey series is designed to describe and monitor the distribution, abundance, and population biology of groundfish stocks off the US Pacific coast. The specific objectives of the 1989 survey included describing and assessing the demersal component of the Pacific whiting resource with concurrent bottom trawl and echo integration surveys; assessing the abundance of the pre-recruit component of sablefish, specifically those 1.5 years old, since survey estimates of this component have been consistent with estimates inferred from commercial catch levels; and continuing to monitor the status of other groundfish stocks. The 90 day bottom trawl survey was conducted aboard two chartered commercial trawlers and collected successful samples from 540 stations between Pt. Conception, California, to Nootka Sound, British Columbia, between the depths of 55 and 366 m (30 to 200 fm). Temperature and CTD profiles were collected at selected stations throughout the survey range to relate oceanographic conditions with the distribution of groundfish species. The Pacific whiting abundance estimate from the bottom trawl survey was approximately 350,000 t in U.S. waters of which 59% occurred in the INPFC Columbia area, 24% in the Monterey area, 11% in the Eureka area, 6% in the U.S. portion of the Vancouver area. Approximately 1,360 t of whiting was estimated for the northern portion of the Conception area that was surveyed. The bottom trawl survey estimate for the Canadian portion of the Vancouver INPFC

area (from the border north to 49°35'N lat.) was 22,765 t, about equivalent to what was found in the U.S. portion of that area. Although the population is still being sustained mostly by the 1980 and 1984 year classes, there was some indication of a moderately successful recruitment of the 1987 year class in the size composition of the survey catches.

b) Sablefish Abundance Indexing

The monitoring of sablefish relative abundance using standardized CPUE from trap sets has continued since 1979. Sampling is conducted on alternate years between the Washington-Oregon and California regions. In 1989, eight index sites off Washington and Oregon were sampled. Strings of 10 conical traps each were fished twice at each of six standard depths (275, 411, 549, 686, 823, and 960 m) and six additional deeper sets were made at selected sites. Catch rates were highest at the 411 and 549 m depths and mean lengths increased with depth. Catch rates for all 8 sites combined were approximately 14% and 68% lower than those from 1987 and 1985 surveys, respectively. In addition to information crucial to the assessment of sablefish stocks for the Pacific Fishery Management Council, 1,260 sablefish were tagged and released, continuing the Center's research on distribution and movement of this species.

c) 1989 NMFS AFSC/SWFC Cooperative Sablefish and Dover Sole Continental Slope Research

Two replicate surveys were completed in 1989 assessing the demersal fish and shellfish species of the upper continental slope (183-1,280 m) off central Oregon. These surveys replicated others which were completed in 1984 and 1988 examining the seasonal effects on maturity, distribution, abundance, and community structure and added late winter and early fall data sets to that collection. In February-March 1989, the NOAA R/V *David Starr Jordan* successfully collected information from 41 stations and in September the chartered trawler *Golden Fleece* completed successful sampling at 46 stations. Sablefish was an important catch component in all depth strata. Pacific whiting, Dover sole, arrowtooth flounder, and shortspine thornyhead were important in samples shallower than 550 m and were replaced in deeper samples by Pacific grenadier, longspine thornyhead, grooved tanner crab, and giant grenadier. Muscle tissue samples were collected from Dover sole by SWFC scientists for an investigation of water content and flesh quality. AFSC scientists will be reporting on the seasonal changes in community structure and species distribution and abundance.

Scientists from SWFC will focus on results of studies of sablefish and Dover sole reproductive biology and physiology.

(b) Recruitment Processes Task

This task has participated annually since 1986 in studies of the distribution and abundance of eggs and larvae from pollock spawning in Shelikof Strait as part of the joint AFSC-Pacific Marine Environmental Laboratory's Fisheries-Oceanography Coordinated Investigations (FOCI). The objective of FOCI is to investigate factors affecting survival of early life history stages (eggs and larvae) of pollock and thus influencing year class success. The task's efforts have concentrated on assessing starvation and relating their distribution to physical processes in the area.

From 1980 through 1987, ten ichthyoplankton surveys were conducted off Washington-Oregon-northern California. Results of each of these surveys have been reported in NWAFC Processed Reports. The results from all of these surveys are now being analyzed together to establish annual patterns of occurrence of fish eggs and larvae of the region, how these relate to local oceanography, and how they vary interannually.

A major emphasis of the task is to increase our ability to identify fish eggs and larvae collected. As a result, a major publication "A Laboratory Guide to Early Life History Stages of Northeast Pacific Fishes" was published in 1989. Research to establish early life history series through rearing and examination of plankton samples is continuing. Rockfishes (*Sebastes*) are a prime target of this research.

(c) Fisheries Resource Pathology Task

Between June 1, 1989 and May 30, 1990, the Fisheries Resource Pathology Task participated in the Eastern Bering Sea (EBS) and West Coast Groundfish Surveys. Several species of fish and crab were collected for continuing disease studies during this period and the analysis of samples collected during the previous year (1988-89) was also completed. That data and the preliminary results of 1989-90 tissue examination are presented below.

Bitter Crab Disease (BCD) is a fatal disease of *Chionoecetes bairdi* and *C. opilio* that is caused by a parasitic dinoflagellate of the genus *Hematodinium*. The disease was first reported in *bairdi* Tanner crab from Southeast Alaska and was subsequently discovered in 1987 in *opilio* Tanner crab from the EBS. Present evidence suggests that two different parasitic dinoflagellate species are involved because, 1) only *opilio* Tanner crab have been found infected in the EBS even though the distribution ranges of both Tanner crab species overlap, and 2) it appears that the two epizootic arose spontaneously and independent of each other. 1988-89 data from prepared blood smears and histopathology show that the disease is widely distributed in *opilio*

Tanner crab north of St. Matthew and in Norton Sound with infection prevalence ranging from 5-80% and 12-67%, respectively (Fig. 1). (The 100% prevalence values depict one infected crab of a sample size of one and are, therefore, not considered reliable.) BCD is less common south of St. Matthew and has not been confirmed in bairdi Tanner crab in the EBS.

1989-90 histopathology data indicate that the disease is still prevalent in *C. opilio* north of St. Matthew (Fig. 2). BCD was not found in *opilio* Tanner crab that were collected south of St. Matthew. The examination of 1500 blood smears that were prepared throughout the sampling area during this period have not been completed.

(d) Conservation Engineering Task

The Conservation Engineering Task continued its vital role of fabrication, reconstruction, and supply of survey fishing gear to a fleet of NOAA and chartered research vessels working from California to the Bering Sea. This included support of research by NMFS laboratories at Seattle, Kodiak, Auke Bay, Honolulu, Tiburon, and La Jolla.

Recent work of the research arm of the task has centered around determining the effects of variability in the operating dimensions of bottom trawls on survey results. Extensive use of acoustic trawl mensuration equipment both during the surveys and in experimental work has shown that the trawl's shape can vary considerably within and between stations in both width and height. In addition to their use for standardizing the area swept by specific survey trawl tows, these data have been analyzed to determine the best predictors of this variation and to evaluate its effects on survey results.

(e) Pelagic Resources Assessment Task

The primary activity of Pelagic Resource Assessment Task is the assessment of non-demersal fisheries resources using hydroacoustic/midwater trawl survey techniques. Associated activities include continuous development of the data collection system, its standardization, and further research into other factors affecting the accuracy and precision of survey results. The task conducted surveys of the Pacific whiting resource along the west coast in the summer of 1989 and a survey of walleye pollock in the Gulf of Alaska (mainly Shelikof Strait) in the late winter and early spring of 1990.

i) Assessment of Pacific Whiting along the West Coast

The fifth triennial hydroacoustic/midwater trawl survey of the West coast Pacific whiting resource (1977-1989) was completed during July 22 - August 4 and August 7-22, 1989. A series of parallel E - W transects spaced 10 nm apart were run between the 55 m (30 fm) and 365 m (200 fm) depth contours from Pt. Conception,

California to near the North end of Vancouver Island, British Columbia, Canada. The total estimated biomass of the pelagic portion of the stock is 1.27 million mt; 5 and 9 year old whiting (1984 and 1980 YC) represent 50 % of the total population and 79 % of the biomass, respectively. Final analysis of the survey data are currently in process and a final report will be completed by mid 1990.

ii) **Assessment of Gulf of Alaska Pollock**

A survey of walleye pollock abundance in the Gulf of Alaska was conducted between February 5 and April 2, 1990. During the first half of the period, the area from Cape Spencer to Unimak Pass and to the south of Kodiak Island was surveyed between the 100 and 500 fathom depth contours. Extra effort was expended in areas where the commercial fleet has reported pollock in harvestable quantities in previous years. These areas included Prince William Sound, Marmot Bay, Chiniak Bay, Barnabus Canyon, areas adjacent to Chirikof Island, and Sanak Bank. No extensive pollock aggregations were encountered in any of these areas but some moderate concentrations were observed to the west of Prince William Sound, in Amatuli Canyon, Marmot Bay, and in Chiniak Bay. During the latter half of the survey period two days were spent resurveying the area South of Chirikof Island; the remainder of the time was expended in Shelikof Strait where two complete survey passes plus some concentrated effort on spawning concentrations of pollock was accomplished. Immature pollock were observed in lower Shelikof Strait during both passes and spawning adult pollock were encountered in the central Strait, especially towards the west side. Lesser concentrations, mostly a mixture of non-spawning adult and juvenile fish were observed toward the east side of the strait, adjacent to the spawning concentration.

(2) **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.

(a) 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 1989, the Observer Program deployed 163 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 8,700 days sampling in the Bering Sea, the Gulf of Alaska, and in waters off Washington, Oregon, and California. Observers covered 95% of the foreign and joint venture fishing effort. Coverage was 94% in the Bering Sea-Aleutian region and 97% off the Washington, Oregon, and California coasts. There was no joint venture or foreign fishing in the Gulf of Alaska in 1989.

Also in 1989, the Program trained and deployed 35 observers to domestic vessels fishing off Alaska. These observers were funded through a variety of sources including: funding by the domestic fishing industry, federal funding for implementation of the 1988 amendments to the Marine Mammal Protection Act and funding from the North Pacific Fishery Management Council for the completion of their pilot domestic observer program. The Program was responsible for defining the sampling duties and data collection methods used by observers, training of the observers prior to deployment, debriefing of observers upon their return, and editing and managing the resulting data. The work 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.

(b) Age and Growth Task

The Age and Growth Task of the REFM Division continues to serve as the Alaska Fisheries Science Center's ageing unit for groundfish species. The task consists of a biometrician, technician, and 10 age readers (3 positions are currently empty). Ages are usually determined from otoliths, scales or finrays.

Data provided by the task are used in stock assessment work which contributes to the estimation of the allowable catch of many commercially important groundfish species. These include species such as walleye pollock, Pacific whiting, Pacific cod, Pacific Ocean perch,

northern rockfish, dusky rockfish, Atka mackerel, yellowfin sole, and rock sole.

Recent research on Pacific cod (Kimura and Lyons, in press) concluded that otoliths, with scales as backups for younger fish, are the best structures for ageing Pacific cod in the Bering Sea. Because of the inherent difficulty of this species, production ageing is proceeding with caution.

Validation research is currently centered on sablefish. In 1988, the Auke Bay Laboratory released 5,808 sablefish with OTC marks. So far 95 tags have been recovered with 37 pairs of otoliths. The most valuable recoveries, from the age determination standpoint, will of course come later.

We now have a graduate student working on a thesis that will attempt to validate sablefish ages using the radioisotopes Pb-210 and Ra-226. This work is currently in its early stage.

(c) Socioeconomic Task

During 1989, 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, the revision of the West Coast groundfish plan, and a comprehensive data collection program for the domestic groundfish fisheries off Alaska.

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, and contributed to an effort by NMFS economists to develop guidelines in valuing commercial and recreational fisheries.

The reports and publications presented the results of research concerning the development of bioeconomic models for pollock, fishery product exports from the Pacific Northwest and Alaska, catch and revenue characteristics of vessels harvesting sablefish off the Pacific Coast and other West Coast groundfish, market analysis for sablefish and halibut, and 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.

(d) Resource Ecology and Ecosystems Modeling Task

The Food Habits Program within the Resource Ecology and Ecosystem Modeling Task continued regular monthly observer training for collection of food habits information on key fish predators in the North Pacific. Program personnel and fishery observers collected fish stomach samples in the eastern Bering Sea and the West coast. Approximately 8700 stomachs were collected in the Bering Sea and 3400 were collected off the West coast. Shipboard scans of fish stomach contents were performed on 1800 fish (primarily walleye pollock) in the eastern Bering Sea and about 1700 Pacific hake off the west coast. Over 6500 stomachs were examined in the laboratory. We initiated a three-year plan to study the food habits of Pacific halibut in the Bering Sea and we doubled our summer coverage of the Bering Sea area.

Primary fish species being studied in the Bering Sea include: walleye pollock, Pacific cod, yellowfin sole, flathead sole, rock sole, Alaska plaice, and Pacific halibut. Fish sampled off the west coast were Pacific hake, Dover sole, *Sebastes* spp., arrowtooth flounder, and sablefish. The program provided food habits information and analysis to others. For example, we examined the possible dietary origin of odors in pollock flesh and we provided information about groundfish and crab trophic interactions.

A videotape of the stomach sampling process was produced by the group and copies were given to instructors at the University of Washington. Student volunteers from Garfield High School interned in the lab and learned about basic taxonomy and fish food habits. Research conducted this year included a statistical analysis of pollock stomach weight variability and flathead sole food habits. Our prey reference collection was expanded and an analysis of gill raker morphology was performed to improve our level of identification of prey. Papers were published on interannual variability in cod predation on crab, walleye pollock and fur seal food web interactions, and interannual differences in walleye pollock cannibalism. Research emphasis continues to be on interannual changes in predation that might provide insight into changes in year class strength or geographic distribution of prey that are of commercial importance.

(e) Status of Stocks and Multispecies Assessments Task

The Status of Stocks and Multispecies Assessments Tasks are responsible for conducting studies which will enhance fishery manager's abilities to manage marine fishery resources properly. Scientists involved in these tasks assist in preparation of stock assessment documents for groundfish in the three management regions (BSA, GOA, and WOC), and they frequently provide management support in an official capacity through membership in regional groundfish management teams.

i) Bering Sea and Gulf of Alaska

During the past year, scientists in the Bering Sea and Gulf of Alaska sub-task analyzed a number of proposed changes to the Groundfish Fishery Management Plans for the Bering Sea/Aleutians (BSAI) and the Gulf of Alaska (GOA). Amendment proposals analyzed included: 1) Revision of bycatch management measures in the BSAI; 2) Development of overfishing definitions for the GOA and the BSAI; 3) Establishment of procedures for interim TAC specifications in the GOA and BSAI; 4) Modification of the authorization language for demersal shelf rockfish management in the GOA; 5) Development of herring bycatch measures in the BSAI; 6) Change in fishing gear restrictions in the GOA and BSAI; 7) Expansion of halibut bycatch management measures in the GOA.

The sub-task is also coordinating research designed to identify the stock structure of pollock found in the Bering Sea donut hole. This involves 1) inquires in the areas of genetic structure, morphometrics, meristics, age composition, and size-at-age, and 2) tagging studies.

ii) West Coast

The West Coast groundfish sub-task has a major role in estimating the productivity of groundfish stocks managed by the Pacific Fishery Management Council. The primary focus is preparation of annual status of stock reports for Pacific whiting and sablefish. In addition, the sub-task provides short-term technical support to Pacific Coast fishery managers and conducts research designed to improve the accuracy of the annual stock assessments.

In 1989 the sub-task developed a generalized version of the synthesis model for assessment of exploited fish stocks. This model shares some characteristics with other catch-at-age analysis techniques but has a greater ability to incorporate a variety of auxiliary information. The model simulates an exploited stock, derives expected values for the available data (fishery age or size composition, survey age or size composition, survey abundance, fishery effort), evaluates the deviations between the observations and expected values, and iteratively adjusts the parameters of the simulation model until the likelihood of the model's fit is maximized. This generalized model was presented at the meeting of the International North Pacific Fisheries Commission, and was used in 1989 for assessment of sablefish, Pacific whiting, and widow rockfish on the west coast, and pollock in the Gulf of Alaska.

The Pacific whiting stock assessment was based on an age-structured version of the synthesis model, and contained a new

evaluation of the optimum level of fishing mortality. Geographic and temporal changes in the age composition of the resource were described in order to better understand growth and migration. Environmental influences on growth were investigated in an ongoing study designed to elucidate the cause of a declining trend in the body size of Pacific whiting. These studies will be published in 1990 and will contribute to current research on the bi-national distribution of available yield.

The assessment of sablefish was conducted in collaboration with the Southwest Fisheries Center, and used the size-structured version of the stock synthesis model. New work on sablefish in 1989 emphasized the consequences of a change in the criteria for age determination.

(f) Auke Bay Laboratory

The Auke Bay Laboratory (ABL), located near Juneau, Alaska, is a major division of the NMFS Alaska Fisheries Science Center (AFSC). The laboratory supports a diversity of research projects on the fishery resources of Alaska, including studies relating to U.S.-Canada Salmon Treaty issues, habitat investigations, and marine fisheries assessment. ABL's groundfish task (part of the laboratory's marine fisheries assessment program) since 1982 has focused its efforts on research and assessment of sablefish and rockfish in the Gulf of Alaska. Presently, the groundfish task is staffed by 10 permanent and 3 temporary biologists, although some of the staff are sometimes assigned to other projects within the laboratory. Past resource assessment activities of the groundfish task have included:

1. conducting an annual trap index survey for sablefish off southeastern Alaska (1982-86).
2. participating in and analyzing results of the annual Japan-U.S. cooperative longline survey for sablefish in the Gulf of Alaska (1982-89).
3. conducting triennial trawl surveys of the eastern Gulf of Alaska from Cape St. Elias to Dixon Entrance (1984 and 1987).
4. initiating and conducting an annual domestic longline survey for sablefish in the Gulf of Alaska (1987-89).

In all these assessment projects, ABL has worked closely with the AFSC's Resource Assessment and Conservation Engineering Division (RACE); in particular, the domestic longline survey is a joint project between ABL and RACE. Since 1985, ABL's groundfish staff has also provided annual status of stock information for sablefish and rockfish in the Gulf of Alaska, together with recommendations of acceptable biological catch, to the North Pacific Fishery Management Council. In

these Council-related activities, ABL has worked in cooperation with the AFSC's Resource Ecology and Fishery Management Division (REFM).

ABL's groundfish task has also conducted a number of ancillary research projects in support of its assessment activities, including tagging studies, gear experiments, and studies on juvenile sablefish.

The past year ABL continued participation in the two longline surveys of the Gulf of Alaska (Japan-U.S. and domestic). ABL also conducted a research cruise using the NOAA R/V *Townsend Cromwell* in Aug-Oct 1989 in waters of southeastern Alaska. The two studies completed on the cruise included a trawl/submersible study of slope rockfish and a sablefish population experiment. In addition, members of the groundfish staff conducted trawl surveys of Prince William Sound to document possible effects of the *Exxon Valdez* oil spill on groundfish species.

i) **Trawl/submersible study**

Biomass estimates of slope rockfish in the Gulf of Alaska are derived from bottom trawl surveys. The validity of the estimates, however, is subject to much debate. To test the accuracy of these estimates, in August 1989, the NOAA R/V *Townsend Cromwell* was used in conjunction with a Delta two-man submersible in the Gulf of Alaska south of Sitka. Densities of rockfish (numbers per unit area) were determined at specific sites using two methods: standard area-swept trawling by the *Townsend Cromwell*, and visual transect counts from the submersible. The submersible was also used to observe rockfish spatial distributions over untrawlable vs. trawlable substrate. Nineteen submersible dives and 11 bottom trawl hauls were made during the study. Preliminary results indicate that the bottom trawls captured almost twice the number of Pacific ocean perch per area than were observed from the submersible. This suggests that the trawl may have been "herding" the fish. The submersible observations showed more rockfish were present in rocky, untrawlable areas than in trawlable areas, but few adult Pacific ocean perch were seen in the rocky areas.

ii) **Population/catchability coefficient study**

ABL and the Alaska Department of Fish and Game (ADF&G) conducted a cooperative study of sablefish in Chatham Strait, southeastern Alaska, in Aug-Oct 1989. Objectives of the study were twofold: 1) estimate the population size of sablefish in a study area within Chatham Strait; and 2) estimate the catchability coefficient (q) of sablefish caught on the longline gear used. In the study, the NOAA R/V *Townsend Cromwell* was used to fish 33 longline stations prior to the Sept 23-24 commercial fishery for sablefish in Chatham Strait, and 22 stations after the fishery. For

the population experiment, 8,882 sablefish were tagged and released from the *Cromwell* before the commercial fishery; 75 of these tagged fish were recovered in the commercial fishery. This low recovery rate suggests that many of the tagged fish may not have recovered from the shock of tagging soon enough to be recaptured in the fishery. The *Cromwell's* average catch rate for sablefish declined 18.3% after the commercial fishery, which indicates that a substantial percentage of the sablefish population in Chatham Strait was removed by the fishery. An analysis of these catch rates before and after the fishery will be used to estimate the catchability coefficient of the longline gear used in the study.

iii) Tag analysis

A tag analysis of sablefish movements in the northeastern Pacific Ocean was completed by ABL. The analysis was based on tagged fish released in the Gulf of Alaska, Aleutian Islands, and eastern Bering Sea from 1979 to 1987 by the Japan-U.S. cooperative longline survey, and on recoveries of these fish through 1987. A Markov model was used to describe the movement dynamics of tagged sablefish between management areas of the North Pacific Fishery Management Council (NPFMC). The model included terms for natural and fishing mortality, tag reporting rates, and movement probabilities between NPFMC areas. Parameters of the model were estimated with maximum likelihood. The model indicated that 19-71% of the small (<57 cm FL), 25-72% of the medium (57-66 cm FL), and 28-85% of the large (>66 cm FL) sablefish in a given area move to another area in a year. Large sablefish mostly moved eastward along the continental slope, and small sablefish mostly moved westward. Movement parameters were robust to perturbations in input values of mortality and reporting rates, although some estimates for large sablefish were imprecise. The results indicate that movement plays an important role in determining the amount of sablefish available for harvest in an area. To understand the interactions among the fisheries in different areas, movement of fish between areas should be incorporated into a size- or age-structured stock assessment.

iv) Juvenile sablefish studies

ABL has conducted annual research on the abundance, distribution, and migration of juvenile sablefish (<50 cm fork length) in waters of southeastern Alaska since 1985. During this period, approximately 70 sites have been surveyed for juvenile sablefish, using hand-jigs, pots, longlines, and trawls. Hand-jigs have proven to be the most successful method for sampling these fish. Except for 1985, when juvenile sablefish were abundant at many locations, the fish have been consistently found at only one site: St. John Baptist Bay on the northwest coast of Baranof Island, north of

Sitka. Preliminary data indicate that 0+ fish (17-20 cm fork length) arrive during September and reside in the bay for about 1 year, with some remaining almost two years. The reason juvenile sablefish have been found in this bay, and not others, is unknown at this time. Until other index sites are located, St. John Baptist Bay will be the focal point of ABL's efforts to monitor juvenile sablefish.

An important aspect of these juvenile sablefish studies has been an ongoing program to tag and release the fish to determine migrational patterns. As of Dec 1989, 19,379 juvenile sablefish have been tagged and released in waters of southeastern Alaska. Over 11,000 of these were tagged and released at St. John Baptist Bay; most of the rest were tagged at various locations in 1985. Presently, 135 of the tagged fish have been recovered, mostly from the commercial longline fishery. An analysis of these recoveries is in progress.

v) **Sablefish tag recovery program**

Since 1983, ABL has tagged and released sablefish for migration, population, and age studies in the eastern Gulf of Alaska. Releases currently total 78,721, broken down as follows: 21,698 in the Japan-U.S. cooperative longline survey, 22,962 in various localities of southeastern Alaska during ABL research cruises, 19,379 juvenile sablefish, 5,800 oxytetracycline-injected fish for age validation, and 8,882 in a cooperative study with the Alaska Department of Fish and Game in Chatham Strait. As of April 1990, 3,321 of these tags have been recovered. In 1990, the AFSC (including both ABL and RACE) instituted a new tag reward system to provide fishermen with additional incentives for returning tags. Fishermen are now given a choice of rewards, including caps, pins, \$5.00 (the old reward), or a chance for an annual lottery drawing.

(g) **Southwest Fisheries Center**

Groundfish-related research is conducted by three major components of the NMFS Southwest Fisheries Center (SWFC): 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.

i) **Coastal Division (La Jolla)**

The Coastal Fisheries Resources Division has been involved in 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 (*Sebastes* sp.) 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 a stock assessment for shortspine thornyhead in the Eureka area (INPFC areas 1C and 2A). An analysis of national and international economic factors that affect the fishery for thornyheads is also underway.

The Division in conjunction with the Tiburon Laboratory (Groundfish Communities Investigation) and the Monterey Bay Aquarium Research Institute (MBARI) is developing new methods for surveying demersal fishes using Remotely Operated Vehicles (ROVs). The emphasis is on slope species. Preliminary work has involved comparing line transects with trawl swept area estimates. A joint SWFC-Tiburon cruise with MBARI is planned for this summer pending availability of the Navy's SeaCliff research submersible.

A manuscript on a method for estimating biomass of Dover sole in central California using the Daily Egg Production Method was completed. The work is based on ichthyoplankton and trawling surveys taken in 1987 and 1988. It documents new methods, and indicates that Dover sole biomass can be estimated using these new methods. Costs relative to precision and bias are discussed. A manuscript on the water content of Dover sole and how it changes with depth, fish size and age will be published in CalCOFI Report Vol. 31 in October 1990. One on the reproduction and fecundity of sablefish was published in the 1989 CalCOFI Report Vol. 30. The data will be used to assist in the estimation of sablefish biomass using ichthyoplankton methods.

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 short-term economic effects of fishery regulations.

NMFS' Marine Recreational Fisheries Statistics Survey is supplemented by special economic surveys organized by CFRD economists. The Bay Area Sportfish Economic Study, documented in Thomson and Huppert's Technical Memorandum NOAA-TM-NMFS-SWFC-78 (August 1987, "Results of the Bay Area sportfish economic study, BASES"), provides substantial information on central California fishing effort, travel costs, species targeting, catches and angler expenditures for groundfish and other fishing trips during 1985-1986. A similar economic survey of southern California marine anglers was completed in 1989 and analysis of the data is currently underway.

ii) 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 now being initiated addresses the effect of bottom-trapped hydrodynamic structures in patterning the feeding and reproductive habitats of west coast groundfish.

iii) 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, principally in stock assessments and developing management alternatives.

The recruitment work aims to detect differences in relative strength of rockfish year-classes prior to their entry into the fishery. 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. One recently published paper evaluates the statistical power of data from the recruitment surveys for detecting below or above average year classes. Manuscripts are under review on birthdate distributions, growth and diet of early stages of rockfish.

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 widow rockfish, shortbelly rockfish and sablefish are in large part products of this work, as will be an assessment of bocaccio now being prepared.

Two projects now underway intend to improve methods of stock assessment. The first, an effort to model both the widow rockfish fishery and management process, is being used to evaluate the accuracy and precision of management recommendations based on different types of catch-at-age analysis. Estimates of abundance and fishing mortality made by the simulated fishery manager are compared to the actual levels for the known underlying population. The second project analyzes historical trends in length distribution of commercially important California rockfish species to determine

the present status of their populations. These analyses will supplement analyses of age distribution for chilipepper, bocaccio, widow and yellowtail rockfishes, but where age data are lacking, as for the splitnose rockfish, they will be the primary means of assessing present status.

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 Fisheries 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. 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 and other data to determine environmental factors relating to condition and reproductive variability and to place species populations in the context of their habits.

Measurements made of adult yellowtail rockfish captured at Cordell Bank during the 1989-1990 spawning year showed reduced condition and reproduction when compared to previous years (e.g., lower fish, liver and gonad weight at age, less mesenteric fat, higher parasite and disease prevalence, delayed maturation and spawning, lower effective fecundity).

There was a 10% prevalence of melanophore hyperplasia (70 fish/668 sampled) in yellowtail rockfish at Cordell Bank. The prevalence of neoplastic melanophoromas was 1.5%. The possible causal mechanisms of this condition will be studied in cooperation with hisopathologists at the U. of California.

Samples from more northern populations, closer to the center of yellowtail abundance, did not exhibit reduced condition or reproduction during the 1989-1990 spawning year. In addition, we have not observed chromatophore hyperplasia or neoplasia in fish sampled from populations further north.

4. North Pacific Fishery Management Council (NPFMC)

Dr. Weeks reviewed NPFMC actions on groundfish during 1989. The Council's management measures are usually general to the conduct of mixed species groundfish fisheries off Alaska (3 - 200 miles), and are rarely species specific. The Council works closely with, and is supported by the research and assessment programs of, the Alaska Fisheries Science Center of the National Marine Fisheries Service.

The Bering Sea/Aleutian Islands groundfish management plan was amended twice since the last meeting of the subcommittee. Amendment 12a established crab and halibut bycatch caps which are apportioned among domestic and joint venture flatfish and "other" fisheries. Attainment of a cap by a given fishery results in closure of specific areas to that fishery for the remainder of the year. This amendment remains in force until December 31, 1990. Amendment 13 (1) implemented an observer program and enhanced data gathering and reporting requirements for domestic groundfishing vessels, (2) established a framework to revise fishing seasons by regulatory amendment, (3) clarified the Secretary of Commerce's authority to split or combine species groups within the target species category, (4) allocated sablefish between trawl and fixed gear fisheries, and (5) established twelve mile closed zones around the Walrus Islands in Bristol Bay.

The Gulf of Alaska plan was amended by Amendment 18 which shares the first three elements of the amendment to the Bering Sea/Aleutian Islands plan. In addition, this amendment created a Shelikof management district for pollock in the Central Gulf of Alaska, revised the time/area closures around Kodiak Island to protect king crab stocks for three years, and established fixed halibut bycatch limits for fixed gear and trawl gear fisheries for one year.

Several regulatory amendments also came into effect during 1989. New definitions for directed fishing, requirements for owner identification on longline gear, and provisions to reopen prematurely closed fisheries and to set season openings and closures at noon local time are applicable to both the Bering Sea/Aleutian Islands and Gulf of Alaska management areas. In addition, a provision for a directed fishery to be closed prior to attainment of a total catch limit, thereby providing for retainable bycatch in other groundfish fisheries, was established for the Gulf of Alaska.

Critical issues facing the Council as it enters the 1990s include overcapacity in the groundfish fisheries, allocation between on-shore and offshore processors, and prohibited species bycatch management. Each of these topics will be addressed during 1990. In particular, the Council is working toward the development of incentives for groundfish fisheries to reduce bycatch rates of prohibited species (halibut, crab, herring and salmon), and is expected to decide whether to adopt an IFQ management system for the sablefish longline fishery.

5. Alaska Department of Fish and Game

a. Program Description

During 1989 the Southeast Region commercial fisheries Groundfish Project was staffed with the project leader and a port sampler in Petersburg, an assistant project leader, a port sampler, and a resource assessment coordinator in Sitka, a full-time port sampler in Ketchikan, and a part-time sampler in Yakutat. In addition, an age reader in Kodiak and clerical staff in Sitka and Petersburg were 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 sablefish and rockfish; skipper interview and logbook collection and data entry; and biological studies of important commercial species. Three resource assessment surveys were completed during the year. These are described in more detail in the section regarding the individual species involved. Regulation development and review and information dissemination also require considerable staff time.

During 1989 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 and closure of that fishery when the harvest objective was reached. Central Region groundfish staff also participated in the monitoring effort required in the wake of the March 24 *Exxon Valdez* oil spill.

In the Westward Region a Groundfish Coordinator was responsible for the oversight of observer programs funded from general fund money and from several observer contracts outside the department. Two staff biologists and a total of thirteen observers were employed during portions of the year. The accumulated data was analyzed in Kodiak and the summarized results were made available to the North Pacific Fisheries Management Council, the International Pacific Halibut Commission, and to other agencies. The Groundfish Coordinator served as a member of the Gulf of Alaska and the Bering Sea/Aleutian Island Groundfish Plan Teams. Westward Region biologists also participated in an annual crab trawl assessment survey in the Kodiak and Alaska Peninsula area to determine catch rates of important commercial groundfish species.

ADF&G personnel continued to enter fish tickets from the Exclusive Economic Zone (EEZ) off Alaska through 1989 as the result of a renewed cooperative agreement with NMFS to accomplish that task. Fish tickets from all groundfish fisheries in federal waters were collected, edited, and entered on micro computers in four coastal communities. A programmer analyst working in the NMFS Regional Office in Juneau was responsible for the master database and for providing summary groundfish catch information to NMFS, ADF&G and PACFin.

b. Groundfish Management

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 if resource problems are detected. The department also cooperates with the National Marine Fisheries Service (NMFS) for opening and closing fisheries which are under joint jurisdiction.

Fish tickets are required by regulation for each commercial landing 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, batched, and entered on microcomputers in Petersburg, Sitka, 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.

c. Groundfish research

State of Alaska groundfish research is currently divided into two major components in Southeast Alaska. These are port sampling/ skipper interviews and resource assessment.

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 length frequency of the landed catch by management area. It also provides an opportunity to collect age structures and sex and reproductive status from round deliveries of rockfish. During 1989 port sampling was conducted in Sitka, Ketchikan, and Petersburg.

Skipper interviews are conducted for landings of the key groundfish species. Interview effort concentrated on the state managed sablefish and rockfish fisheries during 1989. This program is designed to provide detailed location and effort information which, when coupled with the fish ticket data, provides an estimate of CPUE by management area for the landed catch. During the Northern area sablefish fishery the effort was expanded with the cooperation of NMFS to include virtually all major ports including Seattle to enhance our tag recovery efforts.

Catches of all groundfish species are monitored routinely as part of our stock assessment programs for other species. That information provides an estimate of population trends for some commercially important groundfish species. 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.

The state on-board observer program was operated primarily out of Kodiak during 1989. The primary objective of this program was to determine the bycatch rates of prohibited species during the trawl and longline fisheries for groundfish. Preliminary results indicated much higher rates of bycatch, particularly halibut, in the domestic fisheries than was previously estimated from the foreign and joint venture data.

6. Washington Department of Fisheries

The Washington Department of Fisheries Marine Fish Program is responsible for research, management and enhancement of non-anadromous finfish resources. There are currently three divisions actively engaged in groundfish management.

a. Coastal Marine Fish Management.

The Coastal Marine Fish Management 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 Gulf of Alaska Plan Team 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.

The central focus of the Division is effective management of the coastal groundfish stocks. This 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 Marine Fish Program of the Washington Department of Fisheries defines Puget Sound as those waters east of the Sekiu River including the Strait of Juan de Fuca. The Puget Sound Marine Fish Division is responsible for the management of the marine fish resource in this area. The Division is organized into three units: Baitfish, Marine Fish Assessment, and Marine Fish Monitoring and Operations.

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 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 Marine Fish Divisions. Areas of work covered by Technical Services include: hydroacoustics, age determination, and computer data processing.

The Hydroacoustics Unit conducts biomass surveys for marine fish stock assessment from our 37-foot boat, M/V Pasquale, with specialized on-board hydroacoustic equipment. Species and areas surveyed on an ongoing 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 examinations 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. The unit is presently working on consolidating the Trawl Logbook and Biological Sample Databases on our in-house computer system, and streamlining our data storage and retrieval capabilities.

7. Oregon Department of Fish and Wildlife

Oregon's contribution to this agenda item was submitted on a species by species basis. No general overview of the department's program was submitted.

8. California Department of Fish & Game

The California Department of Fish and Game's did not submit a report for 1989.

B. By Species

1. Pacific Cod

a. Canada

Mr. Saunders, presented the Canadian report on Pacific Cod.

(1) Research programs

DFO completed a research cruise (Jan-Feb 1989) and port sampling series of Pacific cod ovaries for histological sections in our study of maturity stages in relation to oocyte development. After spawning, recovering fish have a single mode of oocytes 2- 100 microns in diameter. By summer, some of these oocytes have increased in size so that a second mode is evident. This mode increases in size until February, when eggs are released at 1.0-1.1 mm.

In further analysis, we are comparing development rates and fecundity from the northern and southern stocks of the west coast. Another fecundity sample was collected from the southern area in January 1990. It has been processed and results will be incorporated with those from earlier collections.

A report was completed and published providing a guide to the ovarian histology of Pacific cod. This report includes color photographs giving examples of the exterior appearance of the ovary at various stages of development as well as photomicrographs of ovary sections at each stage and typical diameter-frequency histograms.

Another report was completed describing the timing of spawning of Pacific cod in the major regions of B.C. This utilized a maximum likelihood technique to describe the timing of spawning activity. Dates of 50% completion of spawning for females by area were: March 4 for Strait of Georgia, March 9 for the west coast of Vancouver Island, February 22 for southern Hecate Strait and March 17 for northern Hecate Strait.

(2) Stock assessments

We developed a new model for estimation of potential yields of the Hecate Strait stock of Pacific cod. The model is dependent on recruitment estimates from length and age frequency samples, and a recruitment response-surface estimator that incorporates parent stock-size and northward transport indices. Analysis has shown that net recruitment maximizes at a parent stock size of about 4000 t. The 1990 potential yield from the stock is estimated as 3800 t. The historic high catches, 2 to 3 years after the production of a large year-class, have been about 10,000 t (eg. 1987). The potential yield in 1988 was 19,000 t, of which only 6200 t were taken (rounded figures). The rapid decline in stock biomass and potential yield is due to the high rate of annual natural mortality ($M = 0.6$).

(3) Management and regulations

The provisional quota of 3800 t for 1990 was not implemented when it was discovered that the 1989 year-class was very strong. 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.

b. National Marine Fisheries Service - AFSC

Mr. Wilkins reported on NMFS Pacific cod studies.

Biomass of Pacific cod (*Gadus macrocephalus*) in the eastern Bering Sea and Aleutian Islands remained relatively high during 1989, when a catch of 168,919 t was taken. Although down slightly from the record catch of 197,892 t taken in 1988, the 1989 catch was still the second highest in history.

While stock biomass appears to remain stable, a cause for concern exists in the 1989 estimate of stock numbers, which showed a decline of 34% from the 1988 estimate (509,336,000 to 338,264,000 fish). This result is difficult to explain, and may not be representative of the actual population. However, if it is accurate, it may foreshadow a major decline in abundance.

The model constructed in 1988 was used again to generate alternative estimates of the 1990 ABC for Pacific cod. In addition to the usual harvest strategies corresponding to F_{MSY} , $F_{0.1}$, F_{MAX} , and $F=M$, a new harvest strategy was provided in the 1989 assessment. This new strategy attempts to account for uncertainty in the stock-recruitment relationship by deriving the fishing mortality rate that maximizes the expected value of the logarithm of sustainable yield (F_{MELSY}). The F_{MELSY} strategy resulted in a fishing mortality rate of 0.104, compared to the F_{MSY} rate of 0.182.

Because of concern over the dramatic decline in stock numbers observed during the 1989 survey, the plan team initially recommended that ABC for this stock be calculated using the F_{MELSY} strategy. However, the North Pacific Fishery Management Council's Scientific and Statistical Committee rejected this recommendation, which was then withdrawn. Instead, ABC was calculated using the F_{MSY} rate. This gave a 1990 ABC of 417,000 t (ABC is usually much higher than actual catch for this stock because a 2 million ton cap constrains the sum of groundfish TACs in the eastern Bering Sea and Aleutian Islands).

The Gulf of Alaska stock yielded a catch of 41,783 t in 1989, surpassing the previous record of 36,401 t set in 1983. The stock reduction analysis for this management unit was recalibrated in 1989, using a correction factor that allows the model to exhibit continuous growth and continuous harvest simultaneously. This resulted in a new F_{MSY} estimate of 0.124 (down from the previous estimate of 0.143). Using this estimate, the plan team recommended a 1990 ABC of 60,600 t. However, the North Pacific Fishery Management Council and its Scientific and Statistical Committee rejected this recommendation, and ABC was set at 90,000 t (ABC is usually much higher than actual catch for this stock because a halibut bycatch cap closes the fishery before the TAC is reached).

Dr. Methot reported that most of the P. cod work is conducted by Grant Thompson. He has recommended a reduced exploitation rate for cod in the Bering Sea and a reduced ABC in the Gulf of Alaska. The reduced ABC in the GoA was rejected by the North Pacific Fisheries Management Council.

c. Alaska Department of Fish and Game

Mr. Bracken reported on ADF&G Pacific cod studies.

ADF&G does not currently conduct research or stock assessment programs directed specifically at Pacific cod. There are no harvest restrictions or seasons in effect in territorial waters of the state. With the exception of the internal waters of Southeast Alaska, the state manages the P. cod fisheries in conjunction with the federal government. All openings, closures, and harvest levels in offshore waters are set in accordance to federal regulations. Catch rates and limited biological information is gathered on P. Cod during stock assessment surveys for other species.

d. Washington Department of Fisheries

Mr. Jagielo presented a brief synopsis of Pacific cod work conducted by WDF.

The population in central and southern Puget Sound is at a low level. Sport catch indices indicate a decline in the stock size. The recreational daily bag limit was reduced to 10 fish in 1989, and further reductions are under consideration. In the Gulf of Bellingham, commercial trawl fishery catch rates were stable in 1989.

e. Oregon Department of Fish and Game

Mr. Demory stated that Oregon had nothing to report.

f. California Department of Fish and Game

There was no report from CDF&G.

2. Rockfish

It was decided to discuss rockfish research by species or species group rather than by agency as was done in the past. Therefore the report is separated into yellowtail rockfish, slope rockfish, and nearshore rockfish as major sections with a full presentation of each agency's contribution under each of those sections.

a. Yellowtail Rockfish

(1) Canada

Dr. Richards reported that most of Canada's research on yellowtail rockfish is reported in the Yellowtail Working Group report. Rick Stanley is conducting research on stock separation using parasites as a natural tag.

The first catch-at-age analysis for *S. flavidus* stocks in B.C. waters was completed, using Methot's stock synthesis model and the jointly-developed U.S-Canada database. Model estimates are regarded cautiously due to the lack of a reliable independent index of stock status, which could be used to tune the model. The general conclusions of this analysis are that the Queen

Charlotte Sound stock biomass underwent a gradual decline over the 1967-1983 period, but has increased to pre-fishing levels in the recent years. However, since the most recent years of recruitment are the most poorly estimated in such analyses, the author endorsed the general conclusion that stock status was similar to pre-fishing abundance but did not place much confidence in the absolute level of biomass estimated. Biologists from the two countries are continuing their cooperative assessment of the Vancouver Area stock.

(2) National Marine Fisheries Service - AFSC

Mr. Wilkins reported that some meristic work was being conducted in conjunction with the West Coast Triennial Survey. A biomass estimate is also being calculated as a result of that work.

Dr. Methot stated that anecdotal information based on bycatch rates in the "hake" fishery suggests that stocks are declining.

Dr. Lenarz added that fish are in generally poorer condition in the southern end of the range in California waters because of parasites which result in melanoma blotches.

(3) Alaska Department of Fish & Game

Ms. O'Connell reported briefly on the long-range recoveries from tagging studies conducted by the University of Alaska - Juneau. Fish tagged off Southeast Alaska have been recovered from as far away as Washington.

(4) Washington Department of Fisheries

Mr. Jagielo reported that a stock assessment was completed in 1989 for the Vancouver and Columbia INPFC areas. A cooperative assessment is currently underway with Canada and is reported in the TSC yellowtail rockfish working group report.

Neither ODF&W or CDF&G contributed to this section. A general discussion of yellowtail research and management ensued.

Dr. Richards reported that Canadian scientists feel that yellowtail rockfish in the Vancouver INPFC Area are all part of a single stock rather than discreet stocks. Because of that, she stated that the catch cannot be appropriately allocated according to the available biomass in each national zone because of movement between zones. Canada is waiting to review the working group report and its management recommendations which is expected to be available later this summer. Mr. Jack Tagart and Mr. Rick Stanley are working independently on this issue, but will co-author a report with management recommendations for the trans-boundary portion of the stock.

b. Slope Rockfish

(1) Canada

(a) Research programs

A synoptic sampling cruise for slope rockfishes, primarily *Sebastes alutus* was conducted aboard a chartered commercial trawler during July. Biological samples of slope rockfishes from Areas 5E-3C were collected, including a coincident set of gill raker samples for stock delineation using the copepoda parasite *Neobrachiella robusta*. These samples will be combined with others to examine the seasonal stability of stock-specific differences noted previously. Preliminary screening of *S. flavidus* samples for parasites suitable for use in stock delineation studies was completed. Two copepods from the branchial and nasal cavities, a monogenean from the nasal cavity, and myxosporidians from the gall bladder were identified as having promise as natural tags. Difficulty of screening samples increases in the order presented.

The first work on school structure of slope rockfishes was conducted in March, 1990. Hydroacoustic and trawl sonar equipment were used to examine the diel behavior of *S. reedi*/*S. proriger*/*S. alutus* aggregations, as well as the behavior of the fish around the mouths of midwater and bottom trawls. The transition from diurnal on-bottom, aggregated patterns to nocturnal, dispersed patterns occurred over a 30 min period. The timing of the transition was strongly correlated with ambient light conditions. Midwater species (*S. reedi*, *S. proriger*) showed no distinct pattern of behavior within the mouth of the trawl, although the aggregations dove with its approach. *S. alutus* also appeared to dive, as all fish entered in the bottom one-half to one-third of the trawl, although pre-trawling aggregations extended up to 15 m off bottom.

A review of life history strategies and the impact of the unique features of rockfish life histories on their management was completed. The review concluded that indices of stock status much more sensitive than CPUE, such as reproductive value, must be employed if we are to understand the role of life span and cohort strength variation in the management of *Sebastes* stocks. These other indices have merit due to their linear response to stock changes, compared with the asymptotic behavior of CPUE. In addition, a general model for examining length-at-age data and resolving growth hypotheses was completed.

Synopses of *S. alutus* and *S. flavidus* life histories were also completed as components of a background document on the effects of global warming on fisheries resources off the coast of B.C.

Biological studies conducted or planned for 1990 include: the study of the three-dimensional school structure of slope rockfish, and its response to trawling, will be continued in October; analysis of age and size-specific fecundity in *S. brevispinis* will be completed; a program on the

early life stages of slope and shelf rockfishes will be initiated; a paper on the parasites of *S. flavidus* and their potential use in stock delineation will be prepared; and, a final paper on the seasonal dynamics of *N. brachiella* infection of *S. alutus*, and its usefulness as a biological tag will be completed.

Rockfish communities from trawlable and untrawlable habitats off the northwest coast of Vancouver Island were studied during two cruises in 1989. The first cruise emphasized hydroacoustic methods. Rockfish schools from the two areas have distinct acoustic signals and further digital analysis of the acoustic data is in progress. During both cruises, sunken gill nets were used to sample rockfish. The catch from the trawlable area was dominated by Pacific ocean perch and splitnose rockfish, while sharpchin rockfish and red-banded rockfish dominated the catch at similar depths (near 200 m) from the untrawlable area.

(b) Stock assessment

Slope rockfish assessments showed little change from those in 1989. However, managers reduced the total allowable catch for the Moresby Gully stock of Pacific ocean perch, due to concern for continuing declines in CPUE. The 1990 stock assessments also included a review of the achievement of management quotas for each species and area. A progress report on the experimental harvest programs conducted in Areas 3C (1980-1985) and Area 5E(N) (1983-) is in preparation.

A review of rockfish sampling procedures was completed and sample sizes for rockfishes were reduced to 50-lb samples. The analysis indicated substantial gains in precision and accuracy if increased numbers of vessels were sampled, even when sample setup time was considered. A paper examining CPUE variance and sampling and logbook coverage was also completed.

(c) 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 1990, 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.

The only component of the rockfish complex actively managed by the state at this time is the demersal shelf rockfish assemblage. 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.

Separate harvest ranges have been established for each of the five southeast management areas based upon the best available information on the condition of rockfish stocks in each area. The seasons open concurrently and the landings are tracked for each area. The closure of a particular area is announced when it appears that the harvest objective for that area will be reached.

Mr. Saunders reported that Dr. Bruce Leaman and Mr. Rick Stanley are conducting research on slope species. He elaborated slightly on their sampling program to determine stock identification from the gill parasite *Neobrachiella robusta*. He also reported that yellowmouth and redstripe rockfish and Pacific Ocean perch were observed to show a dive response in front of a trawl.

Dr. Richards reported that hydroacoustic surveys are being conducted in conjunction with sunken gillnets to sample species composition. Aggregations in high relief substrate are very different than on the slope. Sunken gillnets were also used to sample rough bottom near Vancouver Is., but catch rates were very small.

Dr. Richards also reported that she will be taking over the lead on conducting slope rockfish stock assessment studies. Mr. Stanley will be conducting a juvenile study on stocks in the Vancouver area.

(2) United States

(a) National Marine Fisheries Service

i) Alaska Fisheries Science Center

Previous assessments of Pacific ocean perch (POP) (*Sebastes alutus*) stocks in waters of the WOC region indicate that the resource continues at depressed levels of abundance. Stock recovery is likely to be a slow process unless one or more strong year classes recruit to these stocks. An analysis was conducted in 1987 to detect the presence or absence of incoming strong year classes. This analysis utilized research trawl length and age data from the INPFC Vancouver and Columbia areas and length data obtained from the Washington Department of Fisheries samples of

commercial landings. Analysis of these data suggest that no strong recruitment was forthcoming, but there were indications that some improvement in recruitment had occurred. A new stock assessment of the POP resource in the WOC region will be completed in 1990.

The POP resource of 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. In both regions, Pacific ocean perch is currently managed as a complex of five species (*S. alutus*; northern rockfish, *S. polyspinus*; rougheye rockfish, *S. aleutianus*; shortraker rockfish, *S. borealis*; and sharpchin rockfish, *S. zacentrus*). For the POP complex, biomass is estimated to be about 105,400 t in the eastern Bering Sea and about 276,500 t in the Aleutian region. Applying the $F_{0.1}$ exploitation rate to these biomass estimates results in potential yields of 6,300 t for the eastern Bering Sea and 16,600 t for the Aleutian region.

The GOA slope rockfish assemblage is determined to be at low levels of abundance relative to the early 1960s. This assemblage is comprised of 18 species, of which Pacific ocean perch, northern rockfish, rougheye rockfish, shortraker rockfish, sharpchin rockfish, and harlequin rockfish, comprise the bulk of the biomass. The determination of ABC is based on using an exploitation rate equal to the natural mortality rate of Pacific ocean perch with adjustments made to protect the more valuable and vulnerable shortraker and rougheye rockfish stocks from over exploitation. The recommended ABC for the slope rockfish assemblage in 1990 is 17,600 t.

ii) Gulf of Alaska (ABL report)

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 the Alaska Department of Fish and Game 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 in the slope assemblage. Exploitable biomass for the slope assemblage is based on the 1987 triennial trawl survey of the Gulf of Alaska, and is estimated to be 702,200 mt. This exploitable biomass is dominated by Pacific ocean perch (47%) followed by northern (17%), harlequin (12%), sharpchin (10%), rougheye (7%), and shortraker (7%) rockfish. The remaining 12 species in the assemblage comprise <1% of the exploitable biomass.

Abundance of slope rockfish in the Gulf of Alaska is considered to be at a low level but is increasing. The 1990 acceptable biological catch (ABC) for the slope assemblage was based on use of an $F=M$ (0.05) exploitation policy as the upper range of an acceptable exploitation rate. This exploitation rate of 0.05, when multiplied by the exploitable biomass, yields an ABC of 35,100 mt. An assumption of this method is that species composition of slope rockfish in the commercial catch is the same as in the 1987 trawl survey. This assumption, however, is probably invalid, since fishermen likely target on the more valuable species in the assemblage, such as shorttraker and roughey rockfish. Unfortunately, at present there is no reliable information on species composition in the commercial fishery. Therefore, to prevent possible over-exploitation of individual species in the assemblage, the computed ABC of 35,100 mt was reduced by 50%. This resulted in the recommended 1990 ABC of 17,600 mt for the assemblage. Management and assessment of slope rockfish should be greatly improved in future years when the new domestic observer program provides data on the actual species composition in the commercial catch.

iii) Southwest Fisheries Center

Cohort analysis, catch-at-age analysis, and the stock synthesis model were used to estimate fishing mortality rates and population size for widow rockfish, using 1979-1988 landings estimates and 1980-1988 age composition data. Estimates of 1990 biomass were similar to recommended equilibrium levels. Acceptable biological catch was 8,900 mt from cohort analysis and 6,900 t from the stock synthesis model. Future yields are expected to be similar to the average recommended equilibrium yield of 8,300 mt.

Revised age data obtained from broken and burnt otoliths were used to revise estimates of potential yield for shortbelly rockfish. Using the potential yield model $MSY=0.3MB_0$ and biomass estimates from hydroacoustic surveys, maximum sustainable yield in the Ascension Canyon to Farallon Islands area was estimated to be between 13,944 and 27,989 mt. The corresponding estimates for fishing mortality rate $F_{0.1}$ ranged from 26,862 to 47,008 mt.

The Tiburon Laboratory has also begun studies to determine if the abundance of shortbelly rockfish can be estimated from the abundance of their larvae.

The SWFC Coastal Division has initiated a joint effort involving scientists at Scripps Institution of Oceanography that involves use of radioisotope ratios to validate criteria used to age shortspine thornyhead.

Dr. Lenarz reported that Pacific Ocean perch continue to be at depressed levels along the west coast according to the triennial trawl survey. No strong recruitment has been observed, but some improvement in year class strength has been noted.

Mr. Clausen noted that species composition needed for assemblage management was lacking prior to the implementation of the domestic observer program. SRA analysis is being conducted to estimate biomass and a value of $F=.05$ is being applied to POP and other slope species. The harvest of the entire slope assemblage is being restrained below ABC to protect the deep water species (shortraker and rougheye rockfish).

Mr. Clausen also reported that the ABL had conducted manned submersible surveys to compare area swept trawl methods with visual transects. Surprisingly, the trawl was found to be more efficient than the sub transects indicated. Triennial surveys are scheduled to be conducted during 1990.

A discussion followed regarding targeting on the deep water species and harvesting those species disproportionately to their abundance. Mr. Clausen indicated that shortraker and rougheye rockfish may be separated from the slope complex in the 1990 status of stocks report.

Dr. Lenarz reported on the west coast widow rockfish assessment. They estimate a biomass of 8,000 t from several sources, CAGEAN, stock synthesis, delayed difference, etc. He is working on a simulation model for this species. They are currently using an F.1 approach which results in an $F = 0.3$. He feels that F.01 is more appropriate.

A stock synthesis model is also being used for bocaccio and they are beginning to examine thornyhead rockfish and the SWFC is collecting length composition for 12 species from port samples.

Larval studies for shortbelly rockfish are being conducted and daily fecundity and daily growth studies are planned. The center is also exploring the relationship between recruitment variability, the ecology of early life history, and adult spawn timing in relationship to the environment.

(b) Alaska Department of Fish and Game

ADF&G did not report on slope rockfish and Mr. Bracken reported that the state's primary management interest is restricted to near-shore species at this time.

(c) Washington Department of Fisheries

WDF did not report on slope rockfish.

(d) Oregon Department of Fish & Wildlife

ODFW did not report on slope rockfish.

(e) California Department of Fish & Game

CDFG did not present a report at the 1990 meeting.

c. Nearshore Rockfish

(1) Canada

Dr. Richards reported on nearshore rockfish in the Canadian zone.

(a) Research programs

A method was developed for determining the relationship between fecundity and another fish attribute, such as size or age, and data for quillback and copper rockfish were used for illustration. Simple linear and logarithmic models could not adequately describe fecundity-length relationships for these species, justifying the extra complexity of the new model.

(b) Stock assessment

The coastwide catch of quillback and yelloweye rockfish continues to escalate. There are few biological samples available from outside of the Strait of Georgia. Yield options in the 1989 assessment for outside areas were based on the southeast Alaska harvest recommendations.

(c) Management and regulations

For 1990, the Strait of Georgia will be open from May 1 through October 31. A 650 t quota is in effect for the north coast. A new industry advisory committee was established to deal with hook and line issues.

Dr. Richards further reported that no field work had been completed over the last year and all efforts dedicated toward this species group involved analysis of existing data. They expect an expansion of the fishery especially for yelloweye and quillback rockfish and have set preliminary quotas based on ADF&G research. A winter closure is currently in effect and the quota applies only to waters inside the surf line.

(2) United States

(a) National Marine Fisheries Service

The pelagic shelf rockfish assemblage is comprised of five species that inhabit waters of the continental shelf of the Gulf of Alaska and exhibit midwater, schooling behavior. Based on the 1987 trawl survey, dusky rockfish comprise more than 99% of the Gulf of Alaska exploitable biomass of 164,600 mt. Abundance of dusky rockfish appears to have increased in recent years, although little biological information is available on this species. If one assumes that pelagic shelf rockfish are comparable to slope rockfish in growth, mortality, and stock condition, then the exploitation rate used for slope rockfish (0.05) is applicable to pelagic shelf rockfish. Multiplying the estimate of current exploitable biomass by 0.05 resulted in an ABC of 8,200 mt for pelagic shelf rockfish in 1990.

(b) Alaska Department of Fish and Game

i) Research

Port sampling, skipper interview, and logbook programs monitoring the Southeast Alaska demersal shelf rockfish fishery continued through 1989. A major difference was that as of July 1, 1989 the logbook program was converted from voluntary to mandatory because of a change in regulations.

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 1989 age structures were obtained from principal demersal shelf rockfish species and both ovaries and otoliths were obtained from yelloweye rockfish for fecundity studies. Data from these programs is entered on micro computer in Sitka. Fecundity work is conducted by biologists in Sitka and the age structures are read at the ADF&G aging lab in Kodiak.

An ADF&G staff biologist participated on a survey to determine species composition of slope rockfish targets off Southeast Alaska conducted by the NMFS Auke Bay Laboratory during August, 1989. Target schools of fish were located electronically and then sampled by trawl gear and observed in situ via a manned submersible. The primary objective of this work was to determine if schools of predominant species of slope rockfish have a characteristic sonar signature.

ii) Stock Assessment

The stock assessment survey for demersal shelf rockfish was modified extensively during 1989. After two years of attempting to ascertain relative abundance from longline surveys, it was determined that the most promising approach for stock assessment involves estimation of rockfish density per unit of habitat, coupled with an areal estimate of suitable rockfish habitat to determine estimates of rockfish density and biomass over a broader area. Funding was received from the National Undersea Research Program (NURP) to evaluate the use of remote operated vehicles (ROVs) and manned submersibles for this task. Secondary objectives included determining distribution of juvenile rockfish in relationship to populations of adult fish, determining if line transect methods are useful in the uneven terrain inhabited by rockfish, and determining if use of either ROVs or manned submersibles is an appropriate method for delineating rockfish habitat.

Preliminary results indicate that ROVs are not a useful indexing tool in the uneven bottom areas occupied by demersal shelf rockfish. Also, when using manned submersibles strip transects appear to be a better indexing tool than line transects, and, while expensive to operate, manned submersibles appear to provide the best approach found to date for estimating demersal shelf rockfish biomass.

Funding from NURP has been requested for two more years of demersal shelf rockfish research work in Southeast Alaska. Funding for 1990 has already been approved and the information obtained during the 1989 survey was used to modify and improve the survey design for subsequent research.

iii) Management

a) Commercial fisheries

The only component of the rockfish complex actively managed by the state at this time is the demersal shelf rockfish assemblage. 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 the five southeast management areas based upon the best available information on the condition of rockfish stocks in each area. Beginning in 1989 a 7,500 pound weekly trip limit and mandatory logbooks were adopted as new regulations. Also,

the season was separated into three components to assure that the harvest is spread out over an extended portion of each year. The seasons open concurrently and the landings are tracked independently for each area. The closure of a particular area is announced when it appears that the seasonal harvest objective for that area will be reached.

The state recognizes that bycatch of rockfish occurs routinely in fisheries for other species and has provided for this by allowing for retention of rockfish after the closure of the directed fishery. This practice serves two purposes. Because survival of rockfish is minimal after capture, retention of rockfish minimizes waste of an otherwise valuable product. In addition, allowing retention of rockfish provides the managers with a better understanding of bycatch rates in fisheries for other species.

(c) Washington Department of Fisheries

Objectives of the ongoing black rockfish stock assessment project are to conduct a multi-stage tagging experiment to estimate survival rates, exploitation rates, and abundance of the population adjacent to the Washington coast. A secondary objective is to obtain further information on growth and migration of black rockfish. The coast has been stratified into subareas from Tillamook Head to Neah Bay with equal tagging effort expended in each subarea. The experimental design calls for completion of tagging in 1990. Fecundity and maturity studies are planned for 1991.

In addition to tagging, acoustic surveys were conducted again in 1989 to estimate black rockfish population size along the Washington coast. The surveys began in 1986. The target area is stratified by bottom type.

(d) Oregon Department of Fish and Wildlife

Canary rockfish - A revised canary rockfish stock assessment document is nearing completion. Extensive use was made of the stock synthesis model. Results will not differ greatly from what was reported in 1989.

(e) California Department of Fish and Game

CDF&G did not present a report at the 1990 meeting.

3. Sablefish

a. Canada

Mr. Saunders presented the DFO sablefish report.

(1) Research Programs

For the fifth year, a survey determining the relative abundance and distribution of pelagic sablefish larvae was conducted in April in the Vancouver Area. 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.

Larval sablefish rearing studies were continued. Both gametes collected at sea and those from hormone induced captive brood stock were used successfully. Experiments were conducted to determine the appropriate time of presentation, size, density, and type of food organisms required to successfully bring sablefish through the larval stages.

Examination of biotic and abiotic factors controlling year-class success was continued.

(2) Stock assessment

Nominal CPUE was standardized to account for variation due to trap type and records from vessels with skippers having on or more years of experience were selected. The standardized CPUE increased slightly in 1989 (preliminary) to 22.6 kg/trap from 21.2 kg/trap in 1988. The 1988 and 1989 figures are considerably higher than the 1987 value of 11.2 kg/trap. The difference may indicate an increase in abundance however it may also be an artifact of the changes in the fishery. In 1988 and 1989 the number of openings increased from two to seven.

As in previous assessments yield options were determined using forward simulations of a deterministic age-structured model. Numbers-at-age, used as the starting vector in the model, were calculated using Virtual Population Analysis (VPA).

(3) Management and regulations

Sablefish are managed by quota with a 5000 mt coastwide quota in effect for 1990. The quota is split between trawl (8.75%) and longline/trap (91.25%) vessels. Both trawl and longline licenses are limited entry.

In 1990 longline/trap license holders will be entitled to an individual vessel quota. The quota actually entitles the fishermen to a proportion of the quota rather than a permanent tonnage. The program is experimental in nature and will be in place for two years subject to a review of its effectiveness. 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 is in place, to be paid for by fishermen and overseen by a consultant, to verify the landings in 5 designated ports.

Mr. Millikan asked about anticipated problems with "black marketing as a result of the IFQ system. Mr. Zyblut responded that they are attempting to track sablefish through the market and are not certain how big a problem it will be.

Mr. Millikan then asked about transferability of IFQs to which Mr. Ackerman responded that transferability is limited to whole blocks, but there is no restriction on accumulation of holdings.

Mr. Demory asked about the potential for highgrading. Mr. Zyblut admitted that it was a concern, particularly with the longline vessels.

Mr. Bracken asked if owners were required to be on board to which Mr. Ackerman responded that under the current law it was not required.

Mr. Saunders reported on a side note that there are currently approximately 100,000 tagged juvenile sablefish at large.

b. United States

(1) National Marine Fisheries Service - AFSC

Mr. Wilkins, Dr. Methot, and Mr. Clausen all contributed to the National Marine Fisheries Service - AFSC report on sablefish.

(a) West Coast

The stock synthesis model was used to estimate historical fishing mortality rates and population size for sablefish (*Anoplopoma fimbria*) along the coasts of California, Oregon and Washington. The model simultaneously analyzed 1971-1989 landings data, 1986-1988 fishery age and length composition data, estimates of age 1.5 recruit abundance in 1980, 1983, and 1986 from trawl surveys, and estimates of relative abundance in pot surveys from 1971 and 1979-1988. A revision in the ageing criteria caused an increase in the observed proportion of old fish and a decrease in the estimate of natural mortality rate from 0.15 in the 1988 assessment to 0.0875. This change causes an increase in the estimate of current biomass, a decrease in the estimates of historical recruitment, and a decrease in the estimate of long-term potential yield. The estimates of mature female biomass and of age 3+ biomass at the beginning of 1990 are 58,000 and 136,000 t, respectively. If recruitment is assumed to be reduced by 10% when mature female biomass is reduced by 50%, then the maximum long-term yield is 6,770 t and the level of acceptable catch for 1990 is 7,020 t. If recruitment is assumed to be constant over the range of biomass levels that will be observed and a $F_{0.1}$ fishing mortality rate is applied, then the maximum long-term yield will be 10,630 t and the 1990 ABC could be 10,760 t. The average of the two equilibrium yield levels is 8,700 t which is a 500 t increase from the estimate made in 1988. The average of the two 1990 ABC levels is 8,900 t, which is 100 t less than the 1989 ABC.

The estimates of equilibrium yield and ABC assume that the trawl fishery will discard a level of biomass equal to 10% of its landings. The fishery continues to harvest high percentages of small, immature fish so that the above, standard harvest policies are expected to reduce spawning biomass to less than 25% of its unfished level. An alternative harvest policy which would reduce spawning biomass per recruit to 30% of its unfished level indicates a 1990 ABC of 8,000 mt.

(b) Bering Sea and Gulf of Alaska

The sablefish (*Anoplopoma fimbria*) stock in the BSAI region has rebuilt from low levels of abundance during the 1970s. Increases in abundance during the early 1980s were attributed to the strong 1977 year class. Relative indices from longline surveys indicate fairly steady abundance in the Aleutians, although a drop occurred in 1989. A sharp decrease in relative abundance occurred in the Bering Sea in 1987, and then a modest increase was indicated by the 1989 survey. There have been no indications of significant recruitment in the eastern Bering Sea since the appearance of the strong 1977 year class. Absolute biomass was calculated by calibrating the relative abundance trends to trawl survey biomass estimates. The current estimate of exploitable biomass for the BSAI region is 128,900 t. The Acceptable Biological catch (ABC) was estimated by applying the $F_{0.1}$ fishing mortality rate to the 1990 projected biomass, resulting in values of 3,800 t and 9,600 t for the Bering Sea and Aleutian Islands, respectively.

Sablefish of the GOA region have been determined to be in good condition due to good recruitment from the 1977 and 1980 year classes. The 1989 longline survey indicated a reduction of sablefish stocks in the Gulf of Alaska region, with most of the reduction occurring in the Shumagin and Chirikof areas. While the population is still at a relatively high level, no strong recruitment is predicted for the near future. Current exploitable biomass is estimated to be around 300,000 t. The ABC was estimated by applying the $F_{0.1}$ fishing mortality rate to the 1990 projected biomass, resulting in a value of 26,000 t.

(c) Gulf of Alaska (ABL report)

The sablefish population of the Gulf of Alaska is still at a relatively high level, but no strong recruitment is predicted for the near future. Exploitable biomass in 1989 for outside waters as estimated from the NMFS trawl and longline surveys is estimated to be 349,000 mt, down slightly from 389,000 mt the previous year.

Yield estimates are determined from stock reduction analysis modified to explicitly track estimates of exploitable biomass and provide an estimate of recruitment. To alleviate some of the departures from the assumption of a closed population, the Gulf of Alaska, Bering Sea, and Aleutian Islands regions were combined and analyzed as one stock in 1989. The recommended yield was then apportioned according to

estimates of current biomass. The recommended acceptable biological catch (ABC) for the Gulf of Alaska was 26,200 mt in 1990. This ABC was based on a fishing rate that will maintain the population until at least 1993 above the all-time measured low level, when projected under conservative biomass and recruitment assumptions.

It was reported that the results of the 1989 BS/AL and GoA cooperative survey show a biomass decline of between 17.5 and 18% from the previous year. The BS/AL trawl survey indicated a 6% decline from 1988. On the west coast the pot indexing survey indicated a decline of 14% since 1987 and a 68% decline since 1985. The 1990 slope survey is also expected to yield a sablefish biomass estimate. No significant recruitment has been observed in the Bering Sea since the 1977 recruited to that area.

Mr. Clausen reported that there had not been any significant recruitment to the GoA in recent years.

Mr. Clausen also gave a brief overview of the ADF&G/NMFS cooperative study in the Northern Southeast Inside area in 1989. Stations were fished before and after the fishery to determine changes in the catchability coefficient. A mark-recapture study was also conducted. Approximately 9,000 tags were deployed of which only 75 were returned from the fishery. Conversely, the catchability declined by 18% after the fishery. The inconsistency between these findings is being explored.

Extensive tagging since 1979 shows considerable movement consistent with the original hypothesis of directional movement by size category. Over 79,000 fish have been tagged through 1989 including the approximately 9,000 in the ADF&G/NMFS study.

Dr. Methot reported that there will be no pot indexing study on the west coast during 1990, but that a trawl survey will replace it for part of the area. He is applying the stock synthesis model to the pot indexing data for +1 year fish. These data will be analyzed by depth range to predict recruitment.

Changes in aging criteria have resulted in a modification of the mortality estimate (M). The current west coast biomass estimate is 58,000 t resulting in an ABC of 8,700 t. Alternative harvest strategies are being explored in relationship to the distribution of biomass. The 1986 pot indexing survey showed a smaller size of fish in California compared to Oregon and Washington. Over 50% of the fish landed in the trawl fishery are under 55 cm.

There was a brief discussion on the application of the stock synthesis model to the GoA stocks. It was suggested that SRA may have some difficulty dealing with the pulse of fish generated by the strong 1977 year class.

(2) Alaska Department of Fish & Game

Mr. Bracken presented the ADFG report on sablefish.

(a) 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 1989 ADF&G cooperated with the NMFS Auke Bay Laboratory to conduct an exploitation rate study in the Northern Inside Area of Southeast Alaska. Over 8,000 tags were deployed from the NOAA ship *Townsend Cromwell* just prior to the fishery. An extensive tag recovery effort was implemented during the fishery and a subsequent survey was completed to determine the change in catch rate as a result of the fishery. Analysis of the data collected is continuing, but initial examination suggests a very high exploitation rate in that fishery.

(b) Stock Assessment

Sablefish stock assessment surveys were conducted in each of the two Southeast Alaska inside management areas for the second year during 1989. 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 second year surveys indicate significant declines in the abundance of sablefish in each of the two inside management areas between 1988 and 1989. Data from these surveys is still being analyzed and the results will be used to plan subsequent surveys in those areas. Both of these surveys are part of a five-year study and no conclusive results in abundance trends are expected until after the 1990 surveys are completed.

Fish on every fourth set conducted during the 1989 Southern area survey were tagged and released. The tagging effort is not considered to be sufficient to provide an estimate of total abundance or even exploitation rate from these fisheries, but provides an indication of movement of sablefish within and between management areas over time. All tagging in the Northern area during 1989 was conducted in association with the cooperative exploitation rate study.

These surveys are designed such that the cost of the work is at least 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.

(c) Management

Sablefish fisheries in internal waters of the state are managed by season and guideline harvest ranges. The seasons are set by the Board of Fisheries based upon industry recommendations. In recent years the season framework in the Southeast area 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.

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.

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. The seasons have been very short in both of the Southeast fisheries in recent years with five days allowed in the Southern area and only one day (24 hours) allowed in the Northern area the past four seasons.

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 normally opens by regulation on April 1 and continues until the annual harvest objective is reached. In 1989 the opening was delayed until June 12 to avoid the possibility of gear or product adulteration from the March 24 *Exxon Valdez* oil spill. The fishery progressed slowly and the area remained open through December 31.

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.

(3) Washington, Oregon, and California

No report on sablefish.

4. Flatfish

a. Canada

Dr. Richards presented the DFO 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. Spawning occurred in September-October for the study period. Research in 1990 will focus on age validation and recruitment studies 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 was estimated to be at the highest level in 20 years. Hecate Strait English sole recruitment was estimated to be at an average level and, in 1989, the stock trend of declining abundance, which began in 1982, continued. Yield per recruit analyses were completed for International Area 5D rock sole, and Hecate Strait English sole. $F_{0.1}$ values of 0.23, 0.21, respectively, were estimated for these species. Sustainable yields estimated from these analyses were 700-1000 t for rock sole and 700 t for English sole. The Dover sole stock in International Area 5C,E, is estimated to be at moderate levels. Sustainable yield for this stock was estimated from results of surplus production analyses at 1000 t. Landings of Dover sole off the west coast of Vancouver Island increased to 1340 t in 1989. Yield for this stock is estimated to be 1000-2000 t if the stock is intermediate in size to the Washington and International Area 5CDE stocks. There is also the possibility that the west coast Vancouver Island Dover sole stock is a trans-boundary stock.

(3) Management

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.

In International Areas 5C,D,E combined, an 800 t Dover sole quota is in place. When the quota is attained, a 9.1 t trip limit will be imposed.

A 700 t quota is in effect for English sole in Hecate Strait.

Mr. Saunders reported that Jeff Fargo was working on reproductive biology of some flatfish species.

It was also reported that the West Coast Vancouver Is. dover sole stock is suspected of being a trans-boundary stock and that rock sole harvests are increasing in Canadian waters.

b. United States

(1) National Marine Fisheries Service - AFSC

The NMFS flatfish report was presented by Mr. Wilkins.

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, 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. This stock has undergone a long-term sustained recovery due to a series of stronger than average year classes originating in 1968-77. The current biomass is believed to be at least 2.4 million t which may be higher than the biomass when exploitation of this species started. The abundance of yellowfin sole is expected to decline because of recent lower levels of recruitment, but the decline is anticipated to be slow. The $F_{0.1}$ fishing strategy suggests that this resource can be exploited at about 278,900 t (ABC) in 1990, but the catch will be limited to about 207,650 t because of concern for the bycatch of prohibited species and the overall harvest limit of 2.0 million t in the eastern Bering Sea--Aleutian Islands region management area.

Survey data have indicated that the other three principal species of small shelf flatfish were also at observed high levels of abundance in 1989. The estimates were 1.3 million t for rock sole, 523,000 t for flathead sole, and 599,400 t for Alaska plaice. The abundance of these species remains high, particularly for rock sole and flathead sole, and recruitment remains strong for rock sole. The estimated combined catches that these three species would be able to support in 1990 was about 404,300 t, but other management considerations will limit harvests to about 120,150 t.

The conditions of the two principal species of large flatfish in the eastern Bering Sea, arrowtooth flounder and Greenland turbot, differ. Based on survey estimates, the abundance of arrowtooth flounder has increased from less than 100,000 t in 1982 to 410,700 t in 1989. Recruitment for this species also continues strong. Because exploitation at a F_{MSY} fishing rate (0.41) would cause a rapid decline in population abundance, ABC (106,500 t) was based on an $F_{0.1}$ exploitation rate (0.18). Because of the lack of interest in this species by the commercial fisheries and the 2.0 million t catch limit, the total allowable catch was limited to 10,000 t.

Over this same period, recruitment of Greenland turbot has been very low and the shelf area formerly occupied by juvenile Greenland turbot has been dramatically 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. The 1988 triennial survey data indicated that the abundance of adults has not changed significantly since 1985. Thus, management restrictions appear to be protecting the adult spawning population. Although an ABC of 19,400 t was derived for the stock, the management council will limit catches to 7,000 t to allow bycatch to be retained to prevent wastage while at the same time protecting the adult spawning population.

Dr. Lenarz reported that the SWFC is also working on dover sole. A summary of the work being conducted was reported in the section on agency programs. Ichthyoplankton and larval studies have been conducted and from that an egg production estimate of biomass has been generated. The results of this study will be reported in CALCOFI Reports.

Dr. Lenarz also indicated that there is a push for a coast wide nearshore flatfish survey which would assess flatfish stocks out to 100 fathoms with more appropriate gear than is currently being used.

Dr. Weeks and Mr. Saunders both wondered how to explain the increased biomass of most flatfish species in the Bering Sea. Mr. Wilkins stated that he didn't have a clue.

A question was asked regarding the utilization of arrowtooth flounder. Mr. Millikan responded that over 2,000 t had been harvested in Washington and northern Oregon in 1989 making it the second most important commercial species by weight.

(2) Alaska Department of Fish & Game

The ADF&G report on flatfish was presented by Mr. Bracken.

(a) Research

Port samples were taken from the landed catch of flatfish during 1989 to determine species composition and to obtain data on sex ratio, maturity, and 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.

(b) Management

Trawl fisheries for flatfish are allowed only in the internal waters of Southeast Alaska and require 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 internal waters.

Beginning in the 1989-90 season the flatfish trawl fishery was restricted to four areas with a guideline harvest range established for each area. As with the other fisheries, the department sets a harvest objective within the ranges annually for each area based on the best available information. Landings are tracked using information from fish tickets and logbooks.

(3) Washington Department of Fisheries

Washington did not report on flatfish in their 1989 report. Mr. Jagielo reported at the meeting that Martha Rickey had been hired by WDF to study flatfish, but had not worked extensively on the project yet. Much of the emphasis will be to analyze the deep water complex from trawl logbook data.

(4) Oregon Department of Fish & Wildlife

Dover sole - Work continues on the coastwide assessment of Dover sole. A draft document was anticipated in 1989 but this proved overly optimistic. A draft document is planned for August 1990.

Mr. Demory reported that ODF&W is supporting an OSU graduate student who is examining petrale sole otoliths and bringing ages up to date.

(5) California Department of Fish and Game

CDF&G did not submit a report in 1990.

5. Pacific Whiting (Hake)

a. Canada

Mr. Saunders presented the DFO report on Pacific whiting (hake).

(1) Research programs

Monitoring and biological sampling of Pacific hake in the Vancouver Area was continued through an extensive offshore observer program. A hydroacoustic survey of offshore hake biomass in the La Perouse region of the Vancouver Area was conducted and the northern extent of the hake summer distribution examined. Hake were found along the 200 m contour extending into Queen Charlotte Sound.

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

(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 1989 as in previous years, the remainder was allocated to foreign and joint-venture fisheries. In 1990 the foreign allocation will be eliminated.

(4) Discussion

Mr. Saunders reported that whiting are managed as two stocks, the Strait of Georgia stock with a 10,000 t quota and an offshore stock. Canadian scientists are concerned with the relationship between fish in Puget Sound and the Strait of Georgia.

The LaPeruse study combines oceanography and fisheries ecology and looks at the herring and hake food webs. A relationship between hake and euphausiids has been determined.

DFO uses GIS to incorporate fisheries and oceanographic data. Data from observer programs and stock assessment surveys are included. There has been some effort at conducting hydroacoustic estimates for hake, but success has been limited.

The hake quotas are allocated to various countries for J.V. fisheries with small amounts held back for DAP fisheries. Some allowance may also made for directed harvest by JV processors when catcher vessels are not available.

b. United States

(1) National Marine Fisheries Service - AFSC

Dr. Methot reported on NMFS whiting work.

The coastal stock of Pacific whiting (*Merluccius productus*) was assessed in 1989 by application of the stock synthesis model, a separable catch age analysis. Estimates of population biomass and age composition from the triennial west coast trawl and acoustic surveys were used as auxiliary information in the estimation procedure. Estimated age 2+ biomass at the start of 1990 was 1,189,000 t, 42% below mean 1976-88 biomass of 2,054,000 t. Female spawning biomass in 1990 is close to the expected long-term average, 615,000 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 178,000 t and 251,000 t depending on the harvest strategy and the level of risk.

The combined U.S. and Canadian harvest of Pacific whiting in 1989 was 309,000 t, the largest since the inception of the fishery. This harvest was dominated by the strong 1980 and 1984 year classes. There has been no evidence of strong recruitment to the population since the 1984 year class; as a consequence, short-term projections of the resource forecast declining biomass and yield in the immediate future. The recommended acceptable biological catch (ABC) for 1990 was 240,000 t, a 21% decline in the ABC from 1989.

Research in 1989 at Alaska Fisheries Science Center on the biology and management of the coastal Pacific whiting population focused on 1) development of catch age models within the stock synthesis framework to model age-specific migration of the population and different selectivity patterns of the U.S. and Canadian fisheries; 2) statistical analysis of growth variability of Pacific whiting; 3) investigation of the spatial and temporal distribution of the population as indicated by catch at age; and 4) assessment and revision of the population simulation model used to forecast sustainable and short-term yields from the resource. Analysis of the 1989 triennial west coast trawl and acoustic surveys will contribute substantially to the assessment of the Pacific whiting resource in 1990.

Dr. Methot also reported that whiting are a primary target species on both the triennial trawl survey and on west coast hydroacoustic surveys. He expects that age-specific biomass estimates will soon be available. Assessment data is used in a stock synthesis model indicating a biomass of approximately 1.2 million t. This is 42% below the 12-year mean biomass, but is about what was expected. Approximately 309,000 t were harvested in 1989 and there has been no strong recruitment since 1984. The current fishery is mostly JV, but is expected to become primarily a domestic fishery in the near future.

On-going research includes a catch at age model which will incorporate 1990 assessment data and biological sampling at shore plants in California.

c. Working Group Discussion Paper

After reviewing whiting research and management by agency, the TSC entered into a deliberation on the "hake" working group discussion paper. The working group was instructed to look at management options and the discussion paper is the result of a recommendation at the 1989 TSC meeting. The paper had been distributed to the TSC members earlier in the meeting for review.

The document indicates that 50% of the population matures at age 3, 75% by age 4, and 100% by age 5. The approach used was to determine the total allowable yield from the exploitable biomass and to allocate it between U.S. and Canadian waters. The recommendation for 1990 was for 80% of the harvest in U.S. waters and 28% in Canadian waters. The discrepancy of 8% in the Canadian zone accounts for the exclusion of the northern B.C. areas from the 1989 survey.

Dr. Methot reported that no research had been conducted since last year and that the recommendation was the result of analysis of existing data.

Mr. Saunders suggested that a paragraph be included in the section on progress on 1989 recommendations to state that managers met as requested and that the discussion paper was drafted as a result of that recommendation.

Mr. Millikan stated that we should note that the meeting was sponsored by the Parent Committee and he felt that the working group did a "great job".

Mr. Bracken suggested that perhaps the TSC should recognize the efforts of the group, note that the TSC recommendation had been fulfilled, but that the TSC should not necessarily endorse the working group recommendation as a specific course of action.

Mr. Saunders noted that he felt the TSC had completed its task and that no other options were available. Mr. Demory responded that other options might be available ie. economic considerations based on fish size, but we don't really know.

Mr. Jagielo formally recommended acceptance of the Working Group discussion paper.

Dr. Lenarz asked if the hake status paper by Dr. Richards and Mr. Saunders was included as part of the working group discussion. Dr. Richards responded that it had not been and Mr. Saunders followed up by stating that the discussion paper only examined one approach.

Mr. Zyblut stated that the working group had done its job. The recommendations should be endorsed, but adjustments could be made as new information becomes available. Dr. Methot suggested that the implications of the existing recommendation also need to be evaluated.

A general discussion on survey methods and modification ensued and a joint survey to evaluate stocks in the northern area was addressed as a possibility.

At this point Mr. Jagielo, as Chairman, requested crystallization of the discussion and asked if there was a consensus. Mr. Bracken, as secretary, summed it up for the minutes by recommending that the TSC accept the working group paper and further recommend continuing to evaluate stock status and trans-boundary distribution. Mr. Six added that we should also recommend modification of the survey to include the northern area and state that unresolved issues still need to be addressed. That position was agreed to by the TSC.

6. Dogfish

a. Canada

Mr. Saunders presented the Canadian report on dogfish.

(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.

A longline survey of dogfish abundance in the Strait of Georgia portion of the Vancouver Area was conducted in October.

(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 separated 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 results of the tagging experiments show more exchange between areas and more long-range movement than previously thought. Tags have been recovered from Baja California to Japan and all around the Pacific rim.

He also stated that the average age at 50% maturity for females is 35 years and the current quota represents an exploitation rate of 5%.

Dogfish rank among the top five species along the west coast by weight.

b. Alaska

(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.

c. Management

There are no seasons, gear restrictions, or harvest limits for dogfish in the territorial waters of the state at this time.

7. Pollock

a. Canada

The DFO pollock report was presented by Mr. Saunders.

(1) Research programs

Swept-volume trawl and hydroacoustic abundance estimates were determined for pollock in the Strait of Georgia, during March 1987. Evidence for delineation of pollock stocks in Canadian waters was summarized.

(2) 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.

(3) Management and regulations

Pollock are managed by annual quota in the Strait of Georgia (3,400 mt). Given extreme variation in availability and uncertainty regarding stock discreteness, fishing is not restricted in other areas of the coast.

Mr. Saunders reported that Sandy McFarlane found older ages than previously thought for this species using break and burn otoliths as an indicator.

Mr. Clausen asked about pollock stock conditions in northern B.C. to which Mr. Saunders responded that small fish are found in bays and inlets and older fish are found in Hecate Strait and Dixon Entrance.

b. National Marine Fisheries Service - AFSC

Mr. Wilkins presented the NMFS report.

Based on the available information, the status of the Gulf of Alaska pollock stock remains uncertain. Estimates of the total biomass of the walleye pollock (*Theragra chalcogramma*) stock are derived from bottom trawl surveys and annual hydroacoustic surveys. Bottom trawl surveys of the western and central management areas were made in the summers of 1984 and 1987. 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 stock biomass may be increasing. The Gulf wide bottom trawl surveys showed a 10% decline from 1984 to 1987 (952,901 t to 856,821 t). However, the 1989 bottom trawl biomass estimate in the Kodiak INPFC area alone was 825,904 t. Biomass estimates based on the annual hydroacoustic surveys show a sharp decline from 3,700,000 t in 1981 to 290,000 t in 1989 (ages 2 - 12). Clearly, the bottom trawl estimates and the hydroacoustic estimates of the pollock biomass are not in agreement (290,000 t spring 1989, 825,904 t fall 1989 Kodiak area only).

Important biological information on the status of the Gulf of Alaska pollock stock is also provided from samples collected by domestic observers and port samplers. This biological data includes length frequencies, age composition, maturity schedules, and sex ratios. A considerable amount of information was collected from the shore-side operations, however, sampling of the catcher/processor catch was minimal in 1989.

The 1989 assessment of the Gulf of Alaska pollock stock was based on results of the stock synthesis catch-at-age model. The stock synthesis model incorporates catch, abundance and age composition data. The catch-at-age model was tuned using either the bottom trawl or hydroacoustic survey biomass abundance and age composition data. Depending on the magnitude of the incoming 1987 and 1988 year classes, the 1990 mid-year biomass estimates for pollock in the western and central Gulf of Alaska ranged between; 685,000-873,000 t when the model was tuned using bottom trawl data, or 298,000-381,000 t when the model was tuned using hydroacoustic survey data.

The Groundfish Management Team did not consider the model projections tuned to the hydroacoustic survey data. This decision was based on evidence that the hydroacoustic biomass estimates from Shelikof Strait no longer represented the total adult pollock stock in the Gulf of Alaska and the relatively high biomass estimate derived from the fall 1989 bottom trawl survey of the Kodiak INPFC area. The Team assumed that the 1987 year class would be below average and recommended an ABC of 70,000 t for 1990. Following this recommendation, the North Pacific Management Council set a 1989 quota of 7,000 t for Shelikof Strait District and 63,000 t outside of Shelikof Strait. The quota was allocated on a quarterly basis to enhance the collection of information from different seasons.

Mr. Wilkins further reported that the adjusted estimates indicate that pollock stocks in the Central Gulf in 1989 increased 131% over the estimate from the 1987 triennial survey.

The FOSI study on egg and larval distribution in Shelikof Strait is continuing and hydroacoustic surveys in both Shelikof Strait and the Central Gulf are planned.

Dr. Methot noted the discrepancy between the hydroacoustic and the trawl survey biomass estimates.

Mr. Bracken asked about spawning aggregations outside of Shelikof Strait and Mr. Wilkins answered that moderate concentrations were located just west of Prince William Sound.

Mr. Bracken asked about survey design for the 1990 triennial survey to which Mr. Wilkins responded that he was not familiar with the sampling design and was not aware of any special consideration for assessing GoA pollock.

8. Lingcod

a. Canada

Dr. Richards presented the Canadian report on lingcod.

(1) Research programs

There has been a considerable research effort on lingcod over the past year, directed at developing a monitoring program for stocks in the Strait of Georgia. A nesting survey was conducted in early 1990 near Nanaimo. No nests were found at the site of a previous survey in 1978 (high current area), but a high density was recorded at a low current site. A larval purse seine survey was conducted in May 1989 and repeated in May 1990. A juvenile survey is planned for July 1990. In addition, an ultrasonic tracking study was completed in April. Lingcod relocated over 2 km away returned to the exact site of their capture within 24-72 hours, with all movement occurring at night.

Using mark-recovery data obtained from 1982-87, growth, dispersal, and mortality rates were estimated for Strait of Georgia lingcod. Von Bertalanffy growth parameters estimated using length-frequency and length increment data indicated that male lingcod grow more slowly than female lingcod, and growth rates are less in the Strait of Georgia than off southwest Vancouver Island. Females dispersed further than males and in general, dispersal rates were greater than previously believed.

(2) Stock assessment

Lingcod stocks in the Strait of Georgia are in poor condition. The commercial catch in 1988 was about 60 t, compared with a sport catch of about 100 t and a harbor seal catch of 100-500 t. The commercial fishery is most likely responsible for the long-term decline in stocks, but the sport fishery and marine mammal predation are keeping the stocks at low levels.

No new assessments were conducted for lingcod in other areas of the coast.

(3) Management and regulations

The Strait of Georgia is closed to the commercial harvest of lingcod for 1990. A size limit of 58 cm (the current commercial limit) is being implemented for the sport fishery.

Dr. Richards further reported that both the sport and commercial catches are declining. A sport bag limit of 3 fish /day will go into effect for the Strait of Georgia in July.

They found no nests in the old study site this year, but did find nesting occurring at another site. Larval studies indicate decline in abundance.

Untrasonic tracking study indicated very little movement of males after nest guarding. Fish relocated up to 2 km returned to their original location within 24 to 72 hours.

Studies on growth rate, stock integrity, and interaction with harbor seals are being conducted in the Strait of Georgia.

Mr. Gordon asked how they locate nesting fish to which Dr. Richards replied that they rely on information from fishermen and local dive groups. She stated that the best sites are low relief reefs with sloping granite and boulders.

b. United States

(1) National Marine Fisheries Service - SWFC

The NMFS lingcod report was presented by Dr. Lenarz.

Research on lingcod at the Tiburon Laboratory is conducted in three areas: age validation, examination of the catch by individual trip and modeling the basis of what may be a disturbed sex ratio.

Age Validation

The importance of population age-structure in fisheries management places great importance on the validity of aging techniques. Thus age validation has been a major issue in lingcod management because the method currently used to age this species__examination of rings in dorsal fin rays__ remains inadequately tested. To resolve this problem Tiburon researchers have undertaken a program of age validation where fish are caught and then simultaneously tagged and injected with oxytetracycline (OTC) before being released. The OTC produces a mark in the dorsal fin rays that can be seen under UV light, and when the fish is recaptured it can be determined whether the number of rings beyond the mark does in fact match the length of time the fish is known to have been at liberty. The work was blocked until recently by regulations prohibiting this use of OTC, but prohibition has now been removed and tagging has resumed. As of May 1990, 213 lingcod have been tagged and there have been six returns. The two that were at liberty longer than four weeks show growth outside the OTC mark, thus demonstrating there is promise for success in this project. The goal is 50 returns of fish that had been at liberty for at least a year, and 20 for at least two years.

Examination of Lingcod Catch by Individual Trip

There has been question whether fishermen target on lingcod, or whether they take lingcod only incidentally to other species. The answer to this question is important because effective management requires significant targeting on this species. To determine the extent to which fishermen target on lingcod, catch records of individual trips were obtained from the PacFin database of groundfish landings in California, Oregon and Washington. These data show that 80% percent of the total lingcod catch is taken by less than 30% of the trips that landed lingcod, which indicates significant targeting by the fishery. The apparent targeting on lingcod is greatest in Washington, and least in California, although in all three states trips with large catches involve a limited number of boats. The degree of targeting suggests that management of the species through quotas or trip limits is feasible.

Possibility of a Disturbed Sex Ratio

Certain problems inherent in lingcod management come from the species' reproductive habits. Lingcod are segregated by sex, with males predominating in shallow water and females in deeper water. To at least some extent this distribution is related to the fact that during reproduction males guard the masses of fertilized eggs that are attached in nests to shallow-water rocks. Because the two major fisheries for lingcod--the shallow-water recreational fishery and the deeper-water trawl fishery--inflict differing mortalities, there is potential in this situation for a disturbed sex ratio. Whether or not the sex ratio has been disturbed is an important consideration for management. Although the system is complex, it is amenable to modeling; nevertheless, to develop such a model there is need to more precisely define the extent to which the sexes are segregated.

Additional comments referred directly to the text and no additional information was presented.

Mr. Saunders asked what structures NMFS is using for aging to which Dr. Lenarz responded that they are using fin rays.

(2) Alaska Department of Fish & Game

Ms. O'Connell presented the ADF&G lingcod report.

(a) Research

A preliminary study which was begun during the winter of 1988 continued through 1989. 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.

(b) 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 "dinglebar" fleet.

Ms. O'Connell added that ADF&G has submitted a proposal for NURP funding to determine nesting distribution below diver depths. She also gave a brief summary of the 1989-90 research which confirms that nest guarding occurs later in Alaskan waters than has been reported for B.C. or Washington. Management recommendations will be made based on this research.

(3) Washington Department of Fisheries

Mr. Jagielo presented the WDF lingcod report.

WDF is continuing a multi-stage tagging experiment to determine survival rates, exploitation rates, and population size of lingcod in the Neah Bay - Cape Flattery area. In 1990, 977 tagged fish were released bringing the total to date to 4,885. A total of 175 fish were recovered in 1989. Ongoing biological sampling stratified by gear, area, and month, will be used with catch statistics to evaluate the coastal recreational and commercial lingcod fisheries. Historical catch at age information has been compiled for the INPFC Vancouver and Columbia areas and an age structured population analysis is underway.

The Puget Sound division has completed the scoping phase of a project to evaluate lingcod and rockfish in rocky reef habitats in the San Juan Islands and Strait of Juan de Fuca. The next step will be to field test some sampling approaches.

Mr. Jagielo further reported that their tagging studies show movement to be somewhat greater than expected with 20% of the fish recovered more than 5 nm from the release site. Biological sampling has continued and a stock synthesis incorporating both U.S. and B.C. data is being evaluated. He also reported that Wayne Palssen and Cyreis Schmitt are conducting a lingcod habitat evaluation study in Puget Sound.

Dr. Lenarz asked what WDF used for aging and Mr. Jagielo responded that fin rays are used.

Mr. Zyblut asked for information on the commercial fishery to which Mr. Jagielo stated that about 800- 1,000 t are taken by trawls plus some additional harvest by longline and dinglebar vessels.

Mr. Bracken asked if there was any pattern of movement by size. The response was that there is no significant pattern, but most nearshore recreation and jig fisheries which provide returns target on male fish.

Mr. Gunstrom requested information on the type of tag being used. WDF is using a twist-tied spaghetti tag attached to the pre-opercular plate.

Dr. Richards commented on the problems with capturing lingcod with trawl gear.

(4) Oregon and California

Oregon Department of Fish & Wildlife nor the California Department of Fish and Game reported on lingcod at the 1990 meeting.

9. Other Species

a. Canada

(1) Hagfish

A brief overview on hagfish was presented by Mr. Saunders.

An experimental fishery for Pacific hagfish and Black hagfish has been conducted off the west coast of Vancouver Island and in Barkley Sound since 1988. The information available on the life history of these species is limited. Information on catch and effort by fishing area, and biological samples of length, sex, condition, maturity and fecundity have been collected to establish a baseline database for management purposes.

Permits are currently issued and managed by Fisheries Division staff. Analyses of CPUE, sex, length and maturity are being performed in association with PBS to determine whether the hagfish stock is capable of sustaining a commercial fishery.

Mr. Saunders further reported that the catch rates in the experimental fishery "plumeted" after a small harvest.

Mr. Ackerman relayed that there are currently two permits issued for the west coast and 9 permits issued for Barkley Sound.

Mr. Bracken asked how hagfish were handled to which Mr. Ackerman replied that they are either frozen at sea or treated in 45-gallon drums of MS-222 on shore.

b. United States

(1) Alaska Department of Fish and Game

There are no research or regulations in effect for other species of groundfish in state waters of Alaska at this time.

(2) Washington Department of Fisheries

WDF did not report on other species.

(3) Oregon Department of Fish & Wildlife

(a) Hagfish

In 1989 ODF&W presented a limited summary of biological statistics collected in 1988 on the black and Pacific hagfish. In 1989 additional samples were collected which provided a much larger sample. Results are shown in Appendix H.

Mr. Demory reported that hagfish are dumped in peat moss for handling. They also use freezing and MS-222, although MS-222 is not sanctioned by the FDA.

He suspects that the fishery is not viable. Modification of the entrance hole size works as an escape mechanism for smaller fish. A 1" hole retains no fish, a 3/4" hole retains larger fish, and a 1/2" hole retains a mixture of large and small fish.

Preliminary fecundity studies show an average of 12 eggs for black hagfish and an average of 22 eggs for Pacific Hagfish.

Mr. Millikan reported that an experimental hagfish fishery had begun in Washington and that the quality of product looks good. No permits have been formally issued to date.

Mr. Bracken reported that a fledgling trap fishery for hagfish was also being conducted in Southeast Alaska.

C. Other Related Studies

1. Canada

a. Hecate Strait Project

A technical report on distribution of major demersal fish species in Hecate Strait from survey data for the period 1984-87 is complete. Results indicate stable seasonal patterns of distribution for spiny dogfish, Pacific sanddab, arrowtooth flounder, and petrale sole. Estimate of standing crop by species indicated that the most abundant species in summer were arrowtooth flounder and spiny dogfish.

In winter, the most abundant species were big skate, ratfish, and English sole. Spiny dogfish, English sole, ratfish, Pacific halibut, rock sole, Pacific sanddab, and petrale sole appeared to be decreasing in abundance over the study period, while Dover sole and rex sole appeared to be increasing in abundance. Big skate, sablefish, and arrowtooth flounder appeared to be at stable levels of abundance over the survey period.

A primary publication is currently being completed regarding demersal fish assemblages in this region. Another survey is to be completed in May-June 1991. This survey will concentrate on making replicate tows at selected stations for the purpose of estimating the variance for catch rates of major species on the survey.

b. La Perouse Program

This cooperative research project, with the Institute of Ocean Sciences, was continued in 1989. 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 first order estimates of the impact of inter-annual oceanic fluctuations on 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.

c. Statistics and Sampling

The principal activity in 1989 was the maintenance of the trawl and trap catch and effort database. Vessel captains were interviewed at time of landing, and biological data on the catch (length frequency, sex, age structures, gonad condition, etc.) were collected by sampling the various species landed. Work was completed on an interactive database entry system for logbooks and this system was put into operation. In addition, an interactive system was also developed to add sales slip information to logbook information. An advanced version of the computerized measuring board that allows data to be directly dumped to a microcomputer was developed. This system will be used by port samplers in 1990.

An analysis was conducted on optimizing sample size versus sample number. It indicated that for generating catch-at-age estimates sample sizes of 50-100 were optimal.

d. Strait of Georgia

This program began in 1988 to study the marine community structure of the Strait of Georgia. The program is focusing on the interactions of the major species as identified by their abundance or commercial importance. The present study is looking at the early marine mortality of hatchery-released chinook and coho salmon due to predation by other marine fish species. Field programs in progress are analyzing the abundance and stomach contents of spiny dogfish and Pacific hake at Big Qualicum River estuary and Comox Harbor, Vancouver Island. A community model reflecting the historic and present species composition of the strait is also being developed.

Mr. Wilkins asked about the electronic measuring board. Mr. Saunders replied that so far it works very well, but it is still being evaluated.

Mr. Clausen asked for more detail on Rick Stanley's work on optimizing sample size. Dr. Richards stated that Rick had a draft paper available and that Mr. Clausen should contact him directly for a copy.

2. United States

a. National Marine Fisheries Service - AFSC

Two bottom trawl surveys were conducted in 1989 throughout Prince William Sound and immediately adjacent waters to assess the impact of the *Exxon Valdez* oil spill on bottomfish and shellfish, especially the commercially important species. The surveys were a cooperative study between ABL and the Alaska Department of Fish and Game's Commercial Fishery Division. Both surveys used the NOAA R/V *John N. Cobb* for all their sampling. The first survey duplicated most stations of a 1978 trawl survey in the Sound and was used to collect hydrocarbon and histopathology tissue samples. The second survey was based on a stratified random sampling design that provided biomass estimates of 15 selected species of bottomfish and shellfish. The number of hauls during the first and second surveys was 61 and 62, respectively. Results of these surveys are considered litigation sensitive, and for legal reasons cannot be released at this time.

Mr. Wilkins also reported that the AFSC had begun work on determining the distribution and extent of "bitter crab disease" in the Bering Sea.

The Conservation Engineering Task is working with equipment to evaluate the effect of trawl shape with electronics. The estimated vs actual trawl widths are being determined by using a restrictor wire between the doors.

FOCI study is continuing to compare species composition and recruitment to physical oceanographic parameters.

Dr. Methot reported on REFM research including the domestic observer program and the associated training program. He also related studies which lead to the adoption of otoliths for aging Pacific cod and stated that NMFS is continuing

work on sablefish age validation. The Economics Task is evaluating FMP action for groundfish management.

Mr. Clausen reported on additional research being conducted by the Auke Bay Laboratory including continuing trawl evaluation of Prince William Sound which entail both tissue samples and biomass estimates.

Mr. Jagielo asked if FOCI uses GIS to which Mr. Wilkins responded that it is not planned.

Dr. Lenarz relayed that "FOCI type work" is being planned for the west coast. The original proposal is to look at the San Francisco Bay plume. Economic surveys are also planned for the west coast.

b. Washington Department of Fisheries

(1) Geographic Information Systems (GIS).

The technical services unit is conducting a pilot study to evaluate the use of GIS technology as a tool for aiding the assessment and management of the coastal groundfish resource. The pilot project will include trawl catch and effort data, habitat information (bottom type), biomass data from hydroacoustic surveys, and tagging data.

(2) Hydroacoustic studies.

The hydroacoustic unit continued to conduct routine surveys on the Washington coast and in Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia. Species of major interest included Pacific herring, black rockfish, whiting, and sockeye salmon pre-smolts. Projects in 1989 included in-situ target strength measurement using a SIMRAD 400 split-beam echo sounder, capable of generating detailed length frequency distributions. Information of this type has proven very useful for target identification and discerning the composition of pelagic fish schools. Habitat mapping is continuing on the coast, plans are to acquire ROXANNE software for digitized bottom mapping.

(3) Age determination.

Current activities focus on the aging of yellowtail and black rockfish otoliths and lingcod spines in support of stock assessments on these species.

Mr. Jagielo was asked what type of GIS software was being used. He replied that they were using ArcInfo software which allows integration of tow-by-tow data from logbooks. He indicated that Martha Rickey had attended a GIS workshop.

Mr. Jagielo also reported that they are using a Simrad 400 split-beam SONAR to determine length frequency distribution of some groundfish species. Hydroacoustic studies are also being used to determine bottom

type. Mr. Bracken asked if WDF was using this technology for habitat mapping. Mr. Jagielo responded that they were, but primarily for black rockfish. The hydroacoustic program is set up to run on a 486 PC.

c. Oregon Department of Fish & Wildlife

(1) Heceta Bank Submersible Studies

ODFW again participated in the Heceta Bank studies in 1989. They assisted in the planning for the 1989 dives and participated in 4 of the 12 dives made.

Mr. Demory related that Bill Barrs was the ODF&W participant in the Heceta bank study and that he and Mr. Barrs comprise the ODF&W "aging unit". (None of us are getting any younger).

Mr. Demory also stated that they are using GIS to examine catch and effort data including fish ticket, tow-by-tow logbook, species composition, and value. With this they are determining the comparative value of different blocks of the Oregon coast. This system runs off a large Mackintosh computer.

3. Other Studies

Mr. Six reported that the Pacific Council is working on three amendments to the Pacific Coast Plan. Amendment four would framework the plan to allow for more management flexibility, amendment five includes an overfishing definition required by law, and amendment six is a limited access plan for longline, pot, and trawl vessels. Both a moratorium and a phase out are being considered and they might even consider IFQs within a license limitation program.

Dr. Weeks reported that the NPFMC was going to determine if they will recommend IFQs in the sablefish fishery at their June meeting.

Mr. Six related that the MFCMA does not allow for collection of fees to cover the cost of a buy-back program. A change in the existing law which is being proposed would allow the Secretary of Commerce to amend FMPs without Council approval.

Mr. Zyblut reported that the Canadians are exploring the use of an IQ system for halibut in 1991. They are currently working with the industry on this. A fact sheet will be circulated to all license holders and the program will be voted up or down. As proposed, 70% of the quotas will be based on best catch and 30% on vessel length. There are currently 436 licenses with vessels locked into a specific length class. There would be no transferability for the first two years and the quota would remain with the licensed vessel. The fishery would only run from March through November even under an IQ system. In order to tighten enforcement vessels will only be allowed to land at 16 pre-selected ports. The catcher vessel must land the fish and an observer must be present. No funding is available to run the program at this time and the observers will have to be contracted by the vessel.

Dr. Weeks reported that the NPFMC was also working on a groundfish amendment package which includes an overfishing definition, bycatch issues for herring, crab and halibut, and inshore/offshore allocation. The Government Accounting Office is currently examining ownership of groundfish operations.

Dr. Methot requested an update on the status of Steller sea lions to which Dr. Weeks responded that they were being designated as a threatened species because of the decline in abundance. The reason for the decline is unknown. As a result, of the threatened species status, a three-mile operating ban is being imposed around all rookery areas.

Mr. Demory stated that Steller sea lions are not considered endangered in Oregon, but Dr. Lenarz said that they were considered to be endangered in California.

Mr. Zyblut said that he thought that there are some restrictive regulation regarding sea lions in B.C., but he was not certain what they are. Mr. Saunders indicated that sea lion populations are considered to be stable or even up slightly in Canadian waters.

IX. OTHER TOPICS FOR DISCUSSION

A. Agenda

Mr. Jagielo requested that agenda item VII, Review of Groundfish Fisheries, be waived from future agendas. After further discussion it was agreed that this section would be deleted and item VIII will become item VII. The fisheries review will become part of this section which will be renamed "*Review of Agency Groundfish Research, Assessment, Management, and Fisheries*". Under this agenda topic we will add "Agency Overview" as item A. "By Species By Agency" will become item B, and item C, "other related studies" will be changed to "other related topics".

B. Data Reporting in TSC Agency Status Reports

Mr. Jagielo indicated that he preferred the combined PACFIN format to the individual agency catch reports. He feels that a single report by species by nation by INPFC area is adequate. Dr. Methot stated that Canadian Hake landings are not currently included in the PACFIN database, but Mr. Wilkins responded that they could be.

Mr. Demory stated that most agencies are using their own data for stock assessment purposes and feels that the PACFIN format satisfies the TSC reporting needs.

It was reported that PACFIN will be restructured during the latter half of 1990 to accept logbook and other data, but will not be on line for at least another year.

Dr. Richards stated that it is better to have a compilation of data on a single table rather than working from individual agency records.

After further discussion the group agreed that the PACFIN table is adequate for TSC reporting needs. We should have a preliminary table available for the meeting and an updated version for the final report. It will be the chairperson's responsibility to provide

the preliminary report at the meeting. The report will be compiled by gear, by state or nation, by species, by INPFC area.

A short discussion on the scope and purpose of the final TSC report ensued, but nothing was resolved.

X. PROGRESS ON 1989 RECOMMENDATIONS

A. The TSC To Itself

No recommendations were made.

B. From The TSC to The Parent Committee

1. PACFIN Data Merger

This project is currently in progress. It was agreed that the restructuring of the PACFIN database will go a long way toward satisfying this recommendation.

2. Pacific Whiting (Hake) Working Group

The TSC accepted the Pacific Whiting Working Group report and recommended continued research on this species.

3. HAL Resolution

It was reported that no further progress had been made on the recommendation to update the Historic Annotated Landings (HAL) Database. Dr. Methot reported that the author and the agency are at an impasse as there is no guarantee on the accuracy of the data. Some bugs have been worked out of the system, but it has not been republished and is not available for release.

It was agreed that the TSC should again recommend that the needed work be accomplished. Mr. Millikan suggested that the current data base be made available for use at the request of the agencies. After further discussion, Dr. Methot suggested that the TSC should formally recommend that the data be made available to the contributing agencies.

XI. 1990 TECHNICAL SUBCOMMITTEE RECOMMENDATIONS

A. TSC to Itself

1. CARE Recommendation, prepared by Mr. Saunders - approved

The TSC endorses the C.A.R.E. report and recommends that an executive summary of the major recommendations be sent from the TSC to the senior managers responsible for groundfish ageing within each agency.

Under this recommendation CARE would be responsible for writing an executive summary and the Chairperson of TSC would be responsible for assuring that a copy is sent to each agency contact.

TSC members will each send back the name of an agency contact to Mr. Jagielo. Mr. Saunders will contact the Chairperson of CARE to have her draft the executive summary.

2. Dover Sole Age Validation, prepared by Mr. Saunders - approved.

The committee of age reading experts (C.A.R.E.) has reported a need for validation studies of Dover sole. Given the difficulties in ageing this species and its commercial importance, the TSC recommends that the Dover sole working group be activated and be asked to prepare over the next year a validation study proposal. The TSC recognizes that if a mark/recapture with OTC injection approach is used, it will not be undertaken until U.S. government regulations allow the use of OTC.

The "old" group was made up of Frank Henry, Jergen Westrheim, and Bob Demory. It was decided that one member from each agency except Alaska would participate in the "new" group. The recommendation was adopted as written.

B. From the TSC to the Parent Committee

1. Sablefish Symposium - prepared by Dr. Richards and Mr. Saunders - approved.

"A symposium on sablefish was last held in 1983. Since that time, agencies have actively conducted research on sablefish. Another symposium is now warranted to report the research results. Therefore, the TSC recommends that a symposium on sablefish be considered for early 1992."

Mr. Jagielo suggested that contact persons should interact with PSMFC regarding this recommendation. Mr. Saunders and Mr. Wilkins agreed to act as contact persons for the TSC.

Mr. Six indicated that he would pass on the information to the Executive Director of PSMFC.

2. Pacific whiting (Hake), prepared by Drs. Methot and Richards and Mr. Saunders - approved.

"The TSC commends the working group for its documentation of historical hake allocation and for its description of an allocation option based on the distribution of mature biomass in summer surveys. The TSC recommends that the Parent Committee again requests the participation of U.S. and Canadian fishery managers to deliberate this option, and possible other options for bi-national allocation of this resource's yield. Continued delay in agreement on allocation may result in overharvest and decline in future total yields."

3. Historic Annotated landings (HAL) database, prepared by Mr. Millikan - approved.

"The Technical Subcommittee discussed the status of the Historic Annotated Landings (HAL) coastwide groundfish database. We believe that this important data set should be submitted to contributing agencies for final review and subsequent to review, be made available upon request."

Dr. Methot suggested that a letter to this effect should be sent from Guy Thornburgh of the PSMFC to Richard Marasco of the AFSC. This suggestion was adopted as part of the recommendation.

C. From the TSC to the Working Groups

1. The TSC made the following specific recommendations to the Pacific Whiting (Hake) Working Group. The recommendation was attached as part of the Hake recommendation to the Parent Committee by Drs. Methot and Richards and Mr. Saunders.

"The current description of the survey-based allocation option does not include some technical issues:

- a. Adjustment for biomass located north of the historical survey area,
- b. Examination of the adequacy of survey coverage within the survey area,
- c. Correction for inaccuracy in the previous assumption that the survey measured the mean biomass within the fishery period.

The TSC recommends that the working group thoroughly examine these issues in the stock assessment document and make adjustments as necessary."

Dr. Methot explained that recommendation "c" is a timing issue where data needs to be corrected for survey timing in relationship to the fishery. The recommendation was adopted as amended.

XII. SCHEDULE OF FUTURE MEETINGS

Mr. Demory stated that the next meeting would be held in Newport, Oregon during the first full week in June, June 4,5, and 6, 1991.

XIII. ELECTION OF CHAIRPERSON

Mr. Jagielo lead us through a discussion on rotation. Each agency contributes a chairperson for two years. This was Washington's second year and so it is time to change.

The rotation will be as follows:

1991-92 NMFS
1993-94 California
1995-96 Canada
1997-98 Alaska
1999-2000 Oregon
2001-2002 Washington

Mr. Wilkins, NMFS, AFSC was appointed as the 1991-92 chairperson.

IVX. ADJOURNMENT

The meeting adjourned at 1145 hours, June 7, 1990.

Mr. Jagielo thanked the Alaskan delegation for hosting the meeting on behalf of the TSC. Chairman Jagielo was in turn thanked for a job well done.

Appendix A. List of attenders, TSC meeting, June 5-7, 1990, Sitka, Alaska.

| <u>Name</u> | <u>Agency</u> | <u>Address</u> | <u>Telephone No.</u> |
|------------------|---------------|---|----------------------|
| Gary Gunstrom | ADF&G | P.O. Box 20 Douglas, AK 99824 | (907)465-4250 |
| Dave Carlile | ADF&G | P.O. Box 3-2000 Juneau, AK 99802 | (907)465-4210 |
| Joan Ried Brodie | ADF&G | 211 Mission Road Kodiak, AK 99615 | (907)486-4791 |
| Mark Saunders | D.F.O. | Pacific Biological Station Nanaimo, B. C. V9R5K6 | (604)756-7154 |
| Laura Richards | D.F.O. | Pacific Biological Station Nanaimo, B. C. V9R5K6 | (604)756-7177 |
| Ed Zyblut | D.F.O. | 555 W. Hastings St. Vancouver, B.C. V6B5G3 | (604)666-3167 |
| Barry Ackerman | D.F.O. | 55 W Hastings St Vancouver, B.C. V6B5G3 | (604)666-3991 |
| Hal Weeks | NPEMC | PO Box 103136 Anchorage, AK 99510 | (907)271-2809 |
| Al Millikan | WDF | 7600 Sand Point Way Bin C 15400 Seattle, WA 98195 | (206)545-6597 |
| Bob Trumble | IPHC | PO Box 95009 Seattle, WA 98145 | (206)634-1838 |
| Larry Six | PFMC | 2000 SW First Ave. Rm 420 Portland, OR 97201 | (503)326-6352 |
| Richard Methot | NMFS-AFSC | 7600 Sand Point Way NE Bin C15700, Bldg 4 Seattle, WA 98115 | (206)526-6525 |
| Robert Demory | ODFW | Bldg 3, Marine Science Dr. Newport, OR 97365 | (503)867-4241 |
| Bill Lenarz | NMFS- SWFC | 3150 Paradise Drive Tiburon, CA 94920 | (415)435-3149 |

| <u>Name</u> | <u>Agency</u> | <u>Address</u> | <u>Telephone No.</u> |
|----------------|---------------|--|----------------------|
| Mark Wilkins | NMFS-AFSC | 7600 Sand Point Way NE Bin C-15700, BLdg 4 Seattle, WA 98115 | (206)526-4104 |
| Dave Clausen | NMFS-ABL | Auke Bay Laboratory Box 210155, Auke Bay, AK 99821 | (907)789-6049 |
| Dave Gordon | ADF&G | 304 Lake Street, Rm 103 Sitka, AK 99835 | (907)747-6688 |
| Tory O'Connell | ADF&G | 304 Lake Street, Rm 103 Sitka, AK 99835 | (907)747-6688 |
| Barry Bracken | ADF&G | PO Box 667 Petersburg, AK 99833 | (907)772-3806 |
| Tom Jagielo | WDF | 7600 Sand Pt Way, BLdg 4 Seattle, WA 98115 | (206)545-6594 |

Appendix B. Agenda for the 31st annual meeting of the Technical Subcommittee of the Canada-USA Groundfish Committee, Sitka, Alaska, June 5-7, 1990.

- I. CALL TO ORDER
- II. APPOINTMENT OF SECRETARY
- III. INTRODUCTIONS
- IV. APPROVAL OF THE 1989 REPORT AND THE 1990 AGENDA
- V. TERMS OF REFERENCE
- VI. WORKING GROUP REPORTS
 - A. CARE
 - B. PACFIN - PSMFC Data Series Project
 - C. Stock Assessment Groups (Include discussion of current management practices)
 - 1. Yellowtail Rockfish
 - 2. Pacific whiting (Hake)
 - D. Other
- VII. REVIEW OF GROUND FISH FISHERIES
 - A. Commercial
 - B. Recreational
 - C. Foreign
 - D. Joint Venture
- VIII. REVIEW OF AGENCY GROUND FISH RESEARCH, ASSESSMENTS, MANAGEMENT, AND FISHERIES
 - A. Agency Overviews
 - B. By Species, by Agency
 - 1. Pacific Cod
 - 2. Rockfish (primarily yellowtail, Pacific ocean perch, canary, nearshore spp).
 - 3. Sablefish
 - 4. Flatfish
 - 5. Pacific Whiting (Hake)
 - 6. Dogfish
 - 7. Pollock
 - 8. Lingcod
 - 9. Other
 - C. Other Related Topics

- IX. OTHER TOPICS FOR DISCUSSION
 - A. Data reporting in TSC agency status reports
 - B. Future reports and agenda
- X. PROGRESS ON 1989 RECOMMENDATIONS
 - A. The TSC to itself
 - B. From the TSC to the Parent Committee
 - 1. PacFIN -PSMFC data series merger resolution
 - 2. Pacific whiting (hake) resolution
 - 3. Historic Annotated Landings (HAL) resolution
- XI. 1990 TECHNICAL SUBCOMMITTEE RECOMMENDATIONS
- XII. SCHEDULE OF FUTURE MEETINGS
- XIII. ELECTION OF CHAIRPERSON
- XIV. ADJOURNMENT

Appendix C. CARE Report to the TSC, June 1990.

CARE REPORT TO TSC JUNE 1990

C.A.R.E. met at the Sand Point, Seattle facilities between 1:00 p.m. 16th May and noon 18th May 1990. There were 15 participants from Alaskan, Canadian, Washington, Oregon and Californian fisheries agencies. New participants came from California and the I.P.H.C. A list of participants is attached.

Format changes to the manual were recommended. It was decided that only information and recommendations that could be finalized and agreed upon would be added to the manual. All other information presented in the biannual meetings would remain detailed in the minutes to act as a reference for future meetings and discussions.

Changes and additions to the manual text are being submitted to P.S.M.F.C. They include: minor text changes to the "old" manual, the exchange and sablefish addenda, otolith storage methods, and the Bill Barrs Method for permanent storage of otolith burnt cross-sections. Photos and illustrations chosen for the rockfish and the sablefish criteria will be added to the manual once the text has been revised.

The C.A.R.E. minutes will include detailed information and recommendations on the following topics discussed at the May 1990 meeting: agency species status and validation updates, the fish ageing support system, precision systems, new age validation work, training methods, edge growth interpretation, age designation and flatfish ageing methods, criteria and problems. Copies of the minutes will be sent to each C.A.R.E. member and will be available to the T.S.C.

SUMMARY OF TOPICS AND RECOMMENDATIONS, MAY 1990 MEETING:

SPECIES AND VALIDATION UPDATES: See attached 1988 and 1990 updates.

FISH AGEING SUPPORT SYSTEM: This topic was met with a lot of interest by members. The object of verbalizing this system was to provide a way of making future recommendations to TSC to help promote satisfaction and therefore continuity of fish ageing personnel, in the interests of producing quality age data. Discussions revealed that most personnel and work problems were the result of two things: 1. lack of staffing which lead to time constraints and to the lack of job variety and 2. lack of communication between readers and users in terms of the "give and take" of age data information.

PRECISION SYSTEMS: Not all agencies conduct precision testing. Of those that do, it is used to monitor criteria drift over years and between readers, to assess precision within certain stocks or samples and during training to assess progress.

No recommendations were made as to any particular scheme, although it was noted that AFSC had a well documented system which has been in place for a number of years. The C.A.R.E. minutes will document the systems used by each group.

RECOMMENDATION to TSC: All agencies should institute a well documented and regular systematic precision testing program. Time to do this must be made available to the readers and should become a part of routine ageing procedure.

AGE VALIDATION WORK: AFSC is conducting radioisotope, OTC tag mark recovery research and juvenile incremental edge growth studies on sablefish otoliths.

DFO reported the write up for journal submission of the 1983 El Nino natural tag found on offshore Pacific whiting otoliths.

Preliminary work was finished on some otoliths of OTC injected English sole, with some opercular recovered as well.

Also there have been some recent recoveries of OTC tagged *S. flavidus* otoliths which have been at liberty up to 10 yrs (not processed at this time).

Cal Blood gave a brief presentation on the results of the IPHC's 1982 and 1983 OTC halibut tagging programs. Results indicated that the accuracy of readers ageing commercial age ranged halibut is within one year using the otolith surface method.

TRAINING METHODS: AFSC and DFO have comprehensive systems in place. Other agencies do have training plans, but not as formal. Similar methods are used in terms of supplying sample numbers, personal instruction, time expectations and attaining % agreement goals. Not all agencies formally assess agreement through precision testing. The C.A.R.E. minutes will detail each agencies' method.

RECOMMENDATION to TSC: It is crucial that readers be given the time, instruction, encouragement and assessment necessary in order to learn to provide confident age determinations. It is recommended that each agency institute a formal, documented training program which includes personal instruction with designated goals and precision testing.

EDGE GROWTH INTERPRETATION: Inaccurate interpretation of "new" edge growth on fish ageing structures often results in an ageing error of +/- one yr. All C.A.R.E. members were in agreement that especially for the otolith burnt cross-section method, this was a complex problem that would not be solved simply, if at all. Difficulties were perceived as a combination of artifacts caused by the actual procedure confounded by various seasonal deposition "schedules" of different life history stages and stocks.

It was suggested that perhaps fish should not be sampled during periods when they are actively growing. Avoiding this time frame, if possible, would eliminate some of the difficulties experienced when interpreting edge growth.

Questions were brought up as to "expected" growth and non-growth times not being as straight forward as might be previously assumed. The usual assumption is that fish start to grow in May-June and begin to slow growth in September-October. AFSC indicated that this may not be the case for some of their pollock, sablefish and Pacific whiting stocks.

RECOMMENDATION to TSC: Each agency should undertake to establish and document "expected" times of growth and non-growth for each stock and life history stage of species aged. This would provide fish agers with a time frame for edge growth deposition that would enable them to more accurately assign age class.

AGE DESIGNATION: Each agency described the age designation system they used for the C.A.R.E. minutes. California designates age by year class. Most other agencies simply write down the age class, indicating the number of annuli "completely" formed. The amount of new edge growth and time of year caught are taken into consideration with reference to the Jan. 1st birthday. DFO uses a bracket system which describes both year class and edge growth.

RECOMMENDATION to TSC: It is recommended that a single age designation system be adopted to avoid confusion of future exchanges and cooperative work.

FLATFISH WORKSHOP: The flatfish species and ageing methods used by each agency are listed on the attached species update for 1990.

Problems and criteria: DFO outlined the general criteria used to age their flatfish using the otolith burnt xs. method. All agencies acknowledged using similar criteria and agreed that there were some minor interpretative difficulties involved. These were; tracing annuli, irregular annual growth during younger years, the presence of checks along the "fast-growth" axes close to the distal surface and that the symmetrical and asymmetrical otoliths present somewhat different patterns. CDFG and ODFW were the only agencies with a specific problem, ageing Dover sole (otolith burnt xs.), especially older fish. They feel that recent meetings have overcome some precision problems between agencies and readers.

Workshop: Unfortunately, because of a bomb threat and members having to leave the meeting early, not as much was accomplished during the workshop as was hoped. The group had a brief chance to look at the problems ageing Dover sole. Crystallization and incomplete deposition along the proximal edges of the otolith cross-sections of older fish made determination of total age difficult. Identification of annuli and checks at various life history stages was also an issue. Neither problem was resolved at the workshop.

RECOMMENDATION to TSC : Validation work is required on Dover sole along with further development of criteria to help improve precision.

Officers selected for the next 2 year term were Craig Kastelle (AFSC) as Chair and Bill Barrs (ODFG) as Vice-chair.

Appendix D. Working group report on the yellowtail rockfish fisheries.

Working Group Report on the Yellowtail Rockfish Fisheries

**Jack V. Tagert
and
R. D. Stanley**

June 1990

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

This document follows the earlier progress reports (June 89 ad September 89) of the Yellowtail Rockfish Working Group. It summarizes progress made from September 1989 to June 1990 and outlines the objectives through December 1990.

1. Biological database

1.1 Update

We have not added any records to the Master database since it was first compiled. All agencies will be requested to submit additional biological data from 1988 and 1989 samples by January 1991. The necessary delays in the addition of new records reflect age reading backlogs and available time of Working Group members to collect and compile the data.

1.1.1. Canada

All 1988 records are complete and available at this time. The 1989 sample data will be complete by December 31, 1990, however, recently aged material from 1988 are being utilized for current year stock assessments.

1.1.2. California

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 obtained from samples of landings from the California commercial trawl fishery and covering the period, 1978 to 1988. These data were made available to the working group in a multi-record format which is incompatible with the Master yellowtail rockfish 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 converted to the Master database format. We expect that with the addition of 1989 data, these records will be added to the Master database by January 1991.

1.1.3. Oregon

We have not yet requested additional data from ODFW.

1.1.4. Washington

Age reading is complete for most 1988 samples and in progress for 1989 samples. Final data through 1989 is expected to be complete by December 31, 1990.

1.1.5. NMFS

The NMFS/AFSC collected additional length, weight and age samples from yellowtail rockfish during their 1989 triennial groundfish survey. The length and weight data could be available by January 1991, however, the age structures have yet to be examined. Mark Wilkins (NMFS) advised us that otoliths were collected from 464 yellowtail rockfish during the survey. We will evaluate the available age reader time and determine the feasibility of assigning final ages to these structures by January 1991.

1.2 Data report

A data report/user's guide to the database is being prepared and will be published in the WDR data report series, authored by Jack Tagart and Rick Stanley.

1.3 Release of the database

In late November of 1989, Dr. Maxwell (Mickey) Eldridge, NMFS/SWFC Tiburon Laboratory, Tiburon, California, requested and received a copy of the Master yellowtail rockfish biological database. Dr. Eldridge has been investigating the physiology of yellowtail rockfish for several years and was interested in comparing length and age of fish collected during his research with samples from the coastal fishery.

2. Stock Assessments

2.1 Submitted for 1990

2.1.1. Canada

The Canadian yellowtail rockfish assessment was accepted by the Pacific Stock Assessment Review Committee (PSARC) of the Department of Fisheries, Canada, September 1990.

Stanley, R.D. 1990. Shelf rockfish. In: A.V. Tyler [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. 1732:259-304.

The analysis treats the Queen Charlotte Sound and Nootka areas (central Vancouver Island) as separate stocks. Current stock biomass in Q.CSd. appears similar to pre-fished levels and indicates that the previous 20 years of harvest had not resulted in overfishing. Managers were advised however of the preliminary nature of the catch-at-age analysis.

The time series of fishery data for the Nootka fishery, which only became a significant fishery in 1986, is too short to analyze with traditional methods. Managers have been advised to restrict harvests to 500-1000 t until more information is available.

2.1.2. U.S.

A draft of the U.S. yellowtail rockfish assessment was distributed for review to the Pacific Fishery Management Council's Scientific and Statistical Committee and Groundfish Management Committee on March 1, 1990.

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

The author has received comments from reviewers and a revised document is currently in preparation. The revised final document will be re-submitted to the Council by June 1, 1990.

The current analysis examines biological data from four operational stocks: North Vancouver/Charlotte, South Vancouver, North Columbia, and Eureka/South Columbia. The Vancouver Area is divided so that the southern Vancouver stock includes PMFC area 3B, 3CS and 3CN; the northern Vancouver stock is represented exclusively by PMFC area 3D. In the Columbia Area, the northern stock is from PMFC 3A,

and the southern stock therefore includes PMFC areas 2B and 2C. Population abundance is estimated for all stocks except North Vancouver/Charlotte. The geographical boundaries of these operational stocks is somewhat arbitrary. In part, they represent localized aggregations inferred from the concentration of commercial fishing effort.

Reviewers of the draft document have expressed some criticism of the stock boundaries. Basic concerns involve 1) whether PMFC area 3D should be included with the remainder of the Vancouver area stock, and 2) whether the southern Vancouver area stock should be merged with the northern Columbia area. It has also been suggested that all US data be included in one coastwide US stock excluding any Canadian data.

In section 4.2 of this report we discuss current research on stock delineation. Although research is continuing on this subject, the Working Group is assuming from a limited number of tag recoveries that the Vancouver Area includes a population which is continuous across the US/Canada provisional boundary (Stanley 1990).

Mr. Tagart's report presents population estimates from cohort analysis and stock synthesis, but relies primarily on stock synthesis to estimate current stock condition. The draft report has been criticized for being too optimistic in its view of current population abundance. The revised report will provide a more detailed analysis of the causes of this optimism, and may result in more conservative estimates of stock condition.

2.2 1991 assessments

2.2.1 Canada

A completed assessment for the 1991 management year will be submitted to the PSARC by September, 1990. The Canadian assessment will treat the yellowtail rockfish population as three stocks: Queen Charlotte Sound (PMFC 5A+5B); Central Vancouver Island (PMFC3D); and southern Vancouver Island - Northern Washington (PMFC 3B+3C). The 3B+3C assessment will be conducted jointly by WDF and DFO staff. The assessments will rely heavily on the Stock Synthesis model of Rick Methot (NMFS).

2.2.2 U.S.

There will be no new assessment of yellowtail stock condition for the 1991 fishing year. The 1990 assessment will be used to project recommended ABC's and harvest quotas.

2.2.3 Joint assessments

Based on limited tag returns (Stanley 1990), the Working Group assumes that there is a trans-boundary stock occupying at least PMFC Area 3C (Canada and U.S) and 3B. This stock may also include populations to the north and south but at this time there is no convincing evidence to support this hypothesis.

The current U.S. assessment under review treated these fisheries as one stock. Although no further analysis is planned for the U.S. assessment for 1990, the Canadian assessment due in September 1990, will include an assessment of this stock. The Working Group will conduct this assessment jointly, work schedules permitting.

3. Management options

The Working Group will recommend that the bilateral discussions on the trans-boundary nature of these fisheries treat the PMFC 3C and 3B Areas as a stock and exclude from consideration the fisheries to the north and south. Managers will have available both the U.S. assessment currently under review which is based on fishery data up to 1988, and a joint assessment using more recent data which will be complete for September 1990.

Managers are reminded that the offshore hake fishery results in a significant harvest from this 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.

To assist managers in their allocation discussion, the assessment will include a summary of landings by year, nation, and gear type. The Working Group will provide managers with a recommended plan harvest range or ranges.

4. Research

4.1 Ageing report

The Working Group briefly examined inter-agency agreement in age estimation for yellowtail rockfish. In a test sample of 200 specimens (4 samples), DFO and WDF ageing personnel were in agreement for 20% of the specimens and were within 1 year for 70% of the specimens. A detailed report is attached as Appendix 1.

4.2 Stock delineation

4.2.1 Genetics

4.2.1.1. Review screening

Steve Phelps, Washington Department of Fisheries, completed electrophoretic screening of 45 yellowtail rockfish. Samples of 15 fish were collected from three locations: Central Oregon, Central Washington, and Northwest Vancouver Island. This screening was designed to determine the amount of electrophoretically detectable genetic variation in these samples. Fifty-nine loci were studied, including 21 loci previously examined by Wishard et al., (1980).

Presumptive genetic variation was found at five loci, AH-1 G3PDH-3, MPI, PIPA and PGDH. Variation at two of these loci, PEPA and PGDH, was previously identified by Wishard. None of the low frequency variants found by Wishard were observed in this study.

At G3PDH-3 and MPI, only a single variant fish was observed (G3PDH-3 was a fish from Canada and MPI was a fish from Oregon). At AH-1, three fish carrying the variant allele were observed (2 of 11 samples from Washington and 1 fish from Canada). However, none of the Oregon fish and only five fish from Canada had enzyme activity at this locus (all Washington fish had activity, but four of the Washington fish were used as controls and not tested at this locus). The AH-1 locus is one of the first loci to lose activity, therefore, the lack of activity among some samples may reflect handling problems related to improper freezing. Future examination of this locus will require freshly frozen samples maintained at ultra-cold temperatures.

Two other loci, DIAL and PEPC, have variable isozyme patterns, but increased enzyme activity and resolution is necessary before they will be useful for genetic studies on yellowtail rockfish. Again, high quality tissue samples and laboratory efforts to improve activity and resolution at these loci may make them useful for population genetic studies.

Although the sample sizes were small, Phelps compared the (word can't read) counts at PEPA and PGDH between the U.S (Washington and Oregon combined) and Canadian fish. There was a slightly significant difference at the PEPA locus (@ $X=1.95$, 1 df) and no difference at the PGDH locus (@ $X = 0.39$, 1 df).

The low amount of genetic variation is a hindrance to stock discrimination. Nevertheless, the significant difference observed at the PEPA locus does provide a glimmer of hope that we may be able to discriminate among some stocks.

4.2.1.2. Full sampling study

We plan to conduct a full scale genetic experiment during the fall of 1990 and spring of 1991 using larger sample sizes and more sample units. The current recommended sample size is 100 fish; although, we are investigating the power of the statistical test for difference among areas, to determine if there is an acceptable smaller sample size. We would like to sample a minimum of five sample units: Northwest Vancouver Island, Nootka Sound, Cape Flattery, Grays Harbor, and Heceta Bank/Eureka. Current estimates of costs for the genetic screening alone is \$11/fish, or \$5500 per seasonal sample. We are attempting to secure requisite funds to continue the project.

4.2.2. Parasites

4.2.2.1. Screening for parasite tags

A screening of 20 B.C. and 10 Washington specimens indicated 4 parasite species which showed promise as biological tags for stock identification. Two species of parasite were found which had not previously been observed in yellowtail rockfish. The report is in press.

4.2.2.2. Analysis of coastwide samples

DFO is currently examining the two coastwide collections. The examination protocol is concentrating on the 4 parasites identified in the screening phase. Examinations will be complete by January 1991. Analysis will be conducted in 1991.

4.2.3 Size at maturity

Using a stratified sampling design, 20 observations per (can't read word) increment, WDF sampled yellowtail rockfish females in February and March of 1989 and males in September of 1989 to determine the proportion mature at length. Separate samples were obtained from fish caught in the INPFC Columbia and U.S. Vancouver areas. Stage of maturity was determined through external examination of the gonads. Observations of the proportion mature at length were fit to a logistic equation and compared with estimates derived by Gunderson et al. (1980). Gunderson's samples were collected during summer months. There were significant differences between the curves for each INPFC area. The rate of maturation is similar for females in the Columbia and U.S. Vancouver areas but maturation occurs at an

earlier size for the Columbia area. The estimated length at which 50% of the fish are mature (1.50) was 43.7 cm (not sure of this either) for females in the Columbia area and 45.4 cm in the U.S. Vancouver area. Gunderson's estimate of 1.50 was 45.0 cm. However, their curve has a slower rate of ascent to full maturity than the curves from this study. A similar trend is observable for males with significantly different curves for the two INPFC areas, a more rapid ascent to full maturity and lower 1.50 values than Gunderson (37.5 cm for Columbia area, 30.6 cm for the U.S. Vancouver area and 40.7 cm for Gunderson et al.).

The immediate implication of these observations is that we may be witnessing compensatory changes in maturation as a consequence of declining yellowtail rockfish stock biomass. It also supports the contention of two different stocks between these two areas.

Literature Cited

- Gunderson, D.R., P. Callahan and B. Goiney. 1980. Maturation and fecundity of four species of *Sebastes*. *Marine Fisheries Review* March-April: 74-79
- Stanley, R.D. 1990. Shelf rockfish. In: Tyler, A.V. and J. Fargo [Eds.] *Groundfish stock assessments for the west coast of Canada in 1989 and recommended yield options for 1990*. *Can. Tech. Rep. Fish. Aquat. Sci.* 1732:259:304.
- Wishard, L.N., F. M. Utter, and D.R. Gunderson. 1980. Stock separation of five rockfish species using naturally occurring biochemical genetic markers, *Mar. Fish. Rev.* 42(3-4): 64-73.

Appendix 1

Between Agency Comparison of Yellowtail Rockfish Ageing

December 11-89

The working Group conducted a comparison of ageing results between the agencies responsible for yellowtail rockfish ageing.

Four, 50-fish Canadian samples were aged by staff from both the Washington Department of Fisheries (WDF) and Department of Fisheries and Oceans, Canada (DFO). The samples were chosen to cover the whole age range and all four quarters within the year (Table 1).

Table 1. List of Samples

| Code Numbers | Date | Locality | Vessel |
|------------------|----------|------------|--------------|
| PRRF 6201- 6250 | 15/04/82 | S.E. Goose | Kawadi |
| VNRF 14401-14450 | 20/11/83 | Cape Scott | Nucleus |
| VNRF 18101-18150 | 22/01/85 | Nootka | Eastward Ho |
| VNRF 25201-25250 | 30/09/86 | Cape Scott | Arctic Ocean |

WDF results are expressed relative to DFO age. A difference of -1 indicates that the WDF reading was one year less than the DFO age. Three of the otoliths were rejected.

The overall comparison of the 197 specimens indicated 23% agreement; 72% were within plus or minus 1 year, and 92% were within 2 years (Table 2, Figure 1.).

Table 2. Percent Agreement

| Difference (DFO-WDF) | Number | % |
|----------------------|--------|----|
| -3 | 4 | 1 |
| -2 | 17 | 8 |
| -1 | 41 | 21 |
| 0 | 45 | 23 |
| +1 | 56 | 28 |
| +2 | 23 | 12 |
| +3 | 6 | 3 |
| +4 | 4 | 2 |
| +5 | 1 | 1 |

The difference did not indicate any major bias (Figure 2, Table 3). Mean WDF age was 16.2 and mean DFO age was 16.5. We grouped the ages into 5-year age classes. The mean difference showed no age-dependent trend but imprecision (standard deviation of the differences) did increase with age.

Table 3. Mean difference (diff=DFO-WDF) between agencies by age class

| Age Class | # | Mean Difference | Standard Deviation |
|-----------|----|-----------------|--------------------|
| 7-10 | 37 | 0.108 | 0.711 |
| 11-15 | 90 | -0.096 | 0.982 |
| 16-20 | 19 | 0.100 | 0.946 |
| 21-25 | 26 | 0.049 | 1.157 |
| 26-30 | 8 | -0.016 | 1.250 |
| 31+ | 17 | 0.094 | 1.366 |

The April, September, and November samples were similar. The January sample included a large proportion (>50%) of specimens which DFO aged as 1 year older than the WDF estimates. We have no explanation for this result, other than there may have been some confusion whether the official birthdate used for this sample was January 1. Both agencies will re-examine some specimens from this sample.

Overall, the readings are similar enough that assessments should not differ because of technique differences between agencies. Results are similar enough that stock assessments could safely use age readings from both agencies. The low percentage of agreement between agencies, even for young fish, is discouraging and indicates significant imprecision in ageing. This will not affect the ability of catch-at-large analyses to describe long-term trends but does reduce precision in estimating current biomass levels. It also implies that relative estimates of year-class size from catch at-age analyses will be imprecise. No further work is planned.

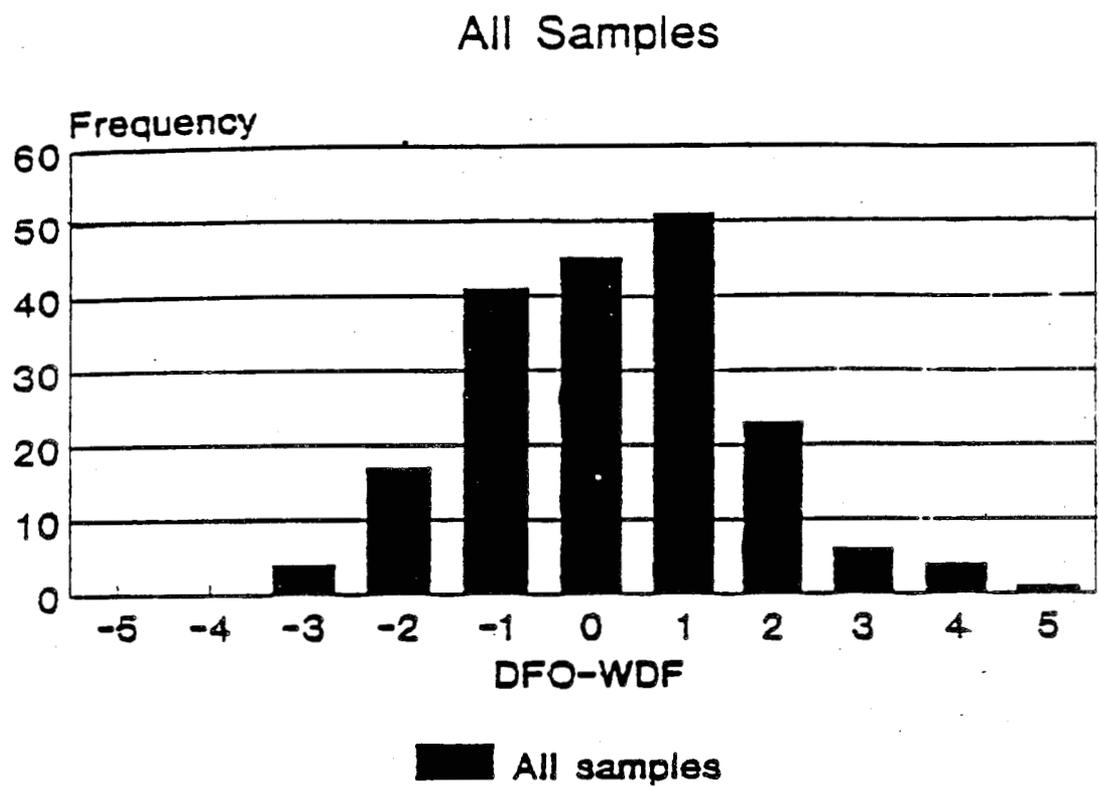


Figure 1. Histogram of differences between DFO and WDF age readings of yellowtail rockfish.

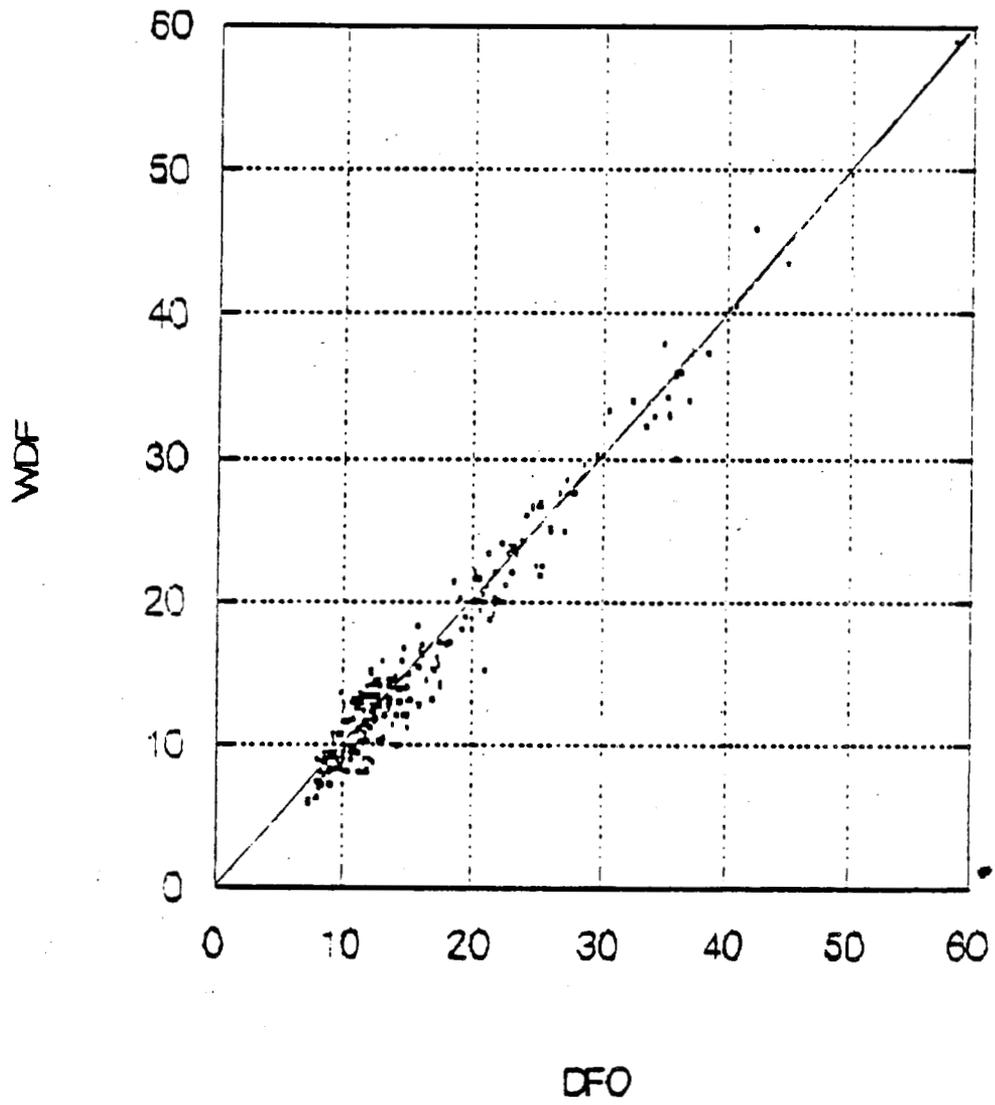


Figure 2. WDF age versus DFO age for yellowtail rockfish.

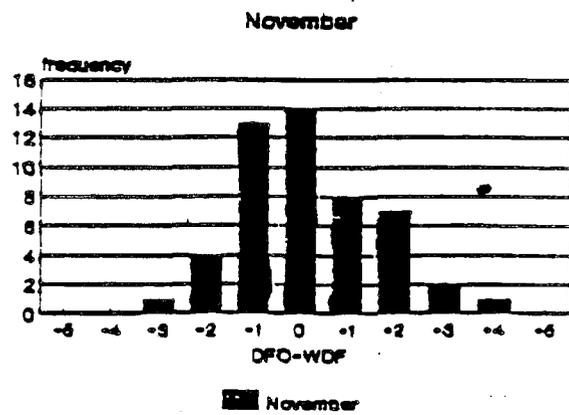
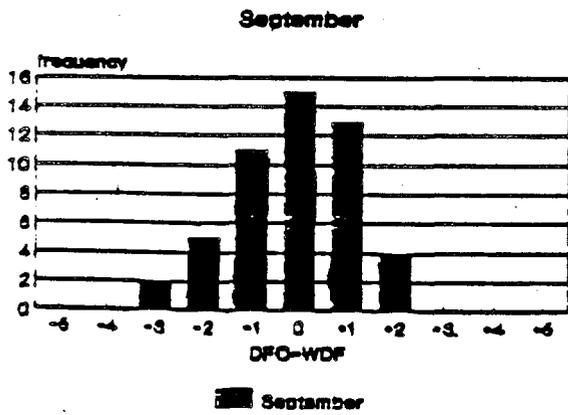
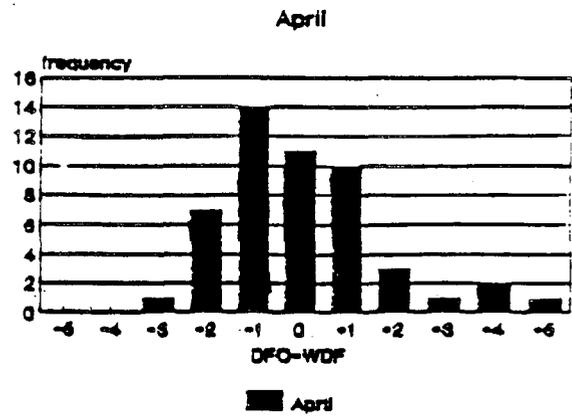
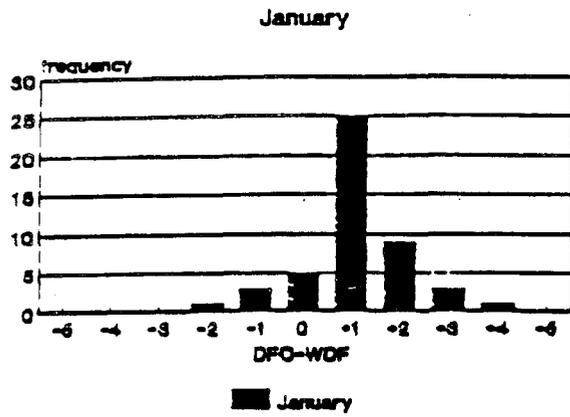


Figure 3. Histograms of differences between DFO and WDF age reading of yellow tail rockfish by sample.

Appendix E. Discussion paper on the bi-national allocation of Pacific hake.

Discussion Paper on the Bi-national Allocation of Pacific hake

U.S.-Canada Groundfish Technical Subcommittee

June 5, 1990

Allocation of the annual yield of Pacific hake between the U.S. and Canadian fisheries has become an important issue as the combined U.S. and Canadian harvests have reached the total ABC. In 1990 the total harvest probably will be slightly greater than the ABC because the U.S. quota is 80% of the ABC, the Canadian quota is 28% of the ABC, and the fleets in each national zone can be expected to take their entire quota. A long-term plan for bi-national allocation was discussed at a January 12, 1990 meeting of biologists and fishery managers from the U.S. and Canada. A draft, informal proposal was discussed and agreed upon, pending approval by each nation's management authority. In response to a request from the managers, this report reviews the allocation history of the Pacific hake resource and summarizes the implications of the proposed allocation plan. This report was prepared by the Pacific hake working group, a team of U.S. and Canadian biologists responsible for stock assessment of the Pacific hake resource.

The percentage of the harvest coming from each nation's coastal zone has not been constant during the exploitation history of resource. Three historical eras may be identified:

| Era | Average annual total harvest | % in U.S. |
|-------------|------------------------------|-----------|
| 1968 - 1972 | 162,000 mt | 63% |
| 1973 - 1979 | 172,000 | 94 |
| 1982 - 1987 | 152,000 | 71 |
| 1988 | 251,000 | 64 |
| 1989 | 309,000 | 70 |

The fraction of the yield in each national zone has been influenced by many factors, most of them unrelated to population biology. Some of these factors are 1) the fishing strategy of the foreign fleets, primarily Soviet and Polish, which dominated the early history of the fishery, 2) the granting and restricting of fishing privileges as a foreign policy tool, and 3) differing economic and management incentives for the fishing industry in the U.S. and Canada to expand joint venture and domestic fisheries for Pacific hake. As a result of these factors the historical record cannot be used to indicate the distribution of potential yield. Furthermore, in recent years management by both nations has been by the quota system and this has constrained the yield in each national zone.

The biological characteristics of Pacific hake need to be taken into account in a plan to allocate hake based on the observed distribution of biomass. The distribution of the hake biomass between the U.S. and Canada is not constant and depends on three (you lost a page here)

The proposed allocation procedure is based on the bi-national distribution of mature biomass-at-age. Mature biomass was used as the basis for allocation because total biomass is too heavily influenced by young fish that are not fully recruited to the fishery, and fishable biomass changes in definition as the

selectivity characteristics of the fishery changes. This allocation procedure is a refinement of the current methods, and is not necessarily the optimum split, which is not known.

The proposed allocation procedure would use the mean fraction of mature fish-at-age in each zone as estimated by the five triennial surveys. The procedure will take into account the timing of the surveys relative to the fishery removals, and incomplete survey coverage in Canadian waters. To obtain a split in biomass for a particular year, the projected numbers of mature fish-at-age for that year would be allocated according to the mean fraction of mature fish-at-age in each zone. These fish would be converted to biomass using zone-specific body weights-at-age (fish in Canadian waters are heavier), then summed over all ages to get the estimated total mature biomass in each zone. Then, fishing mortality rates would be set in each zone so that the percentage of the ABC in Canada would be equal to the percentage of the mature biomass expected to migrate into Canadian waters.

Allocating the annual yield by this method would harvest an equal fraction of the mature biomass on each side of national boundary--provided the age-specific distribution of mature fish at age for that year matched the average distribution as estimated by the triennial surveys. In any given year the actual distribution of mature fish at age may differ substantially from the survey average, as has been documented in the past (e.g. the 1983 El Nino). Since this situation cannot be predicted reliably, allocation would be set by the long range policy, and may result in different exploitation rates on the mature biomass in U.S. and Canadian waters. Provided the surveys give an accurate description of the current migratory behavior of the population, an imbalance of this kind should not persist.

If the above allocation procedure is adopted, the mean and variability of allocation is not expected to differ greatly from allocations calculated in recent years. The allocation will change from year-to-year as the age composition of the stock changes. When there is a sequence of poor recruitments, the mean age of fish will increase, stock size will decrease, and a greater fraction of the available yield will be allocated to Canada. When there is a very strong recruitment, or when high levels of fishing mortality reduce the abundance of old fish, then the fraction allocated to the U.S. fishery will increase. Longer term changes in allocation can occur as future surveys increase our knowledge of the average fraction-at-age found in Canadian waters. In 1990, the stock is dominated by older fish, primarily 6 and 10 years old, so in the short term the fraction allocated to Canada will be greater than the average Canadian allocation.

Appendix F. Reports published by the member agencies during 1989.

Canada

Reports published by the DFO groundfish program during the period May 1, 1989 to April 30, 1990 are listed below:

Antonsen, B. L., R. P. Foucher, J. Fargo, G. E. Gillespie, T. Johansson, A. V. Tyler, and H. L. Waye. Jan. 1990. F/V EASTWARD HO assemblage survey of Hecate Strait, May 24-June 13, 1989. Can. Data Rep. Fish. Aquat. Sci. 783: 142 p.

Beamish, R. J. and G. A. McFarlane (ed.). 1989. Effects of ocean variability on recruitment and an evaluation of parameters used in stock assessment models. Can. Spec. Publ. Fish. Aquat. Sci. 108.

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Alaska Department of Fish and Game

Reports Completed During 1989

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2. Bracken, B. E. 1989. Southeast Alaska and Yakutat area groundfish investigations, final report for the period July 1988 through June 30, 1989. AK. Dept. of Fish and Game Regional Info. Rpt. 1J89-23 ADF&G, Box 667, Petersburg, AK. 99833. 26p.
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Washington Department of Fisheries

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- Stick, K.S., and L.H. Hreha. 1989. Summary of the 1988 Washington/Oregon Experimental Thresher Shark Gill Net Fishery. *Wash. Dept. Fish. Prog. Rept. No. 275.* 40 p.

Oregon Department of Fish and Wildlife

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- Barss, W.H. 1989. Maturity and reproductive cycle for 35 species from the family Scorpaenidae off Oregon. *Ore. Dept. Fish and Wildl., Infor. Repts.*, 89-7. 36 p.
- Barss, W.H. and R. L. Demory. 1989. Movement of lingcod tagged off the central Oregon coast. *Ore. Dept. Fish and Wildl., Infor. Repts.*, 89-8. 12 p.
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California Department of Fish and Game

Nil Report

Appendix G. PacFIN Coast-Wide Grounfish Catch Report.

NOTE: It was agreed during the 1990 meeting 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.

GEAR ON FINA ("ALL USCDOM MT I INPFC Y 89 0 0 D")

DSED MISSING CODE FILE

#

RUN (PMFC0010)RPT/GEAR ON FINA ("ALL USCDOM MT I INPFC Y 89 0 0 D")

RUNNING 7810

7810 DISPLAY:(PMFC0010)FINDB: OPTION CONFLICT: AUDIT

7810 DISPLAY:(PMFC0010)FINDB: OPTION CONFLICT: STATISTICS

ET=7:16.1 PT=1:07.2 IO=22.6

#

RUN (PMFC0010)RPT/GEAR ON FINA ("ALL USCDOM MT I INPFC Y 88 0 0 D")

RUNNING 8365

8365 DISPLAY:(PMFC0010)FINDB: OPTION CONFLICT: AUDIT

8365 DISPLAY:(PMFC0010)FINDB: OPTION CONFLICT: STATISTICS

8365 PK196 (PMFC0120)RPTFILE REMOVED ON PMFC

ET=5:56.6 PT=1:02.6 IO=23.2

RUNNING 8672

US-CANADA DOMESTIC GEAR REPORT: COMM. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR ALL AREAS

| SPECIES | HAND LINE | JIG | LOONGLINE | OTH HK&LN | POLE (COM) | OTH-KNOWN | RVR-TRAWL | UNKN-GEAR | DIP NET | GILL NET |
|----------------------|-----------|-------|-----------|-----------|------------|-----------|-----------|-----------|---------|----------|
| ARROWTOOTH FLOUNDER | | TR | 3.4 | TR | TR | | | 0.4 | | |
| UNSPECIFIED TURBOTS | | | 29.6 | | | | | | | |
| ALASKA PLAICE | | | | | | | | | | |
| DOVER SOLE | | | 1.1 | | 13.9 | 1.2 | | 13.7 | TR | |
| ENGLISH SOLE | | TR | TR | | 6.6 | 1.6 | | 64.3 | TR | |
| GREENLAND TURBOT | | | 893.1 | | | | | | | |
| PETRALE SOLE | | TR | 0.5 | TR | 7.2 | 0.2 | | 34.8 | TR | |
| REX SOLE | | TR | TR | | 1.1 | 0.8 | | 10.4 | TR | |
| ROCK SOLE | | TR | 42.6 | | 0.3 | | | 0.7 | | |
| STARRY FLOUNDER | | TR | TR | TR | 0.1 | | | 11.9 | | 6.4 |
| YELLOWFIN SOLE | | | TR | | | | | | | |
| OTHER FLATFISH | | TR | TR | TR | 33.4 | | | 59.2 | | |
| UNSP. FLATFISH | | | 39.5 | | 2.0 | TR | | 6.7 | | TR |
| ALL FLATFISH | | 0.1 | 1009.7 | TR | 64.7 | 3.9 | | 202.1 | 0.1 | 6.4 |
| BLACK ROCKFISH | | | 14.9 | 13.4 | | | | | | |
| BOCACCIO | | | 0.6 | | 61.8 | | | | | |
| CANARY ROCKFISH | | | 2.0 | TR | 16.4 | | | | | |
| CHILIPEPPER | | | | | 30.2 | | | | | |
| DARKBLOTCHED ROCKFIS | | | 0.8 | | | | | | | |
| DUSKY ROCKFISH | | | 2.2 | TR | | | | | | |
| QUILLBACK ROCKFISH | | | 81.5 | 1.3 | | | | | | |
| REDBANDED ROCKFISH | | | 11.6 | | | | | | | |
| REDSTRIPE ROCKFISH | | | 0.4 | | 0.2 | | | | | |
| ROSETHORN ROCKFISH | | | 3.0 | TR | | | | | | |
| ROUGHEYE ROCKFISH | | | 129.9 | 1.3 | | | | | | |
| SHARPCHIN ROCKFISH | | | | | | | | | | |
| SHORTRAKER ROCKFISH | | | 4.5 | | | | | | | |
| SILVERGREY ROCKFISH | | | 2.5 | 0.1 | | | | | | |
| SPLITNOSE ROCKFISH | | | | | 1.7 | | | | | |
| YELLOWEYE ROCKFISH | | | 431.6 | 8.1 | 0.7 | | | | | |
| YELLOWMOUTH ROCKFISH | | | TR | | | | | | | |
| YELLOWTAIL ROCKFISH | | | 3.0 | 2.7 | 19.2 | | | | | |
| OTHER ROCKFISH | | | 1186.7 | | 184.1 | | | 1.8 | | 0.2 |
| PACIFIC OCEAN PERCH | | | 10.2 | | | | | | | |
| UNSP. POP GROUP | | | 111.7 | | | | | | | |
| SHORTBELLY ROCKFISH | | | | | | | | | | |
| THORNYHEADS | | | 577.4 | 0.3 | 15.6 | 0.1 | | 8.6 | | |
| WIDOW ROCKFISH | | | 0.1 | 0.3 | 5.7 | | | 206.8 | | |
| OTHER DEMERSAL RKFSH | | | 4.9 | TR | | | | | | |
| OTHER SLOPE RKFSH | | | 85.7 | 0.6 | | | | | | |
| UNSP. DEMERSAL RKFSH | | | 133.4 | | | | | | | |
| UNSP. PELAGIC RKFSH | | | 16.9 | | | | | | | |
| UNSP. SLOPE RKFSH | | | 98.1 | | | | | | | |
| UNSP. ROCKFISH | | 189.1 | 412.4 | 239.3 | 1817.2 | 5.8 | | 650.5 | 0.1 | 0.1 |
| ALL ROCKFISH | | 189.1 | 3326.0 | 267.4 | 2152.8 | 5.9 | | 867.7 | 0.1 | 0.2 |
| ATKA MACKEREL | | | TR | | | | | | | |
| JACK MACKEREL | | | | TR | | | | | | |
| LINGCOD | | 76.6 | 804.8 | 177.1 | 346.6 | 0.3 | | 88.6 | | 0.2 |
| PACIFIC COD | | 4.9 | 17641.7 | 1.1 | TR | | | TR | | 1.0 |
| PACIFIC WHITING | | | | | 56.5 | | | 491.3 | | |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR ALL AREAS

| SPECIES | HAND LINE | JIG | LOGLINE | OTH HK&LN | POLE (COM) | OTH-KNOWN | RVR-TRAWL | UNKN-GEAR | DIP NET | GILL NET |
|--------------------|-----------|-------|---------|-----------|------------|-----------|-----------|-----------|---------|----------|
| SABLEFISH | - | 0.1 | 32141.8 | 0.3 | 336.6 | 1.4 | - | 32.4 | - | - |
| WALLEYE POLLOCK | - | - | 284.9 | TR | - | - | - | - | - | - |
| OTHER ROUND FISH | - | - | - | - | - | - | 6.2 | - | 1370.9 | 20.4 |
| UNSP. ROUND FISH | - | - | TR | 0.1 | - | - | - | - | - | - |
| ALL ROUND FISH | - | 81.5 | 50873.3 | 178.6 | 739.7 | 1.7 | 6.2 | 612.3 | 1370.9 | 21.6 |
| SPINY DOGFISH | - | 1.2 | 3416.7 | TR | - | - | - | - | - | 35.5 |
| UNSPECIFIED SHARK | - | - | 0.4 | - | - | - | - | - | - | - |
| UNSPECIFIED SKATE | - | - | 10.5 | - | - | - | - | - | - | - |
| UNSPECIFIED SQUID | - | - | 0.4 | - | - | 0.3 | - | - | - | - |
| OTHER GROUND FISH | 0.1 | 0.8 | 24.7 | 5.4 | 21.5 | 0.2 | - | 15.9 | 1156.6 | 2.8 |
| UNSP. GROUND FISH | - | - | 94.3 | 1.7 | 2.9 | TR | - | 9.8 | TR | 7.8 |
| MISC. GROUND FISH | 0.1 | 2.0 | 3547.0 | 7.1 | 24.3 | 0.5 | - | 25.7 | 1156.7 | 46.1 |
| ALL GROUND FISH | 0.1 | 272.7 | 58756.1 | 453.1 | 2981.4 | 12.0 | 6.2 | 1707.8 | 2527.7 | 74.2 |
| CALIFORNIA HALIBUT | - | - | - | - | 59.3 | - | - | 87.3 | - | 0.3 |
| PACIFIC HALIBUT | - | 2.4 | 2885.9 | 0.3 | - | - | - | 0.1 | - | - |
| PINK SHRIMP | - | - | - | - | - | - | - | - | - | - |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR ALL AREAS

| SPECIES | OTHER NETS | SEINE | SET NET | CRAB POT | FISH POT | OTHER POTS | TROLL | BEAM TRAWL | BTM-TRAWL | GFSH-TRAWL |
|----------------------|------------|-------|---------|----------|----------|------------|-------|------------|-----------|------------|
| ARROWTOOTH FLOUNDER | - | - | 0.1 | - | 0.3 | 6.4 | TR | - | 612.5 | 4182.6 |
| UNSPECIFIED TURBOTS | - | - | - | - | - | - | - | - | - | 6.2 |
| ALASKA PLAICE | - | - | - | - | - | - | - | - | - | - |
| DOVER SOLE | 3.4 | - | TR | - | TR | 9.8 | TR | - | 3075.2 | 13257.6 |
| ENGLISH SOLE | 24.4 | - | 0.1 | - | - | 0.9 | TR | - | 1144.4 | 1675.2 |
| GREENLAND TURBOT | - | - | - | - | - | - | - | - | - | 18.3 |
| PETRALE SOLE | 18.1 | - | - | TR | - | 0.4 | 0.1 | - | 1022.0 | 1354.0 |
| REX SOLE | 3.1 | - | - | TR | - | 0.3 | TR | - | 218.8 | 754.1 |
| ROCK SOLE | TR | - | TR | TR | - | 23.4 | TR | - | 2073.9 | 1053.2 |
| STARRY FLOUNDER | 1.4 | TR | 0.2 | TR | - | - | 0.5 | - | 126.3 | 877.1 |
| YELLOWFIN SOLE | - | - | - | - | - | - | - | - | 2.3 | 57.9 |
| OTHER FLATFISH | 48.7 | - | 0.1 | TR | - | 3.8 | TR | - | 116.6 | 861.1 |
| UNSP. FLATEFISH | 28.2 | - | - | - | - | 0.2 | TR | - | 4.0 | 178.1 |
| ALL FLATFISH | 127.3 | TR | 0.6 | 0.1 | 0.3 | 45.2 | 0.7 | - | 8396.1 | 24275.4 |
| BLACK ROCKFISH | - | - | - | - | - | - | - | - | 9.3 | 131.3 |
| BOCACCIO | - | - | - | - | - | - | - | - | 815.9 | 415.3 |
| CANARY ROCKFISH | - | - | - | - | - | - | - | - | 1771.0 | 2123.3 |
| CHILIPEPPER | - | - | - | - | - | - | - | - | 172.5 | 4.9 |
| DARKBLOTCHED ROCKFIS | - | - | - | - | - | - | - | - | 112.1 | 701.1 |
| DUSKY ROCKFISH | - | - | - | - | - | - | - | - | - | 2.7 |
| QUILLBACK ROCKFISH | - | - | - | - | - | - | - | - | - | TR |
| REDBANDED ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| REDSTRIPE ROCKFISH | - | - | - | - | - | - | - | - | 1601.3 | 389.8 |
| ROSETHORN ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| ROUGHEYE ROCKFISH | - | - | - | - | - | - | - | - | 1003.0 | 0.3 |
| SHARPCHIN ROCKFISH | - | - | - | - | - | - | - | - | 196.0 | 402.7 |
| SHORTRAKER ROCKFISH | - | - | - | - | - | - | - | - | 43.9 | 0.5 |
| SILVERGREY ROCKFISH | - | - | - | - | - | - | - | - | 2814.9 | 222.1 |
| SPLITNOSE ROCKFISH | - | - | - | - | - | - | - | - | 173.2 | 117.1 |
| YELLOWEYE ROCKFISH | - | - | - | - | - | - | - | - | 36.4 | 185.7 |
| YELLOWMOUTH ROCKFISH | - | - | - | - | - | - | - | - | 1560.5 | 379.9 |
| YELLOWTAIL ROCKFISH | - | - | - | - | - | - | 2.6 | - | 2343.6 | 3407.9 |
| OTHER ROCKFISH | 1.7 | - | - | - | - | TR | 592.2 | - | 557.8 | 1229.3 |
| PACIFIC OCEAN PERCH | - | - | - | - | - | - | 0.2 | - | 5941.2 | 2845.4 |
| UNSP. POP GROUP | - | - | - | - | - | - | - | - | - | - |
| SHORTBELLY ROCKFISH | - | - | - | - | - | - | - | - | - | 2.2 |
| THORNYHEADS | 0.3 | - | - | - | 0.2 | 13.4 | - | - | 642.0 | 2732.8 |
| WIDOW ROCKFISH | 37.0 | - | - | - | - | - | - | - | 726.7 | 6215.4 |
| OTHER DEMERSAL RKFSH | - | - | - | - | - | - | - | - | - | - |
| OTHER SLOPE RKFSH | - | - | - | - | - | - | - | - | - | 126.3 |
| UNSP. DEMERSAL RKFSH | - | - | - | - | - | - | - | - | - | - |
| UNSP. PELAGIC RKFSH | - | - | - | - | - | - | - | - | - | - |
| UNSP. SLOPE RKFSH | - | - | - | - | - | - | - | - | - | - |
| UNSP. ROCKFISH | 1792.1 | - | 1.2 | 0.5 | 0.4 | 24.1 | 141.6 | - | 357.7 | 3688.6 |
| ALL ROCKFISH | 1831.1 | - | 1.2 | 0.5 | 0.6 | 37.5 | 736.6 | - | 20879.2 | 25324.5 |
| ATKA MACKEREL | - | - | - | - | - | - | - | - | - | 861.8 |
| JACK MACKEREL | - | - | - | - | - | - | - | - | - | TR |
| LINGCOD | 191.3 | TR | 0.3 | 0.1 | 0.1 | 4.4 | 550.3 | - | 3099.6 | 2176.0 |
| PACIFIC COD | TR | - | 0.1 | - | TR | 540.9 | 3.0 | - | 9148.6 | 65501.1 |
| PACIFIC WHITING | 0.8 | - | - | - | - | 6.9 | TR | - | 0.1 | 8131.9 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR ALL AREAS

| SPECIES | OTHER NETS | SEINE | SET NET | CRAB POT | FISH POT | OTHER POTS | TROLL | BEAM TRAWL | BTM-TRAWL | GFSH-TRAWL |
|--------------------|------------|-------|---------|----------|----------|------------|--------|------------|-----------|------------|
| SABLEFISH | 55.4 | - | - | - | 4834.6 | 861.9 | 2.2 | - | 924.7 | 3862.4 |
| WALLEYE POLLOCK | - | - | - | - | - | - | - | - | 35.1 | 39451.5 |
| OTHER ROUND FISH | - | 43.5 | TR | - | - | - | - | - | - | - |
| UNSP. ROUND FISH | - | - | - | - | - | - | - | - | - | TR |
| ALL ROUND FISH | 247.4 | 43.5 | 0.5 | 0.1 | 4834.7 | 1414.1 | 555.5 | - | 13208.1 | 119984.8 |
| SPINY DOGFISH | - | - | 162.4 | - | - | - | 9.2 | - | 974.5 | 1090.1 |
| UNSPECIFIED SHARK | 0.1 | - | - | - | - | - | - | - | - | - |
| UNSPECIFIED SKATE | - | - | - | - | - | - | 2.1 | - | - | - |
| UNSPECIFIED SQUID | - | - | - | - | - | - | - | - | TR | 4.8 |
| OTHER GROUND FISH | 69.5 | 40.4 | 0.9 | 0.8 | - | 15.4 | 0.3 | 80.3 | 159.3 | 186.2 |
| UNSP. GROUND FISH | 17.5 | - | - | TR | - | 1.3 | 0.3 | - | 250.6 | 169.8 |
| MISC. GROUND FISH | 87.1 | 40.4 | 163.3 | 0.8 | - | 16.8 | 11.9 | 80.3 | 1384.4 | 1450.9 |
| ALL GROUND FISH | 2292.9 | 84.0 | 165.5 | 1.5 | 4835.6 | 1513.6 | 1304.7 | 80.3 | 43867.7 | 171035.6 |
| CALIFORNIA HALIBUT | 277.7 | - | - | - | - | 1.5 | 0.5 | - | 6.4 | - |
| PACIFIC HALIBUT | - | - | - | - | - | - | 4.5 | - | - | 0.3 |
| PINK SHRIMP | - | - | - | - | - | 4.1 | - | 5.8 | - | - |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR ALL AREAS

| SPECIES | MID-TRAWL | OTH TRAWLS | DBL-SHRIMP | SHMP-TRAWL | SGL-SHRIMP | ALL GEARS |
|----------------------|-----------|------------|------------|------------|------------|-----------|
| ARROWTOOTH FLOUNDER | 69.6 | 214.3 | 4.1 | 0.3 | 0.2 | 5094.2 |
| UNSPECIFIED TURBOTS | | 673.8 | | | | 703.4 |
| ALASKA PLAICE | | | | | | 6.2 |
| DOVER SOLE | 0.3 | 6750.7 | 19.4 | 5.7 | 2.2 | 23154.3 |
| ENGLISH SOLE | 0.5 | 842.4 | 0.7 | TR | TR | 3761.5 |
| GREENLAND TURBOT | 0.2 | 7878.6 | | | | 8790.2 |
| PETRALE SOLE | 0.7 | 696.7 | 0.5 | 0.1 | 0.1 | 3135.3 |
| REX SOLE | 5.7 | 651.9 | 0.1 | 0.1 | 0.1 | 1646.6 |
| ROCK SOLE | 15.8 | 23637.4 | | 0.2 | | 26847.6 |
| STARRY FLOUNDER | | 45.0 | | | TR | 1068.9 |
| YELLOWFIN SOLE | 4.9 | 1601.4 | | | | 1666.5 |
| OTHER FLATFISH | 53.4 | 578.9 | 0.4 | 0.2 | TR | 1755.9 |
| UNSP. FLATFISH | 471.7 | 2544.2 | | 0.7 | | 3275.3 |
| ALL FLATFISH | 622.8 | 46115.4 | 25.2 | 7.3 | 2.6 | 80905.9 |
| BLACK ROCKFISH | | 29.0 | | | | 197.8 |
| BOCACCIO | 79.5 | 273.0 | TR | | 0.1 | 1646.2 |
| CANARY ROCKFISH | 45.0 | 63.3 | 21.9 | | 0.7 | 4043.6 |
| CHILIPEPPER | | 516.5 | | | | 724.2 |
| DARKBLOTCHED ROCKFIS | 3.0 | 131.3 | TR | | 0.5 | 948.9 |
| DUSKY ROCKFISH | | | | | | 5.0 |
| QUILLBACK ROCKFISH | | | | | | 82.8 |
| REDBANDED ROCKFISH | | | | | | 11.6 |
| REDSTRIPE ROCKFISH | 13.5 | 2.3 | 0.2 | | 0.4 | 2008.2 |
| ROSETHORN ROCKFISH | | | | | | 3.0 |
| ROUGHEYE ROCKFISH | 0.3 | | | | | 1134.8 |
| SHARPCHIN ROCKFISH | | 14.4 | 0.1 | | 0.5 | 613.6 |
| SHORTRAKER ROCKFISH | TR | | | | | 48.9 |
| SILVERGREY ROCKFISH | 16.5 | | | | | 3056.2 |
| SPLITNOSE ROCKFISH | 1.6 | 39.0 | 0.1 | | 0.1 | 332.7 |
| YELLOWEYE ROCKFISH | TR | 4.3 | TR | | 0.1 | 666.7 |
| YELLOWMOUTH ROCKFISH | 42.1 | | 0.2 | | 0.1 | 1982.7 |
| YELLOWTAIL ROCKFISH | 2046.4 | 134.3 | 534.9 | | 24.1 | 8518.6 |
| OTHER ROCKFISH | 0.4 | 236.0 | 4.1 | 1.0 | 1.4 | 3996.8 |
| PACIFIC OCEAN PERCH | 121.9 | 8.8 | 1.2 | | 0.4 | 8929.2 |
| UNSP. POP GROUP | | 7105.5 | | | | 7217.2 |
| SHORTBELLY ROCKFISH | | | | | TR | 2.2 |
| THORNYHEADS | 0.1 | 7350.4 | 4.8 | | TR | 11346.0 |
| WIDOW ROCKFISH | 5997.3 | 1217.4 | 2.6 | | 0.1 | 14409.3 |
| OTHER DEMERSAL RKFSH | | | | | | 4.9 |
| OTHER SLOPE RKFSH | 2.2 | | | | | 214.8 |
| UNSP. DEMERSAL RKFSH | | 60.8 | | | | 194.2 |
| UNSP. PELAGIC RKFSH | | 1589.3 | | | | 1606.2 |
| UNSP. SLOPE RKFSH | | 16511.4 | | | | 16609.5 |
| UNSP. ROCKFISH | 1.0 | 3523.1 | 16.1 | 502.0 | 3.7 | 13366.5 |
| ALL ROCKFISH | 8370.9 | 38809.9 | 586.1 | 503.0 | 32.0 | 103922.3 |
| ATKA MACKEREL | 84.2 | 17497.3 | | | | 18443.3 |
| JACK MACKEREL | | | | | | TR |
| LINGCOD | 9.6 | 455.8 | 34.3 | 14.6 | 4.5 | 8035.0 |
| PACIFIC COD | 1201.1 | 83256.1 | 5.3 | 2.3 | 0.2 | 177307.4 |
| PACIFIC WHITING | 8838.1 | 6746.3 | | | | 24271.9 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR ALL AREAS

| SPECIES | MID-TRAWL | OTH TRAWLS | DBL-SHRIMP | SHMP-TRAWL | SGL-SHRIMP | ALL GEARS |
|--------------------|-----------|------------|------------|------------|------------|-----------|
| SABLEFISH | 0.3 | 6961.2 | 21.7 | 5.8 | 1.2 | 50044.1 |
| WALLEYE POLLOCK | 209092.3 | 812220.9 | - | - | - | 1061084.7 |
| OTHER ROUND FISH | - | - | - | - | - | 1441.0 |
| UNSP. ROUND FISH | - | - | - | - | - | 0.1 |
| ALL ROUND FISH | 219225.5 | 927137.5 | 61.2 | 22.7 | 6.0 | 1340627.6 |
| SPINY DOGFISH | 52.3 | - | - | - | - | 5742.0 |
| UNSPECIFIED SHARK | - | - | - | - | - | 0.5 |
| UNSPECIFIED SKATE | - | - | - | TR | - | 12.7 |
| UNSPECIFIED SQUID | 146.2 | 5.8 | - | - | - | 157.6 |
| OTHER GROUND FISH | TR | 9.7 | 0.1 | TR | TR | 1790.8 |
| UNSP. GROUND FISH | 50.9 | 263.5 | TR | TR | - | 870.5 |
| MISC. GROUND FISH | 249.5 | 279.0 | 0.1 | 0.1 | TR | 8573.9 |
| ALL GROUND FISH | 228468.7 | 1012341.8 | 672.6 | 533.1 | 40.7 | 1534029.7 |
| CALIFORNIA HALIBUT | - | 116.9 | - | - | - | 550.0 |
| PACIFIC HALIBUT | - | - | 0.1 | - | TR | 2893.6 |
| PINK SHRIMP | - | 5689.5 | 19891.5 | 7209.9 | 2372.5 | 35173.2 |

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

US-CANADA DOMESTIC GEAR REPORT: COMM. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR ALEUTIAN AREA

| SPECIES | LONGLINE | OTHER POTS | GFSH-TRAWL | MID-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|----------|------------|------------|-----------|------------|-----------|
| ARROWTOOTH FLOUNDER | | | 0.8 | | | 0.8 |
| UNSPECIFIED TURBOTS | 0.7 | | | | 197.0 | 197.7 |
| GREENLAND TURBOT | 582.7 | | | | 4179.8 | 4762.5 |
| ROCK SOLE | | | 11.0 | | 40.8 | 51.8 |
| YELLOWFIN SOLE | | | | | 0.4 | 0.4 |
| UNSP. FLATFISH | | | 0.9 | | 53.0 | 53.9 |
| ALL FLATFISH | 583.4 | | 12.6 | | 4471.0 | 5067.0 |
| BLACK ROCKFISH | TR | | | | | TR |
| YELLOWEYE ROCKFISH | 1.1 | | | | | 1.1 |
| PACIFIC OCEAN PERCH | 0.9 | | 121.5 | | | 122.5 |
| UNSP. POP GROUP | 85.2 | | | | 3572.6 | 3657.9 |
| THORNYHEADS | 104.0 | | 0.5 | | 35.5 | 140.0 |
| OTHER SLOPE RKFSH | TR | | | | | TR |
| UNSP. DEMERSAL RKFSH | 83.8 | | | | 0.1 | 83.9 |
| UNSP. PELAGIC RKFSH | 3.8 | | | | 4.1 | 7.9 |
| UNSP. SLOPE RKFSH | | | | | 16.4 | 16.4 |
| UNSP. ROCKFISH | 55.5 | | 4.1 | | 171.8 | 231.4 |
| ALL ROCKFISH | 334.5 | | 126.1 | | 3800.5 | 4261.1 |
| ATKA MACKEREL | | | 842.5 | | 14339.0 | 15181.5 |
| PACIFIC COD | 284.0 | 19.0 | 487.9 | | 3745.0 | 4535.8 |
| SABLEFISH | 2156.8 | 8.3 | 96.6 | | 986.5 | 3248.2 |
| WALLEYE POLLOCK | | | 4.9 | 104.2 | 4853.4 | 4962.6 |
| UNSP. ROUND FISH | TR | | | | | TR |
| ALL ROUND FISH | 2440.7 | 27.3 | 1432.0 | 104.2 | 23923.9 | 27928.1 |
| UNSPECIFIED SQUID | | | | | 2.0 | 2.0 |
| UNSP. GROUND FISH | 19.4 | | | | 87.6 | 107.0 |
| MISC. GROUND FISH | 19.4 | | | | 89.6 | 109.1 |
| ALL GROUND FISH | 3378.1 | 27.3 | 1570.7 | 104.2 | 32285.1 | 37365.3 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR AREA 2 AREA

| SPECIES | LONGLINE | OTHER POTS | GFSH-TRAWL | MID-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|----------|------------|------------|-----------|------------|-----------|
| UNSPECIFIED TURBOTS | 0.3 | - | - | - | 11.2 | 11.4 |
| GREENLAND TURBOT | 91.2 | - | - | - | 78.4 | 169.6 |
| ROCK SOLE | 0.4 | - | - | - | 33.0 | 33.4 |
| YELLOWFIN SOLE | - | - | - | - | 81.2 | 81.2 |
| UNSP. FLATFISH | 4.2 | - | - | - | 101.9 | 106.2 |
| ALL FLATFISH | 96.1 | - | - | - | 305.8 | 401.9 |
| PACIFIC OCEAN PERCH | - | - | 117.7 | - | - | 117.7 |
| UNSP. POP GROUP | 4.5 | - | - | - | 1514.3 | 1518.8 |
| THORNYHEADS | - | - | - | - | 2.4 | 2.4 |
| UNSP. DEMERSAL RKFSH | TR | - | - | - | - | TR |
| UNSP. ROCKFISH | 1.1 | - | - | - | 23.8 | 24.9 |
| ALL ROCKFISH | 5.6 | - | 117.7 | - | 1540.4 | 1663.7 |
| PACIFIC COD | 10933.1 | 56.9 | 635.9 | 21.5 | 9218.4 | 20865.9 |
| SABLEFISH | 40.9 | - | - | - | 4.9 | 45.8 |
| WALLEYE POLLOCK | 209.1 | - | 3430.1 | 16564.2 | 204419.0 | 224622.5 |
| ALL ROUND FISH | 11183.2 | 56.9 | 4066.0 | 16585.8 | 213644.5 | 245536.4 |
| UNSP. GROUND FISH | 42.5 | - | - | - | 6.4 | 49.0 |
| MISC. GROUND FISH | 42.5 | - | - | - | 6.4 | 49.0 |
| ALL GROUND FISH | 11327.5 | 56.9 | 4183.7 | 16585.8 | 215497.1 | 247650.9 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR AREA 1 AREA

| SPECIES | LONGLINE | OTH HK&LN | OTH-KNOWN | OTHER POTS | GFSH-TRAWL | MID-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|----------|-----------|-----------|------------|------------|-----------|------------|-----------|
| ARROWTOOTH FLOUNDER | | -- | -- | -- | 119.3 | 31.8 | | 151.0 |
| UNSPECIFIED TURBOTS | 28.6 | -- | -- | -- | | | 465.7 | 494.3 |
| ALASKA PLAICE | -- | -- | -- | -- | 5.3 | | | 5.3 |
| DOVER SOLE | -- | -- | -- | -- | | 0.3 | | 0.3 |
| GREENLAND TURBOT | 208.7 | -- | -- | -- | 14.3 | 0.2 | 3612.3 | 3835.5 |
| REX SOLE | -- | -- | -- | -- | 3.1 | 3.1 | | 6.2 |
| ROCK SOLE | 41.8 | -- | -- | 0.7 | 36.9 | 9.6 | 23365.4 | 23454.3 |
| STARRY FLOUNDER | -- | -- | -- | -- | 0.9 | | | 0.9 |
| YELLOWFIN SOLE | -- | -- | -- | -- | 55.6 | 4.9 | 1519.7 | 1580.3 |
| OTHER FLATFISH | -- | -- | -- | -- | 7.4 | 53.1 | | 60.5 |
| UNSP. FLATFISH | 5.3 | -- | -- | -- | 59.0 | 455.4 | 1530.6 | 2050.3 |
| ALL FLATFISH | 284.3 | -- | -- | 0.7 | 301.7 | 558.5 | 30493.7 | 31638.9 |
| SHORTRAKER ROCKFISH | | -- | -- | -- | 0.5 | | | 0.5 |
| YELLOWEYE ROCKFISH | 1.2 | -- | -- | -- | 0.5 | | | 1.6 |
| PACIFIC OCEAN PERCH | TR | -- | -- | -- | 25.0 | 34.0 | | 59.1 |
| UNSP. POP GROUP | 10.9 | -- | -- | -- | | | 1126.1 | 1137.1 |
| THORNYHEADS | 8.2 | -- | -- | -- | TR | TR | 75.0 | 83.3 |
| OTHER SLOPE RKFSH | | -- | -- | -- | 0.6 | 2.2 | | 2.8 |
| UNSP. DEMERSAL RKFSH | 5.7 | -- | -- | -- | | | 1.4 | 7.1 |
| UNSP. ROCKFISH | 8.1 | -- | -- | -- | 0.3 | 1.0 | 56.8 | 66.2 |
| ALL ROCKFISH | 34.2 | -- | -- | -- | 26.9 | 37.2 | 1259.3 | 1357.6 |
| ATKA MACKEREL | | | | | 19.3 | 84.2 | 2979.8 | 3083.3 |
| PACIFIC COD | 2735.5 | TR | -- | 88.3 | 27477.6 | 944.2 | 67116.7 | 98362.5 |
| SABLEFISH | 523.6 | -- | -- | 0.1 | 5.0 | | 673.5 | 1202.2 |
| WALLEYE POLLOCK | 71.0 | -- | -- | -- | 29484.8 | 164916.9 | 569658.4 | 764131.0 |
| ALL ROUND FISH | 3330.2 | TR | -- | 88.4 | 56986.7 | 165945.3 | 640428.4 | 866779.0 |
| UNSPECIFIED SQUID | 0.4 | -- | 0.3 | -- | 3.6 | 146.1 | 3.3 | 153.7 |
| UNSP. GROUND FISH | 5.2 | -- | -- | -- | 51.0 | 29.5 | 65.9 | 151.6 |
| MISC. GROUND FISH | 5.6 | -- | 0.3 | -- | 54.6 | 175.6 | 69.2 | 305.2 |
| ALL GROUND FISH | 3654.3 | TR | 0.3 | 89.1 | 57369.9 | 166716.6 | 672250.5 | 900080.7 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR SHUMAGIN AREA

| SPECIES | LONGLINE | OTH HK&LN | GILL NET | OTHER POTS | GFSH-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|----------|-----------|----------|------------|------------|------------|-----------|
| ARROWTOOTH FLOUNDER | 0.1 | - | - | - | - | 38.5 | 38.6 |
| GREENLAND TURBOT | 10.4 | - | - | - | - | 7.6 | 17.9 |
| ROCK SOLE | - | - | - | - | - | 7.5 | 7.5 |
| UNSP. FLATFISH | 29.9 | - | - | - | 2.3 | 48.3 | 80.5 |
| ALL FLATFISH | 40.4 | - | - | - | 2.3 | 101.9 | 144.5 |
| YELLOWEYE ROCKFISH | 3.6 | - | - | - | - | - | 3.6 |
| PACIFIC OCEAN PERCH | 2.4 | - | - | - | - | - | 2.4 |
| UNSP. POP GROUP | 7.9 | - | - | - | - | 199.9 | 207.8 |
| THORNYHEADS | 108.2 | - | - | - | - | 941.7 | 1049.9 |
| OTHER SLOPE RKFSH | 7.8 | - | - | - | 0.1 | - | 7.9 |
| UNSP. DEMERSAL RKFSH | 30.1 | - | - | - | - | 8.6 | 38.7 |
| UNSP. PELAGIC RKFSH | 13.1 | - | - | - | - | 90.3 | 103.4 |
| UNSP. SLOPE RKFSH | 92.2 | - | - | - | - | 3882.9 | 3975.1 |
| UNSP. ROCKFISH | 2.9 | - | - | - | - | 45.3 | 48.2 |
| ALL ROCKFISH | 268.3 | - | - | - | 0.1 | 5168.6 | 5436.9 |
| ATKA MACKEREL | - | - | - | - | - | 161.6 | 161.6 |
| PACIFIC COD | 1721.1 | 0.3 | 1.0 | 102.7 | 11679.9 | 324.6 | 13829.6 |
| SABLEFISH | 3468.1 | - | - | - | 0.1 | 706.7 | 4174.9 |
| WALLEYE POLLOCK | - | - | - | - | 41.2 | 8659.7 | 8701.0 |
| ALL ROUND FISH | 5189.2 | 0.3 | 1.0 | 102.7 | 11721.2 | 9852.6 | 26867.0 |
| UNSP. GROUND FISH | 21.5 | - | - | - | - | 11.1 | 32.7 |
| MISC. GROUND FISH | 21.5 | - | - | - | - | 11.1 | 32.7 |
| ALL GROUND FISH | 5519.4 | 0.3 | 1.0 | 102.7 | 11723.6 | 15134.2 | 32481.1 |
| PACIFIC HALIBUT | 61.6 | - | - | - | - | - | 61.6 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR CHIRIKOF AREA

| SPECIES | ----- | LONGLINE | OTHER POTS | GFSH-TRAWL | OTH TRAWLS | ALL GEARS | ----- |
|----------------------|--------|----------|------------|------------|------------|-----------|-------|
| ARROWTOOTH FLOUNDER | -- | -- | -- | 0.9 | 4.4 | 6.1 | |
| DOVER SOLE | -- | -- | -- | 2.1 | | 2.1 | |
| ROCK SOLE | -- | -- | -- | 85.7 | 70.7 | 156.4 | |
| YELLOWFIN SOLE | -- | -- | -- | | TR | TR | |
| OTHER FLATFISH | -- | -- | -- | 3.4 | | 3.4 | |
| UNSP. FLATFISH | -- | -- | -- | 5.5 | 379.0 | 384.5 | |
| ALL FLATFISH | -- | -- | -- | 105.1 | 454.2 | 560.1 | |
| BLACK ROCKFISH | -- | -- | -- | 0.6 | | 0.6 | |
| CANARY ROCKFISH | -- | -- | -- | TR | | TR | |
| ROUGHEYE ROCKFISH | 0.1 | -- | -- | | | 0.1 | |
| YELLOWEYE ROCKFISH | 0.2 | -- | -- | | | 0.2 | |
| PACIFIC OCEAN PERCH | 1.0 | -- | -- | | | 1.0 | |
| UNSP. POP GROUP | 1.1 | -- | -- | | 48.5 | 49.6 | |
| THORNYHEADS | 67.9 | -- | -- | 0.2 | 423.8 | 491.9 | |
| OTHER SLOPE RKFSH | 1.2 | -- | -- | 0.4 | | 1.6 | |
| UNSP. DEMERSAL RKFSH | 3.7 | -- | -- | | 0.3 | 3.9 | |
| UNSP. PELAGIC RKFSH | | -- | -- | | 78.7 | 78.7 | |
| UNSP. SLOPE RKFSH | 0.6 | -- | -- | | 2018.8 | 2019.4 | |
| UNSP. ROCKFISH | 0.1 | -- | -- | TR | 19.9 | 20.1 | |
| ALL ROCKFISH | 75.9 | -- | -- | 1.3 | 2590.0 | 2667.2 | |
| ATKA MACKEREL | | | | | 14.7 | 14.7 | |
| PACIFIC COD | 157.6 | 17.0 | | 3469.2 | 1059.8 | 4703.7 | |
| SABLEFISH | 2193.1 | | | 4.5 | 407.4 | 2605.0 | |
| WALLEYE POLLOCK | | | | 177.1 | 23099.7 | 23755.4 | |
| ALL ROUND FISH | 2350.6 | 17.0 | | 3650.8 | 24581.7 | 31078.8 | |
| UNSP. GROUND FISH | 1.5 | | | 7.6 | 1.0 | 10.1 | |
| MISC. GROUND FISH | 1.5 | | | 7.6 | 1.0 | 10.1 | |
| ALL GROUND FISH | 2428.1 | 17.0 | | 3764.8 | 27626.9 | 34316.2 | |
| PACIFIC HALIBUT | 311.6 | | | | | 311.6 | |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR KODIAK AREA

| SPECIES | LONGLINE | OTH HK&LN | UNKN-GEAR | OTHER POTS | GFSH-TRAWL | MID-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|----------|-----------|-----------|------------|------------|-----------|------------|-----------|
| ARROWTOOTH FLOUNDER | 1.7 | - | - | 6.4 | 486.1 | 36.8 | 105.2 | 636.2 |
| ALASKA PLAICE | - | - | - | - | 0.9 | - | - | 0.9 |
| DOVER SOLE | - | - | - | - | 1423.2 | - | - | 1423.2 |
| ENGLISH SOLE | - | - | - | - | 5.6 | - | - | 5.6 |
| GREENLAND TURBOT | - | - | - | - | 1.8 | - | 0.5 | 2.3 |
| REX SOLE | - | - | - | - | 347.7 | 2.5 | - | 350.2 |
| ROCK SOLE | 0.1 | - | - | 22.7 | 799.5 | 4.7 | 109.9 | 936.9 |
| STARRY FLOUNDER | - | - | - | - | 8.8 | - | - | 8.8 |
| YELLOWFIN SOLE | TR | - | - | - | 2.2 | - | - | 2.2 |
| OTHER FLATFISH | - | - | - | 3.3 | 413.2 | - | - | 416.5 |
| UNSP. FLATFISH | - | - | - | - | 110.5 | 16.2 | 381.0 | 507.7 |
| ALL FLATFISH | 1.8 | - | - | 32.4 | 3599.5 | 60.2 | 596.6 | 4290.5 |
| BLACK ROCKFISH | 5.6 | 12.3 | - | - | 5.1 | - | - | 23.1 |
| CANARY ROCKFISH | TR | - | - | - | - | - | - | TR |
| DARKBLOTCHED ROCKFIS | 0.1 | - | - | - | - | - | - | 0.1 |
| DUSKY ROCKFISH | - | - | - | - | 2.7 | - | - | 2.7 |
| QUILLBACK ROCKFISH | TR | - | - | - | - | - | - | TR |
| ROUGHEYE ROCKFISH | 26.4 | 1.3 | - | - | 0.3 | - | - | 27.9 |
| SHORTRAKER ROCKFISH | 0.1 | - | - | - | - | - | - | 0.1 |
| YELLOWEYE ROCKFISH | 7.2 | 2.8 | - | - | 0.8 | - | - | 10.8 |
| YELLOWTAIL ROCKFISH | 0.1 | - | - | - | - | - | - | 0.1 |
| PACIFIC OCEAN PERCH | 2.8 | - | - | - | 9.3 | 0.1 | - | 12.1 |
| UNSP. POP GROUP | 1.7 | - | - | - | - | - | 449.2 | 450.9 |
| THORNYHEADS | 155.2 | 0.3 | - | - | 192.7 | - | 601.6 | 949.7 |
| OTHER DEMERSAL RKFSH | 0.4 | - | - | - | - | - | - | 0.4 |
| OTHER SLOPE RKFSH | 22.7 | 0.6 | - | - | 125.1 | - | - | 148.4 |
| UNSP. DEMERSAL RKFSH | 7.7 | - | - | - | - | - | 21.0 | 28.8 |
| UNSP. PELAGIC RKFSH | - | - | - | - | - | - | 750.5 | 750.5 |
| UNSP. SLOPE RKFSH | 2.8 | - | - | - | - | - | 4825.8 | 4828.6 |
| UNSP. ROCKFISH | 15.3 | - | - | - | 4.2 | - | 5.5 | 25.0 |
| ALL ROCKFISH | 248.0 | 17.3 | - | - | 340.2 | 0.1 | 6653.6 | 7259.2 |
| ATKA MACKEREL | TR | - | - | - | - | - | TR | 0.1 |
| LINGCOD | 4.2 | 0.5 | - | - | - | - | - | 4.6 |
| PACIFIC COD | 1568.4 | 0.4 | - | 256.9 | 19079.9 | 231.9 | 1784.4 | 22921.9 |
| SABLEFISH | 7700.8 | 0.3 | - | - | 570.2 | - | 1314.5 | 9585.7 |
| WALLEYE POLLOCK | 4.7 | TR | - | - | 6143.5 | 26434.8 | 1530.6 | 34113.6 |
| ALL ROUND FISH | 9278.0 | 1.2 | - | 256.9 | 25793.6 | 26666.8 | 4629.5 | 66626.0 |
| UNSPECIFIED SQUID | - | - | - | - | 0.7 | 0.1 | 0.5 | 1.3 |
| UNSP. GROUND FISH | 1.7 | TR | 0.1 | 1.3 | 106.3 | 17.6 | 10.3 | 137.3 |
| MISC. GROUND FISH | 1.7 | TR | 0.1 | 1.3 | 107.0 | 17.7 | 10.8 | 138.6 |
| ALL GROUND FISH | 9529.5 | 18.6 | 0.1 | 290.6 | 29840.2 | 26744.8 | 11890.5 | 78314.3 |
| PACIFIC HALIBUT | 76.4 | - | - | - | - | - | - | 76.4 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR YAKUTAT AREA

| SPECIES | LONGLINE | OTH HK&LN | OTHER POTS | GFSH-TRAWL | MID-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|----------|-----------|------------|------------|-----------|------------|-----------|
| ARROWTOOTH FLOUNDER | - | - | - | - | - | 38.1 | 38.1 |
| DOVER SOLE | - | - | - | 1.0 | - | - | 1.0 |
| GREENLAND TURBOT | 0.1 | - | - | 1.2 | - | - | 1.3 |
| ROCK SOLE | - | - | - | - | - | 2.2 | 2.2 |
| UNSP. FLATFISH | - | - | - | - | - | 18.9 | 18.9 |
| ALL FLATFISH | 0.1 | - | - | 2.2 | - | 59.1 | 61.5 |
| BLACK ROCKFISH | 0.3 | - | - | - | - | - | 0.3 |
| BOCACCI | 0.1 | - | - | - | - | - | 0.1 |
| CANARY ROCKFISH | TR | - | - | - | - | - | TR |
| DARKBLOTCHED ROCKFIS | 0.5 | - | - | - | - | - | 0.5 |
| DUSKY ROCKFISH | 0.1 | - | - | - | - | - | 0.1 |
| QUILLBACK ROCKFISH | 0.8 | - | - | - | - | - | 0.8 |
| REDBANDED ROCKFISH | 2.4 | - | - | - | - | - | 2.4 |
| REDSTRIPE ROCKFISH | 0.1 | - | - | - | - | - | 0.1 |
| ROSETHORN ROCKFISH | 0.3 | - | - | - | - | - | 0.3 |
| ROUGHEYE ROCKFISH | 40.8 | - | - | - | - | - | 40.8 |
| SHORTRAKER ROCKFISH | 0.4 | - | - | - | - | - | 0.4 |
| SILVERGREY ROCKFISH | 0.3 | - | - | - | - | - | 0.3 |
| YELLOWEYE ROCKFISH | 52.6 | - | - | - | - | - | 52.6 |
| YELLOWTAIL ROCKFISH | TR | - | - | 1.0 | - | - | 1.0 |
| PACIFIC OCEAN PERCH | 1.6 | - | - | 2.0 | - | - | 3.6 |
| UNSP. POP GROUP | 0.3 | - | - | - | - | 12.2 | 12.5 |
| THORNYHEADS | 72.0 | - | - | - | - | 327.4 | 399.3 |
| OTHER DEMERSAL RKFSH | 0.1 | - | - | - | - | - | 0.1 |
| OTHER SLOPE RKFSH | 21.0 | - | - | - | - | - | 21.0 |
| UNSP. DEMERSAL RKFSH | 2.4 | - | - | - | - | 25.4 | 27.7 |
| UNSP. PELAGIC RKFSH | - | - | - | - | - | 657.5 | 657.5 |
| UNSP. SLOPE RKFSH | 2.4 | - | - | - | - | 4407.1 | 4409.6 |
| UNSP. ROCKFISH | 12.7 | - | - | 0.8 | - | - | 13.5 |
| ALL ROCKFISH | 211.3 | - | - | 3.7 | - | 5429.5 | 5644.5 |
| LINGCOD | 43.0 | TR | 0.1 | - | - | - | 43.2 |
| PACIFIC COD | 13.6 | - | - | - | - | 4.6 | 18.2 |
| SABLEFISH | 6718.0 | - | - | 0.5 | - | 501.6 | 7220.1 |
| WALLEYE POLLOCK | - | - | - | - | 32.8 | - | 32.8 |
| UNSP. ROUND FISH | TR | - | - | - | - | - | TR |
| ALL ROUND FISH | 6774.5 | TR | 0.1 | 0.5 | 32.8 | 506.2 | 7314.2 |
| UNSP. GROUND FISH | 1.3 | - | - | - | - | 6.3 | 7.6 |
| MISC. GROUND FISH | 1.3 | - | - | - | - | 6.3 | 7.6 |
| ALL GROUND FISH | 6987.3 | TR | 0.1 | 6.4 | 32.8 | 6001.1 | 13027.8 |
| PACIFIC HALIBUT | 945.6 | - | - | - | - | - | 945.6 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR S. EASTERN AREA

| SPECIES | LOGLINE | OTH HK&LN | GILL NET | OTHER POTS | GFSH-TRAWL | MID-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|---------|-----------|----------|------------|------------|-----------|------------|-----------|
| ARROWTOOTH FLOUNDER | 0.2 | - | - | - | TR | - | 3.4 | 3.6 |
| DOVER SOLE | TR | - | - | - | 0.3 | - | - | 0.3 |
| ENGLISH SOLE | - | - | - | - | 1.0 | - | - | 1.0 |
| GREENLAND TURBOT | - | - | - | - | 1.0 | - | - | 1.0 |
| REX SOLE | TR | - | - | - | - | - | - | TR |
| ROCK SOLE | TR | - | - | - | 1.0 | - | - | 1.0 |
| STARRY FLOUNDER | - | - | - | - | 107.8 | - | - | 107.8 |
| YELLOWFIN SOLE | TR | - | - | - | 0.1 | - | - | 0.1 |
| OTHER FLATFISH | TR | - | - | - | 1.1 | 0.3 | - | 1.4 |
| UNSP. FLATFISH | TR | - | - | - | - | - | 9.0 | 9.0 |
| ALL FLATFISH | 0.2 | - | - | - | 112.4 | 0.3 | 12.4 | 125.3 |
| BLACK ROCKFISH | 8.9 | 1.0 | - | - | TR | - | - | 9.9 |
| BOCACCIO | 0.5 | - | - | - | - | - | - | 0.5 |
| CANARY ROCKFISH | 1.9 | TR | - | - | - | - | - | 2.0 |
| DARKBLOTCHED ROCKFIS | TR | - | - | - | - | - | - | TR |
| DUSKY ROCKFISH | 2.1 | TR | - | - | - | - | - | 2.1 |
| QUILLBACK ROCKFISH | 80.7 | 1.3 | - | - | TR | - | - | 82.0 |
| REDBANDED ROCKFISH | 9.2 | - | - | - | - | - | - | 9.2 |
| REDSTRIPE ROCKFISH | 0.3 | - | - | - | - | - | - | 0.3 |
| ROSETHORN ROCKFISH | 2.7 | TR | - | - | - | - | - | 2.7 |
| ROUGHEYE ROCKFISH | 62.6 | TR | - | - | - | - | - | 62.7 |
| SHORTRAKER ROCKFISH | 4.0 | - | - | - | - | - | - | 4.0 |
| SILVERGREY ROCKFISH | 2.3 | 0.1 | - | - | TR | - | - | 2.4 |
| YELLOWEYE ROCKFISH | 365.6 | 5.2 | - | - | TR | - | - | 370.9 |
| YELLOWMOUTH ROCKFISH | TR | - | - | - | - | - | - | TR |
| YELLOWTAIL ROCKFISH | 0.3 | TR | - | - | 0.1 | - | - | 0.4 |
| PACIFIC OCEAN PERCH | 1.0 | - | - | - | TR | - | - | 1.1 |
| UNSP. POP GROUP | - | - | - | - | - | - | 182.8 | 182.8 |
| THORNYHEADS | 59.3 | 0.1 | - | - | - | - | 129.0 | 188.4 |
| WIDOW ROCKFISH | TR | - | - | - | - | - | - | TR |
| OTHER DEMERSAL RKFSH | 4.4 | TR | - | - | - | - | - | 4.5 |
| OTHER SLOPE RKFSH | 33.0 | - | - | - | TR | - | - | 33.0 |
| UNSP. DEMERSAL RKFSH | - | - | - | - | - | - | 4.0 | 4.0 |
| UNSP. PELAGIC RKFSH | - | - | - | - | - | - | 8.3 | 8.3 |
| UNSP. SLOPE RKFSH | TR | - | - | - | - | - | 1360.4 | 1360.5 |
| UNSP. ROCKFISH | 78.3 | 0.4 | TR | - | 0.1 | - | 2.9 | 81.7 |
| ALL ROCKFISH | 717.3 | 8.2 | TR | - | 0.3 | - | 1687.3 | 2413.1 |
| LINGCOD | 133.3 | 88.6 | - | - | TR | - | - | 221.9 |
| PACIFIC COD | 200.1 | 0.3 | - | - | 0.1 | - | 2.5 | 203.0 |
| SABLEFISH | 6160.0 | - | - | 4.9 | - | - | 99.1 | 6264.1 |
| WALLEYE POLLOCK | 0.1 | - | - | - | 0.1 | - | - | 0.2 |
| UNSP. ROUND FISH | TR | - | - | - | - | - | - | TR |
| ALL ROUND FISH | 6493.5 | 88.9 | - | 4.9 | 0.2 | - | 101.6 | 6689.2 |
| SPINY DOGFISH | 5.0 | - | - | - | - | - | - | 5.0 |
| UNSP. GROUND FISH | 0.4 | - | - | - | - | - | 0.7 | 1.5 |
| MISC. GROUND FISH | 5.8 | - | - | - | - | - | 0.7 | 6.5 |
| ALL GROUND FISH | 7216.8 | 97.1 | TR | 4.9 | 112.9 | 0.3 | 1802.1 | 9234.2 |
| PACIFIC HALIBUT | 95.8 | - | - | - | - | - | - | 95.8 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR UNK-ALASKA AREA

| SPECIES | LONGLINE | MID-TRAWL | ALL GEARS |
|---------------------|----------|-----------|-----------|
| ARROWTOOTH FLOUNDER | - | 0.2 | 0.2 |
| ALL FLATFISH | - | 0.2 | 0.2 |
| UNSP. ROCKFISH | 0.1 | TR | 0.1 |
| ALL ROCKFISH | 0.1 | TR | 0.1 |
| LINGCOD | TR | - | TR |
| SABLEFISH | TR | - | TR |
| WALLEYE POLLOCK | - | 92.7 | 92.7 |
| ALL ROUND FISH | TR | 92.7 | 92.8 |
| ALL GROUND FISH | 0.2 | 93.0 | 93.1 |
| PACIFIC HALIBUT | 323.3 | - | 323.3 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR CHARLOTTE AREA

| SPECIES | LOGLINE | GILL NET | OTHER NETS | FISH POT | TROLL | BTM-TRAWL | GFSH-TRAWL | MID-TRAWL | ALL GEARS |
|----------------------|---------|----------|------------|----------|-------|-----------|------------|-----------|-----------|
| ARROWTOOTH FLOUNDER | - | - | - | - | - | 537.5 | - | - | 537.5 |
| DOVER SOLE | - | - | - | - | - | 829.8 | - | - | 829.8 |
| ENGLISH SOLE | - | - | - | - | - | 882.2 | - | 0.3 | 882.5 |
| PETRALE SOLE | 0.1 | - | - | - | - | 389.3 | - | 0.3 | 389.7 |
| REX SOLE | - | - | - | - | - | 134.7 | - | - | 134.7 |
| ROCK SOLE | 0.3 | - | - | - | - | 1814.8 | - | 1.5 | 1816.6 |
| STARRY FLOUNDER | - | - | - | - | - | 39.4 | - | - | 39.4 |
| YELLOWFIN SOLE | - | - | - | - | - | 2.3 | - | - | 2.3 |
| OTHER FLATFISH | - | - | - | - | - | 27.2 | - | - | 27.2 |
| ALL FLATFISH | 0.4 | - | - | - | - | 4657.2 | - | 2.1 | 4659.7 |
| BLACK ROCKFISH | - | - | - | - | - | 2.1 | - | - | 2.1 |
| BOCACCIO | - | - | - | - | - | 423.0 | - | 24.3 | 447.3 |
| CANARY ROCKFISH | - | - | - | - | - | 617.8 | - | 26.5 | 644.4 |
| DARKBLOTCHED ROCKFIS | - | - | - | - | - | 44.2 | - | - | 44.2 |
| REDSTRIPE ROCKFISH | - | - | - | - | - | 1010.6 | - | 5.9 | 1016.5 |
| ROUGHEYE ROCKFISH | - | - | - | - | - | 846.9 | - | - | 846.9 |
| SHARPCHIN ROCKFISH | - | - | - | - | - | 144.6 | - | - | 144.6 |
| SHORTRAKER ROCKFISH | - | - | - | - | - | 21.6 | - | - | 21.6 |
| SILVERGREY ROCKFISH | - | - | - | - | - | 1968.7 | - | 12.7 | 1981.5 |
| SPLITNOSE ROCKFISH | - | - | - | - | - | 90.7 | - | - | 90.7 |
| YELLOWEYE ROCKFISH | - | - | - | - | - | 27.8 | - | - | 27.8 |
| YELLOWMOUTH ROCKFISH | - | - | - | - | - | 1205.9 | - | 40.8 | 1246.7 |
| YELLOWTAIL ROCKFISH | 0.3 | - | - | - | 0.1 | 1701.7 | - | 1064.9 | 2767.0 |
| OTHER ROCKFISH | 628.8 | - | - | - | 141.3 | 354.5 | - | - | 1124.5 |
| PACIFIC OCEAN PERCH | TR | - | - | - | TR | 4671.0 | - | 87.3 | 4758.3 |
| THORNYHEADS | 1.1 | - | - | - | - | 80.2 | - | - | 81.3 |
| WIDOW ROCKFISH | - | - | - | - | - | 431.5 | - | 865.0 | 1296.5 |
| UNSP. ROCKFISH | - | - | - | - | - | - | - | - | - |
| ALL ROCKFISH | 630.2 | - | - | - | 141.4 | 13642.9 | - | 2127.4 | 16541.8 |
| LINGCOD | 344.7 | 0.1 | - | - | 172.6 | 1900.6 | - | 7.8 | 2425.8 |
| PACIFIC COD | 2.7 | - | - | - | 0.2 | 5554.2 | - | 2.5 | 5559.6 |
| SABLEFISH | 300.5 | - | - | 2308.2 | - | 182.9 | - | - | 2791.6 |
| WALLEYE POLLOCK | - | - | - | - | - | 27.4 | - | 7.3 | 34.7 |
| ALL ROUND FISH | 647.9 | 0.1 | - | 2308.2 | 172.8 | 7665.1 | - | 17.6 | 10811.7 |
| SPINY DOGFISH | 236.6 | - | - | - | 0.9 | 32.9 | - | - | 270.5 |
| UNSPECIFIED SHARK | 0.1 | - | 0.1 | - | - | - | - | - | 0.2 |
| UNSPECIFIED SKATE | 2.9 | - | - | - | 0.2 | - | - | - | 3.2 |
| OTHER GROUND FISH | - | - | - | - | - | 138.0 | - | - | 138.0 |
| UNSP. GROUND FISH | TR | TR | - | - | TR | 189.6 | - | 3.9 | 193.5 |
| MISC. GROUND FISH | 239.7 | TR | 0.1 | - | 1.1 | 360.5 | - | 3.9 | 605.3 |
| ALL GROUND FISH | 1518.2 | 0.1 | 0.1 | 2308.2 | 315.3 | 26325.7 | - | 2151.0 | 32618.6 |
| PACIFIC HALIBUT | - | - | - | - | - | - | - | - | - |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR GRGIA STRT AREA

| SPECIES | LONGLINE | GILL NET | SEINE | TROLL | BTM-TRAWL | GFSH-TRAWL | MID-TRAWL | SHMP-TRAWL | ALL GEARS |
|---------------------|----------|----------|-------|-------|-----------|------------|-----------|------------|-----------|
| ARROWTOOTH FLOUNDER | - | - | - | - | 0.3 | - | - | - | 0.3 |
| DOVER SOLE | - | - | - | - | 1.5 | - | - | - | 1.5 |
| ENGLISH SOLE | - | - | - | TR | 64.3 | - | - | - | 64.3 |
| PETRALE SOLE | - | - | - | - | 0.4 | - | - | - | 0.4 |
| REX SOLE | - | - | - | - | TR | - | - | - | TR |
| ROCK SOLE | - | - | - | - | 16.4 | - | - | - | 16.4 |
| STARRY FLOUNDER | - | - | - | 0.4 | 46.7 | - | - | - | 47.1 |
| OTHER FLATFISH | - | - | - | - | 12.8 | - | - | - | 12.8 |
| UNSP. FLATFISH | - | - | - | TR | - | - | - | 0.7 | 0.7 |
| ALL FLATFISH | - | - | - | 0.4 | 142.3 | - | - | 0.7 | 143.5 |
| BOCACCIO | - | - | - | - | TR | - | - | - | TR |
| CANARY ROCKFISH | - | - | - | - | TR | - | - | - | TR |
| SILVERGREY ROCKFISH | - | - | - | - | TR | - | - | - | TR |
| YELLOW EYE ROCKFISH | - | - | - | - | TR | - | - | - | TR |
| YELLOWTAIL ROCKFISH | TR | - | - | 0.3 | 0.7 | - | - | - | 1.0 |
| OTHER ROCKFISH | 88.6 | TR | - | 371.1 | 2.3 | - | - | 0.1 | 462.1 |
| PACIFIC OCEAN PERCH | - | - | - | 0.1 | - | - | - | - | 0.1 |
| UNSP. ROCKFISH | - | - | - | - | - | - | - | - | - |
| ALL ROCKFISH | 88.6 | TR | - | 371.6 | 3.1 | - | - | 0.1 | 463.3 |
| LINGCOD | 14.5 | TR | TR | 63.0 | 2.9 | - | - | TR | 80.4 |
| PACIFIC COD | 6.1 | - | - | 1.4 | 604.0 | - | - | 0.1 | 611.7 |
| PACIFIC WHITING | - | - | - | TR | - | - | 7076.7 | - | 7076.7 |
| SABLEFISH | - | - | - | TR | 0.2 | - | - | - | 0.2 |
| WALLEYE POLLOCK | - | - | - | - | 0.4 | - | 435.4 | - | 435.7 |
| ALL ROUND FISH | 20.6 | TR | TR | 64.4 | 607.4 | - | 7512.1 | 0.1 | 8204.7 |
| SPINY DOGFISH | 527.4 | - | - | 7.9 | 99.3 | - | 52.3 | - | 687.0 |
| UNSPECIFIED SHARK | 0.3 | - | - | - | - | - | - | - | 0.3 |
| UNSPECIFIED SKATE | 4.1 | - | - | 1.8 | - | - | - | TR | 6.0 |
| UNSPECIFIED SQUID | - | - | - | - | TR | - | - | - | TR |
| OTHER GROUND FISH | - | - | - | - | 12.1 | - | - | - | 12.1 |
| UNSP. GROUND FISH | TR | 7.8 | - | 0.1 | - | - | - | - | 7.9 |
| MISC. GROUND FISH | 531.9 | 7.8 | - | 9.8 | 111.4 | - | 52.3 | TR | 713.2 |
| ALL GROUND FISH | 641.0 | 7.9 | TR | 446.3 | 864.2 | - | 7564.4 | 1.0 | 9524.7 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR PUGET SND AREA

| SPECIES | JIG | LONGLINE | DIP NET | GILL NET | OTHER NETS | SEINE | SET NET | OTHER POTS | TROLL | BEAM | TRAWL |
|---------------------|------|----------|---------|----------|------------|-------|---------|------------|-------|------|-------|
| ARROWTOOTH FLOUNDER | - | 0.1 | - | - | - | - | TR | - | - | - | - |
| DOVER SOLE | TR | TR | - | - | - | - | 0.1 | - | - | - | - |
| ENGLISH SOLE | - | - | - | - | - | - | - | - | - | - | - |
| PETRALE SOLE | - | - | - | - | - | - | - | - | - | - | - |
| ROCK SOLE | TR | TR | - | - | - | - | TR | - | - | - | - |
| STARRY FLOUNDER | - | TR | - | 0.1 | - | TR | 0.2 | - | TR | - | - |
| OTHER FLATFISH | - | - | - | - | - | - | TR | - | TR | - | - |
| ALL FLATFISH | TR | 0.2 | - | 0.1 | - | TR | 0.4 | - | 0.1 | - | - |
| UNSP. ROCKFISH | 27.3 | 14.8 | - | TR | - | - | 1.0 | - | 2.2 | - | - |
| ALL ROCKFISH | 27.3 | 14.8 | - | TR | - | - | 1.0 | - | 2.2 | - | - |
| LINGCOD | 6.4 | 1.7 | - | - | - | - | 0.2 | - | 2.6 | - | - |
| PACIFIC COD | TR | 9.1 | - | - | - | - | 0.1 | - | 1.0 | - | - |
| PACIFIC WHITING | - | - | - | - | - | - | - | - | - | - | - |
| SABLEFISH | TR | 19.3 | - | - | - | - | - | - | TR | - | - |
| WALLEYE POLLOCK | - | - | - | - | - | - | - | - | - | - | - |
| OTHER ROUND FISH | - | - | 0.2 | TR | - | 11.5 | TR | - | - | - | - |
| ALL ROUND FISH | 6.5 | 30.1 | 0.2 | TR | - | 11.5 | 0.4 | - | 3.6 | - | - |
| SPINY DOGFISH | 1.2 | 579.0 | - | 35.2 | - | - | 162.4 | - | 0.2 | - | - |
| UNSPECIFIED SQUID | - | - | - | - | - | - | - | - | - | - | - |
| OTHER GROUND FISH | 0.1 | 16.7 | 1156.6 | - | 0.4 | 40.3 | 0.6 | 9.2 | TR | 80.3 | - |
| UNSP. GROUND FISH | - | - | - | - | - | - | - | - | - | - | - |
| MISC. GROUND FISH | 1.3 | 595.7 | 1156.6 | 35.2 | 0.4 | 40.3 | 163.0 | 9.2 | 0.2 | 80.3 | - |
| ALL GROUND FISH | 35.1 | 640.7 | 1156.8 | 35.3 | 0.4 | 51.9 | 164.8 | 9.2 | 6.1 | 80.3 | - |
| PACIFIC HALIBUT | 0.1 | 22.7 | - | - | - | - | - | - | 0.8 | - | - |
| PINK SHRIMP | - | - | - | - | - | - | - | 4.1 | - | - | 5.8 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR PUGET SND AREA

| SPECIES | GFSH-TRAWL | ALL GEARS |
|---------------------|------------|-----------|
| ARROWTOOTH FLOUNDER | 7.5 | 7.5 |
| DOVER SOLE | 6.6 | 6.8 |
| ENGLISH SOLE | 305.4 | 305.6 |
| PETRALE SOLE | TR | TR |
| ROCK SOLE | 27.5 | 27.5 |
| STARRY FLOUNDER | 290.9 | 291.2 |
| OTHER FLATFISH | 23.7 | 23.8 |
| ALL FLATFISH | 661.6 | 662.4 |
| UNSP. ROCKFISH | 116.1 | 161.4 |
| ALL ROCKFISH | 116.1 | 161.4 |
| LINGCOD | 23.9 | 35.0 |
| PACIFIC COD | 276.1 | 286.4 |
| PACIFIC WHITING | 63.6 | 63.6 |
| SABLEFISH | 0.8 | 20.1 |
| WALLEYE POLLOCK | 3.3 | 3.3 |
| OTHER ROUND FISH | | 11.7 |
| ALL ROUND FISH | 367.7 | 420.0 |
| SPINY DOGFISH | 349.5 | 1127.5 |
| UNSPECIFIED SQUID | 0.5 | 0.5 |
| OTHER GROUND FISH | 105.2 | 1409.4 |
| UNSP. GROUND FISH | TR | TR |
| MISC. GROUND FISH | 455.2 | 2537.4 |
| ALL GROUND FISH | 1600.5 | 3781.1 |
| PACIFIC HALIBUT | - | 23.6 |
| PINK SHRIMP | - | 9.9 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR VANCOUVER AREA

| SPECIES | JIG | LONGLINE | DIP NET | SEINE | SET NET | TROLL | GFSH-TRAWL | MID-TRAWL | SHMP-TRAWL | ALL GEARS |
|----------------------|-------|----------|---------|-------|---------|-------|------------|-----------|------------|-----------|
| ARROWTOOTH FLOUNDER | TR | 0.4 | --- | --- | 0.1 | --- | 1996.9 | --- | --- | 2069.0 |
| DOVER SOLE | --- | 0.8 | --- | --- | --- | --- | 1518.6 | --- | TR | 2844.9 |
| ENGLISH SOLE | --- | TR | --- | --- | TR | --- | 429.3 | 0.1 | --- | 527.3 |
| PETRALE SOLE | TR | 0.3 | --- | --- | --- | --- | 182.8 | 0.4 | --- | 745.7 |
| REX SOLE | TR | --- | --- | --- | --- | --- | 25.5 | --- | --- | 30.3 |
| ROCK SOLE | TR | TR | --- | --- | --- | TR | 1.0 | TR | --- | 243.3 |
| STARRY FLOUNDER | TR | --- | --- | --- | TR | TR | 161.9 | --- | --- | 198.9 |
| OTHER FLATFISH | TR | TR | --- | --- | TR | TR | 29.4 | --- | --- | 37.9 |
| ALL FLATFISH | TR | 1.5 | --- | --- | 0.2 | TR | 4345.2 | 0.4 | TR | 6697.2 |
| BLACK ROCKFISH | --- | --- | --- | --- | --- | --- | 0.9 | --- | --- | 1.6 |
| BOCACCIO | --- | --- | --- | --- | --- | --- | 162.4 | 5.6 | --- | 492.6 |
| CANARY ROCKFISH | --- | --- | --- | --- | --- | --- | 795.5 | 18.1 | --- | 1963.1 |
| DARKBLOTCHED ROCKFIS | --- | --- | --- | --- | --- | --- | 47.0 | --- | --- | 101.6 |
| REDSTRIPE ROCKFISH | --- | --- | --- | --- | --- | --- | 56.6 | 6.7 | --- | 653.9 |
| SHARPCHIN ROCKFISH | --- | --- | --- | --- | --- | --- | 46.3 | --- | --- | 96.9 |
| SILVERGREY ROCKFISH | --- | --- | --- | --- | --- | --- | 31.8 | 3.8 | --- | 881.8 |
| SPLITNOSE ROCKFISH | --- | --- | --- | --- | --- | --- | 12.5 | 1.3 | --- | 72.4 |
| YELLOWEYE ROCKFISH | --- | --- | --- | --- | --- | --- | 19.4 | --- | --- | 27.8 |
| YELLOWMOUTH ROCKFISH | --- | --- | --- | --- | --- | --- | 42.6 | 0.7 | --- | 397.9 |
| YELLOWTAIL ROCKFISH | --- | 0.2 | --- | --- | --- | 2.2 | 1076.7 | 896.0 | --- | 2609.2 |
| OTHER ROCKFISH | --- | 363.5 | --- | --- | --- | 79.8 | 382.0 | 0.4 | 0.9 | 997.0 |
| PACIFIC OCEAN PERCH | --- | 0.3 | --- | --- | --- | --- | 338.3 | 0.4 | --- | 1608.2 |
| THORNYHEADS | --- | 0.4 | --- | --- | --- | --- | 111.3 | --- | --- | 146.3 |
| WIDOW ROCKFISH | --- | --- | --- | --- | --- | --- | 589.9 | 220.1 | --- | 994.1 |
| UNSP. ROCKFISH | 143.1 | 110.6 | --- | --- | 0.2 | 24.8 | 12.6 | --- | 6.1 | 297.3 |
| ALL ROCKFISH | 143.1 | 474.9 | --- | --- | 0.2 | 106.8 | 3725.9 | 1153.5 | 7.0 | 11520.5 |
| LINGCOD | 70.0 | 185.0 | --- | --- | 0.1 | 281.5 | 597.1 | 0.1 | 1.5 | 2283.5 |
| PACIFIC COD | 4.9 | 6.4 | --- | --- | --- | 0.3 | 905.1 | 0.8 | 0.1 | 3907.9 |
| SABLEFISH | 0.1 | 1930.4 | --- | --- | --- | 0.2 | 350.6 | 0.2 | --- | 4172.4 |
| WALLEYE POLLOCK | --- | --- | --- | --- | --- | --- | 22.3 | 25.4 | --- | 55.1 |
| OTHER ROUND FISH | --- | --- | 1.5 | 32.0 | --- | --- | --- | --- | --- | 33.5 |
| ALL ROUND FISH | 75.0 | 2121.8 | 1.5 | 32.0 | 0.1 | 282.0 | 1875.1 | 1704.4 | 1.6 | 12130.3 |
| SPINY DOGFISH | --- | 1188.7 | --- | --- | --- | 0.1 | 79.2 | --- | --- | 2110.4 |
| UNSPECIFIED SQUID | --- | --- | --- | --- | --- | --- | TR | --- | --- | TR |
| OTHER GROUND FISH | 0.7 | 4.5 | --- | 0.1 | 0.3 | 0.1 | 19.1 | TR | --- | 33.4 |
| UNSP. GROUND FISH | --- | 0.2 | --- | --- | --- | 0.2 | 0.3 | --- | --- | 43.9 |
| MISC. GROUND FISH | 0.7 | 1196.9 | --- | 0.1 | 0.3 | 0.6 | 98.6 | TR | --- | 2191.2 |
| ALL GROUND FISH | 218.8 | 3795.1 | 1.5 | 32.1 | 0.7 | 389.4 | 10044.8 | 2858.4 | 8.6 | 32539.2 |
| PACIFIC HALIBUT | 2.3 | 109.0 | --- | --- | --- | 2.8 | --- | --- | --- | 114.1 |
| PINK SHRIMP | --- | --- | --- | --- | --- | --- | --- | --- | 286.6 | 286.6 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR COLUMBIA AREA

| SPECIES | JIG | LOONGLINE | OTH HK&LN | GILL NET | CRAB POT | FISH POT | OTHER POTS | TROLL | GFESH-TRAWL | MID-TRAWL |
|----------------------|------|-----------|-----------|----------|----------|----------|------------|-------|-------------|-----------|
| ARROWTOOTH FLOUNDER | - | 1.0 | TR | - | - | 0.3 | - | TR | 1517.3 | - |
| DOVER SOLE | - | 0.1 | - | - | - | TR | - | TR | 8989.5 | 0.1 |
| ENGLISH SOLE | - | TR | - | - | - | - | - | - | 906.2 | 0.1 |
| PETRALE SOLE | TR | 0.2 | TR | - | TR | - | - | 0.1 | 1088.9 | - |
| REX SOLE | - | - | - | - | TR | - | - | TR | 351.0 | 0.1 |
| ROCK SOLE | - | - | - | - | TR | - | - | TR | 6.0 | - |
| STARRY FLOUNDER | - | - | TR | TR | TR | - | - | TR | 306.3 | - |
| OTHER FLATFISH | - | TR | TR | - | TR | - | - | TR | 374.0 | - |
| ALL FLATFISH | TR | 1.3 | TR | TR | 0.1 | 0.3 | - | 0.1 | 13539.2 | 0.2 |
| BLACK ROCKFISH | - | - | - | - | - | - | - | - | 124.7 | - |
| BOCACCIO | - | - | - | - | - | - | - | - | 239.2 | 49.6 |
| CANARY ROCKFISH | - | - | - | - | - | - | - | - | 1295.9 | 0.3 |
| CHILIPEPPER | - | - | - | - | - | - | - | - | 4.4 | - |
| DARKBLOTCHED ROCKFIS | - | 0.2 | - | - | - | - | - | - | 643.4 | 3.0 |
| REDSTRIPE ROCKFISH | - | - | - | - | - | - | - | - | 332.6 | 0.9 |
| SHARPCHIN ROCKFISH | - | - | - | - | - | - | - | - | 354.3 | - |
| SILVERGREY ROCKFISH | - | - | - | - | - | - | - | - | 189.1 | - |
| SPLITNOSE ROCKFISH | - | - | - | - | - | - | - | - | 101.2 | 0.2 |
| YELLOW EYE ROCKFISH | - | - | - | - | - | - | - | - | 157.6 | TR |
| YELLOWMOUTH ROCKFISH | - | - | - | - | - | - | - | - | 337.2 | 0.7 |
| YELLOWTAIL ROCKFISH | - | 2.2 | 2.7 | - | - | - | - | 0.1 | 2249.6 | 76.9 |
| OTHER ROCKFISH | - | 86.8 | - | - | - | - | - | - | 805.1 | TR |
| PACIFIC OCEAN PERCH | - | TR | - | - | - | - | - | - | 1101.9 | 0.1 |
| SHORTBELLY ROCKFISH | - | - | - | - | - | - | - | - | 2.2 | - |
| THORNYHEADS | - | 0.8 | - | - | - | 0.2 | - | - | 1655.4 | 0.1 |
| WIDOW ROCKFISH | - | 0.1 | 0.3 | - | - | - | - | - | 5454.8 | 4791.7 |
| UNSP. ROCKFISH | 18.7 | 51.2 | 202.5 | TR | 0.4 | 0.3 | - | 102.5 | 52.9 | - |
| ALL ROCKFISH | 18.7 | 141.3 | 205.5 | TR | 0.4 | 0.6 | - | 102.6 | 15101.6 | 4923.5 |
| JACK MACKEREL | - | - | TR | - | - | - | - | - | TR | - |
| LINGCOD | 0.1 | 22.9 | 83.1 | - | 0.1 | 0.1 | - | 28.9 | 1246.9 | 0.5 |
| PACIFIC COD | - | 0.7 | - | - | - | TR | - | TR | 1258.4 | TR |
| PACIFIC WHITING | - | - | - | - | - | - | - | - | 32.2 | 83.5 |
| SABLEFISH | TR | 837.1 | 0.1 | - | - | 1057.2 | - | 0.2 | 2360.5 | 0.1 |
| WALLEYE POLLOCK | - | - | - | - | - | - | - | - | TR | - |
| UNSP. ROUND FISH | - | TR | 0.1 | - | - | - | - | - | TR | - |
| ALL ROUND FISH | 0.1 | 860.7 | 83.3 | - | 0.1 | 1057.3 | - | 29.1 | 4898.1 | 84.1 |
| SPINY DOGFISH | - | 7.6 | TR | - | - | - | - | TR | 3.3 | - |
| OTHER GROUND FISH | - | 0.8 | 5.4 | 2.7 | 0.8 | - | TR | 0.1 | 23.2 | - |
| UNSP. GROUND FISH | - | TR | 0.6 | - | TR | - | - | TR | 4.6 | - |
| MISC. GROUND FISH | - | 8.5 | 5.9 | 2.7 | 0.8 | - | TR | 0.1 | 31.2 | - |
| ALL GROUND FISH | 18.8 | 1011.8 | 294.7 | 2.7 | 1.4 | 1058.2 | TR | 131.9 | 33570.1 | 5007.9 |
| PACIFIC HALIBUT | - | 90.1 | 0.3 | - | - | - | - | 0.9 | 0.3 | - |
| PINK SHRIMP | - | - | - | - | - | - | - | - | - | - |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR COLUMBIA AREA

| SPECIES | DBL-SHRIMP | SHMP-TRAWL | SGL-SHRIMP | ALL GEARS |
|----------------------|------------|------------|------------|-----------|
| ARROWTOOTH FLOUNDER | 4.1 | 0.3 | TR | 1523.0 |
| DOVER SOLE | 19.2 | 5.7 | 1.3 | 9015.9 |
| ENGLISH SOLE | 0.7 | TR | TR | 907.1 |
| PETRALE SOLE | 0.5 | 0.1 | TR | 1089.9 |
| REX SOLE | 0.1 | 0.1 | 0.1 | 351.4 |
| ROCK SOLE | - | 0.2 | - | 6.2 |
| STARRY FLOUNDER | - | - | - | 306.3 |
| OTHER FLATFISH | 0.4 | 0.2 | TR | 374.6 |
| ALL FLATFISH | 24.9 | 6.6 | 1.6 | 13574.4 |
| BLACK ROCKFISH | - | - | - | 124.7 |
| BOCACCO | TR | - | 0.1 | 288.9 |
| CANARY ROCKFISH | 21.9 | - | 0.7 | 1318.9 |
| CHILIPEPPER | - | - | - | 4.4 |
| DARKBLOTCHED ROCKFIS | TR | - | 0.5 | 647.1 |
| REDSTRIPE ROCKFISH | 0.2 | - | 0.4 | 334.1 |
| SHARPCHIN ROCKFISH | 0.1 | - | 0.5 | 354.8 |
| SILVERGREY ROCKFISH | - | - | - | 189.1 |
| SPLITNOSE ROCKFISH | 0.1 | - | 0.1 | 101.5 |
| YELLOW EYE ROCKFISH | TR | - | 0.1 | 157.6 |
| YELLOWMOUTH ROCKFISH | 0.2 | - | 0.1 | 338.1 |
| YELLOWTAIL ROCKFISH | 532.3 | - | 22.4 | 2886.1 |
| OTHER ROCKFISH | 4.1 | - | 1.4 | 897.5 |
| PACIFIC OCEAN PERCH | 1.2 | - | 0.4 | 1103.6 |
| SHORTBELLY ROCKFISH | - | - | TR | 2.2 |
| THORNYHEADS | 4.8 | - | TR | 1661.4 |
| WIDOW ROCKFISH | 2.6 | - | 0.1 | 10249.6 |
| UNSP. ROCKFISH | 16.1 | 495.9 | 2.8 | 943.6 |
| ALL ROCKFISH | 583.5 | 495.9 | 29.5 | 21603.3 |
| JACK MACKEREL | - | - | - | TR |
| LINGCOD | 33.3 | 13.0 | 1.7 | 1430.7 |
| PACIFIC COD | 5.3 | 2.1 | 0.2 | 1266.8 |
| PACIFIC WHITING | - | - | - | 115.7 |
| SABLEFISH | 21.7 | 5.8 | 1.0 | 4283.7 |
| WALLEYE POLLOCK | - | - | - | TR |
| UNSP. ROUND FISH | - | - | - | 0.1 |
| ALL ROUND FISH | 60.3 | 21.0 | 3.0 | 7096.9 |
| SPINY DOGFISH | - | - | - | 11.0 |
| OTHER GROUND FISH | 0.1 | TR | - | 33.1 |
| UNSP. GROUND FISH | TR | TR | - | 5.2 |
| MISC. GROUND FISH | 0.1 | 0.1 | - | 49.3 |
| ALL GROUND FISH | 668.8 | 523.6 | 34.1 | 42324.0 |
| PACIFIC HALIBUT | 0.1 | - | TR | 91.6 |
| PINK SHRIMP | 18750.1 | 6923.3 | 1413.3 | 27086.7 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR COL RIVER AREA

| SPECIES | RVR-TRAWL | DIP NET | GILL NET | ALL GEARS |
|------------------|-----------|---------|----------|-----------|
| STARRY FLOUNDER | - | - | 6.3 | 6.3 |
| ALL FLATFISH | - | - | 6.3 | 6.3 |
| OTHER ROUND FISH | 6.2 | 1369.2 | 20.4 | 1395.8 |
| ALL ROUND FISH | 6.2 | 1369.2 | 20.4 | 1395.8 |
| ALL GROUND FISH | 6.2 | 1369.2 | 26.7 | 1402.1 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR EUREKA AREA

| SPECIES | HAND LINE | JIG | LOGLINE | OTH HK&LN | POLE (COM) | UNKN-GEAR | OTHER NETS | CRAB POT | FISH POT | OTHER POTS |
|----------------------|-----------|-----|---------|-----------|------------|-----------|------------|----------|----------|------------|
| ARROWTOOTH FLOUNDER | - | - | - | - | - | - | - | - | - | - |
| DOVER SOLE | - | - | - | - | 11.4 | 3.6 | - | - | - | 4.4 |
| ENGLISH SOLE | - | - | - | - | 2.8 | 15.9 | - | - | - | 0.7 |
| PETRALE SOLE | - | - | - | - | 1.7 | 4.1 | - | - | - | 0.1 |
| REX SOLE | - | - | - | - | 0.6 | 2.0 | - | - | - | 0.2 |
| ROCK SOLE | - | - | - | - | - | - | - | - | - | - |
| STARRY FLOUNDER | - | - | - | - | TR | 3.3 | - | - | - | - |
| OTHER FLATFISH | - | - | - | - | 1.3 | 14.6 | - | - | - | 0.3 |
| UNSP. FLATFISH | - | - | - | - | TR | 0.7 | - | - | - | TR |
| ALL FLATFISH | - | - | - | - | 17.8 | 44.1 | - | - | - | 5.7 |
| BLACK ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| BOCACCIO | - | - | - | - | - | - | - | - | - | - |
| CANARY ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| CHILIPEPPER | - | - | - | - | - | - | - | - | - | - |
| DARKBLOTCHED ROCKFIS | - | - | - | - | - | - | - | - | - | - |
| REDSTRIPE ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| SHARPCHIN ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| SILVERGREY ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| SPLITNOSE ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| YELLOW EYE ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| YELLOWTAIL ROCKFISH | - | - | - | - | - | - | - | - | - | - |
| OTHER ROCKFISH | - | - | 19.0 | - | - | - | - | - | - | - |
| PACIFIC OCEAN PERCH | - | - | - | - | - | - | - | - | - | - |
| THORNYHEADS | - | - | - | - | 2.2 | 1.3 | - | - | - | 5.3 |
| WIDOW ROCKFISH | - | - | - | - | - | 165.1 | - | - | - | - |
| UNSP. ROCKFISH | - | TR | 1.1 | 36.3 | 494.6 | 76.8 | - | 0.1 | TR | 4.9 |
| ALL ROCKFISH | - | TR | 20.1 | 36.3 | 496.8 | 243.2 | - | 0.1 | TR | 10.1 |
| LINGCOD | - | - | 5.4 | 4.9 | 157.9 | 18.9 | - | TR | - | 1.5 |
| PACIFIC COD | - | - | - | TR | - | - | - | - | - | - |
| PACIFIC WHITING | - | - | - | - | 54.7 | 491.2 | - | - | - | TR |
| SABLEFISH | - | - | 58.2 | - | 13.0 | 0.6 | - | - | - | 18.8 |
| ALL ROUND FISH | - | - | 63.6 | 4.9 | 225.5 | 510.7 | - | TR | - | 20.3 |
| OTHER GROUND FISH | 0.1 | - | TR | - | 2.9 | 0.3 | 0.3 | - | - | TR |
| UNSP. GROUND FISH | - | - | - | 1.1 | 0.6 | 3.5 | - | - | - | - |
| MISC. GROUND FISH | 0.1 | - | TR | 1.1 | 3.5 | 3.7 | 0.3 | - | - | TR |
| ALL GROUND FISH | 0.1 | TR | 83.8 | 42.4 | 743.6 | 801.7 | 0.3 | 0.1 | TR | 36.1 |
| CALIFORNIA HALIBUT | - | - | - | - | 0.5 | 0.3 | - | - | - | TR |
| PACIFIC HALIBUT | - | - | 0.1 | - | - | - | - | - | - | - |
| PINK SHRIMP | - | - | - | - | - | - | - | - | - | - |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR EUREKA AREA

| SPECIES | TROLL | BTM-TRAWL | GFSSH-TRAWL | MID-TRAWL | OTH TRAWLS | DBL-SHRIMP | SGL-SHRIMP | ALL GEARS |
|----------------------|-------|-----------|-------------|-----------|------------|------------|------------|-----------|
| ARROWTOOTH FLOUNDER | --- | 2.6 | 3.5 | --- | 24.7 | TR | 0.2 | 30.9 |
| DOVER SOLE | --- | 511.7 | 549.8 | --- | 2706.9 | 0.3 | 0.9 | 3789.0 |
| ENGLISH SOLE | --- | 15.5 | 18.7 | --- | 250.0 | --- | TR | 303.5 |
| PETRALE SOLE | --- | 12.2 | 39.8 | --- | 259.2 | --- | TR | 317.2 |
| REX SOLE | --- | 33.9 | 19.3 | --- | 169.7 | --- | --- | 225.6 |
| ROCK SOLE | TR | --- | --- | --- | TR | --- | --- | TR |
| STARRY FLOUNDER | --- | 3.0 | 0.6 | --- | 17.1 | --- | TR | 24.0 |
| OTHER FLATFISH | --- | 8.8 | 8.9 | --- | 225.6 | --- | TR | 259.4 |
| UNSP. FLATFISH | --- | 0.1 | --- | --- | 0.9 | --- | --- | 1.7 |
| ALL FLATFISH | TR | 587.9 | 640.5 | --- | 3654.0 | 0.3 | 1.1 | 4951.4 |
| BLACK ROCKFISH | --- | 6.6 | --- | --- | 28.1 | --- | --- | 34.7 |
| BOCACCIO | --- | 3.5 | 13.6 | TR | 34.9 | --- | --- | 52.0 |
| CANARY ROCKFISH | --- | 2.6 | 31.8 | 0.1 | 36.8 | --- | --- | 71.3 |
| CHILIPEPPER | --- | 3.3 | 0.5 | --- | 38.8 | --- | --- | 42.6 |
| DARKBLOTCHED ROCKFIS | --- | 10.8 | 10.7 | --- | 87.8 | --- | --- | 109.3 |
| REDSTRIPE ROCKFISH | --- | 0.1 | 0.5 | --- | 2.3 | --- | --- | 3.0 |
| SHARPCIN ROCKFISH | --- | 0.8 | 2.1 | --- | 14.3 | --- | --- | 17.3 |
| SILVERGREY ROCKFISH | --- | --- | 1.1 | --- | --- | --- | --- | 1.1 |
| SPLITNOSE ROCKFISH | --- | 2.4 | 3.4 | --- | 17.1 | --- | --- | 22.9 |
| YELLOW EYE ROCKFISH | --- | 0.2 | 7.5 | --- | 2.6 | --- | --- | 10.2 |
| YELLOWTAIL ROCKFISH | --- | 2.3 | 80.5 | 8.6 | 28.9 | 2.6 | 1.6 | 124.6 |
| OTHER ROCKFISH | --- | 4.6 | 42.2 | --- | 50.8 | --- | --- | 116.7 |
| PACIFIC OCEAN PERCH | --- | 1.0 | 4.2 | --- | 8.6 | --- | --- | 13.9 |
| THORNYHEADS | --- | 429.9 | 772.8 | --- | 3186.5 | --- | TR | 4397.9 |
| WIDOW ROCKFISH | --- | 63.0 | 170.7 | 120.4 | 779.9 | --- | --- | 1299.1 |
| UNSP. ROCKFISH | 0.9 | 13.7 | 0.8 | --- | 297.5 | --- | 0.9 | 927.6 |
| ALL ROCKFISH | 0.9 | 544.7 | 1142.6 | 129.1 | 4615.1 | 2.6 | 2.5 | 7244.2 |
| LINGCOD | 1.3 | 11.8 | 57.4 | 1.2 | 114.3 | 0.9 | 2.8 | 378.4 |
| PACIFIC COD | --- | --- | 0.1 | --- | TR | --- | --- | 0.2 |
| PACIFIC WHITING | --- | 0.1 | --- | --- | 6745.8 | --- | --- | 7291.8 |
| SABLEFISH | --- | 170.6 | 369.0 | --- | 1013.1 | TR | 0.2 | 1643.4 |
| ALL ROUND FISH | 1.3 | 182.5 | 426.6 | 1.2 | 7873.3 | 0.9 | 3.0 | 9313.7 |
| OTHER GROUND FISH | --- | 0.1 | 38.4 | --- | 4.4 | --- | TR | 46.4 |
| UNSP. GROUND FISH | --- | 9.8 | --- | --- | 45.5 | --- | --- | 60.4 |
| MISC. GROUND FISH | --- | 9.9 | 38.4 | --- | 49.8 | --- | TR | 106.9 |
| ALL GROUND FISH | 2.2 | 1324.9 | 2248.1 | 130.3 | 16192.2 | 3.8 | 6.6 | 21616.2 |
| CALIFORNIA HALIBUT | --- | TR | --- | --- | 0.7 | --- | --- | 1.4 |
| PACIFIC HALIBUT | --- | --- | --- | --- | --- | --- | --- | 0.1 |
| PINK SHRIMP | --- | --- | --- | --- | 5504.2 | 1141.3 | 959.1 | 7604.7 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR MONTEREY AREA

| SPECIES | LOGLINE | POLE (COM) | OTH-KNOWN | UNKN-GEAR | DIP NET | OTHER NETS | FISH POT | OTHER POTS | TROLL | BTM-TRAWL |
|----------------------|---------|------------|-----------|-----------|---------|------------|----------|------------|-------|-----------|
| ARROWTOOTH FLOUNDER | | TR | | 0.4 | | | | | | 0.5 |
| DOVER SOLE | TR | 2.5 | 1.2 | 10.1 | TR | 3.3 | | 5.4 | | 404.2 |
| ENGLISH SOLE | | 3.9 | 1.6 | 45.8 | TR | 23.4 | | 0.2 | TR | 84.5 |
| PETRALE SOLE | TR | 5.4 | 0.2 | 29.7 | TR | 11.6 | | 0.1 | TR | 57.7 |
| REX SOLE | | 0.5 | 0.8 | 8.5 | TR | 3.1 | | 0.1 | TR | 45.4 |
| ROCK SOLE | | 0.3 | | 0.7 | | TR | | | | 0.4 |
| STARRY FLOUNDER | | TR | | 8.6 | | 1.4 | | | | 0.3 |
| OTHER FLATFISH | TR | 30.7 | | 43.7 | | 48.1 | | 0.2 | | 59.3 |
| UNSP. FLATFISH | | 1.7 | TR | 3.3 | | 20.5 | | TR | | 3.6 |
| ALL FLATFISH | TR | 45.0 | 3.9 | 150.8 | 0.1 | 111.5 | | 6.0 | TR | 655.9 |
| BOCACCIO | | 22.1 | | | | | | | | 64.9 |
| CANARY ROCKFISH | | 2.2 | | | | | | | | 1.1 |
| CHILIPEPPER | | 6.3 | | | | | | | | 169.3 |
| DARKBLOTCHED ROCKFIS | | | | | | | | | | 2.6 |
| SPLITNOSE ROCKFISH | | | | | | | | | | 21.5 |
| YELLOW EYE ROCKFISH | | 0.1 | | | | | | | | |
| YELLOWTAIL ROCKFISH | | 17.4 | | | | | | | | 4.7 |
| OTHER ROCKFISH | | 22.2 | | | | | | | | 26.4 |
| THORNYHEADS | 0.2 | 10.4 | 0.1 | 7.4 | | 0.3 | | 8.1 | | 95.4 |
| WIDOW ROCKFISH | | 4.4 | | 32.3 | | 37.0 | | | | 48.1 |
| UNSP. ROCKFISH | 1.9 | 923.4 | 4.3 | 471.0 | 0.1 | 1376.0 | | 11.3 | 11.2 | 342.5 |
| ALL ROCKFISH | 2.1 | 1008.4 | 4.4 | 510.6 | 0.1 | 1413.2 | | 19.4 | 11.2 | 776.4 |
| LINGCOD | | 186.6 | 0.3 | 68.5 | | 173.9 | | 2.2 | 0.5 | 36.1 |
| PACIFIC COD | | TR | | TR | | TR | | 0.1 | | |
| PACIFIC WHITING | | 0.3 | | TR | | TR | | | | TR |
| SABLEFISH | 27.9 | 279.1 | 1.4 | 30.9 | | 52.3 | 18.5 | 829.3 | 1.8 | 130.4 |
| ALL ROUND FISH | 27.9 | 465.9 | 1.7 | 99.4 | | 226.2 | 18.5 | 831.5 | 2.3 | 166.5 |
| OTHER GROUND FISH | TR | 5.9 | | 3.0 | | 13.6 | | 0.2 | TR | 0.4 |
| UNSP. GROUND FISH | | 2.1 | | 5.6 | TR | 12.8 | | TR | | 8.0 |
| MISC. GROUND FISH | TR | 8.1 | | 8.6 | TR | 26.4 | | 0.2 | TR | 8.5 |
| ALL GROUND FISH | 30.1 | 1527.4 | 9.9 | 769.5 | 0.2 | 1777.4 | 18.5 | 857.1 | 13.5 | 1607.2 |
| CALIFORNIA HALIBUT | | 54.3 | | 30.8 | | 105.9 | | 0.1 | 0.5 | 5.7 |
| PACIFIC HALIBUT | | | | 0.1 | | | | | | |
| PINK SHRIMP | | | | | | | | | | |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR MONTEREY AREA

| SPECIES | OTH TRAWLS | ALL GEARS |
|-----------------------|------------|-----------|
| ARROWTOOTH FLOUNDER | 0.1 | 1.0 |
| DOVER SOLE | 4037.6 | 4464.4 |
| ENGLISH SOLE | 581.5 | 740.9 |
| PETRALE SOLE | 432.1 | 536.8 |
| REX SOLE | 478.2 | 536.7 |
| ROCK SOLE | 8.0 | 9.5 |
| STARRY FLOUNDER | 27.6 | 37.9 |
| OTHER FLATFISH | 353.2 | 535.1 |
| UNSP. FLATFISH | 16.0 | 45.1 |
| ___ ALL FLATFISH | 5934.2 | 6907.4 |
| BOCACCIO | 236.5 | 323.4 |
| CANARY ROCKFISH | 25.5 | 28.8 |
| CHILIPEPPER | 476.3 | 651.9 |
| DARKBLOTCHED ROCKFIS | 39.2 | 41.8 |
| SPLITNOSE ROCKFISH | 21.7 | 43.2 |
| YELLOW EYE ROCKFISH | 1.7 | 1.8 |
| YELLOWTAIL ROCKFISH | 104.7 | 126.8 |
| OTHER ROCKFISH | 184.3 | 232.8 |
| THORNYHEADS | 1609.5 | 1731.2 |
| WIDOW ROCKFISH | 425.6 | 547.3 |
| UNSP. ROCKFISH | 2860.3 | 6001.9 |
| ___ ALL ROCKFISH | 5985.2 | 9730.9 |
| LINGCOD | 338.9 | 806.9 |
| PACIFIC COD | | 0.1 |
| PACIFIC WHITING | 0.1 | 0.4 |
| SABLEFISH | 1234.7 | 2606.2 |
| ___ ALL ROUND FISH | 1573.6 | 3413.6 |
| OTHER GROUND FISH | 5.2 | 28.5 |
| UNSP. GROUND FISH | 28.0 | 56.6 |
| ___ MISC. GROUND FISH | 33.2 | 85.0 |
| ALL GROUND FISH | 13526.1 | 20136.9 |
| CALIFORNIA HALIBUT | 105.6 | 302.9 |
| PACIFIC HALIBUT | | 0.1 |
| PINK SHRIMP | 177.5 | 177.5 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR CONCEPTION AREA

| SPECIES | LOONGLINE | POLE (COM) | OTH-KNOWN | UNKN-GEAR | GILL NET | OTHER NETS | OTHER POTS | TROLL | BTM-TRAWL | OTH TRAWLS |
|---------------------|-----------|------------|-----------|-----------|----------|------------|------------|-------|-----------|------------|
| DOVER SOLE | - | - | - | - | - | - | TR | - | 2.5 | 2.2 |
| ENGLISH SOLE | - | TR | - | 2.6 | - | - | 1.0 | - | TR | 10.9 |
| PETRALE SOLE | TR | 0.1 | - | 0.9 | - | - | 6.5 | 0.2 | TR | 5.4 |
| REX SOLE | - | - | - | - | - | - | - | - | - | 3.7 |
| ROCK SOLE | - | - | - | TR | - | - | - | - | - | - |
| STARRY FLOUNDER | - | - | - | TR | - | - | TR | - | - | 0.3 |
| OTHER FLATFISH | - | 1.4 | - | 1.0 | - | - | 0.6 | TR | - | 0.1 |
| UNSP. FLATFISH | - | 0.3 | - | 2.3 | TR | - | 7.4 | 0.2 | 0.3 | 5.5 |
| ALL FLATFISH | TR | 1.8 | - | 6.8 | TR | - | 15.5 | 0.4 | 2.9 | 28.0 |
| BOCACCIO | - | 38.7 | - | - | - | - | - | - | - | - |
| CANARY ROCKFISH | - | 13.0 | - | - | - | - | - | - | - | - |
| CHILIPEPPER | - | 23.7 | - | - | - | - | - | - | - | - |
| REDSTRIPE ROCKFISH | - | 0.2 | - | - | - | - | - | - | - | - |
| SPLITNOSE ROCKFISH | - | 1.7 | - | - | - | - | - | - | - | - |
| YELLOW EYE ROCKFISH | - | 0.5 | - | - | - | - | - | - | - | - |
| YELLOWTAIL ROCKFISH | - | 1.7 | - | - | - | - | - | - | - | - |
| OTHER ROCKFISH | - | 157.8 | - | 1.7 | - | 1.6 | TR | - | - | TR |
| THORNYHEADS | - | TR | - | - | - | - | - | - | 1.8 | 8.7 |
| WIDOW ROCKFISH | - | 1.3 | - | 9.4 | - | - | - | - | - | 3.3 |
| UNSP. ROCKFISH | 1.2 | 376.7 | 1.5 | 97.9 | - | 405.6 | 7.9 | TR | 1.5 | 39.3 |
| ALL ROCKFISH | 1.2 | 615.3 | 1.5 | 109.0 | - | 407.1 | 7.9 | TR | 3.3 | 51.3 |
| LINGCOD | - | 1.6 | - | 1.1 | - | 17.4 | 0.5 | - | TR | TR |
| PACIFIC WHITING | - | TR | - | TR | - | 0.7 | 6.9 | - | - | 0.4 |
| SABLEFISH | - | 9.8 | - | 0.9 | - | 2.5 | 0.6 | - | 0.5 | 14.9 |
| ALL ROUND FISH | - | 11.4 | - | 2.1 | - | 20.6 | 7.9 | - | 0.5 | 15.4 |
| OTHER GROUND FISH | - | 8.3 | 0.2 | 10.6 | TR | 49.5 | 5.8 | - | 0.1 | 0.1 |
| UNSP. GROUND FISH | - | 0.1 | TR | 0.7 | - | 4.7 | TR | - | - | 0.1 |
| MISC. GROUND FISH | - | 8.4 | 0.3 | 11.3 | TR | 54.2 | 5.9 | - | 0.1 | 0.2 |
| ALL GROUND FISH | 1.2 | 636.9 | 1.8 | 129.2 | 0.1 | 497.5 | 22.2 | TR | 6.8 | 94.9 |
| CALIFORNIA HALIBUT | - | 4.5 | - | 51.4 | 0.3 | 169.4 | 1.4 | - | 0.7 | 10.7 |
| PINK SHRIMP | - | - | - | - | - | - | - | - | - | 7.5 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR CONCEPTION AREA

| SPECIES | ALL GEARS |
|-----------------------|-----------|
| DOVER SOLE | 4.7 |
| ENGLISH SOLE | 14.6 |
| PETRALE SOLE | 13.1 |
| REX SOLE | 3.7 |
| ROCK SOLE | TR |
| STARRY FLOUNDER | 0.3 |
| OTHER FLATFISH | 3.1 |
| UNSP. FLATFISH | 16.0 |
| ___ ALL FLATFISH | 55.4 |
| BOCACCIO | 38.7 |
| CANARY ROCKFISH | 13.0 |
| CHILIPEPPER | 23.7 |
| REDSTRIPE ROCKFISH | 0.2 |
| SPLITNOSE ROCKFISH | 1.7 |
| YELLOW EYE ROCKFISH | 0.5 |
| YELLOWTAIL ROCKFISH | 1.7 |
| OTHER ROCKFISH | 161.1 |
| THORNYHEADS | 10.5 |
| WIDOW ROCKFISH | 14.0 |
| UNSP. ROCKFISH | 931.5 |
| ___ ALL ROCKFISH | 1196.6 |
| LINGCOD | 20.6 |
| PACIFIC WHITING | 8.2 |
| SABLEFISH | 29.2 |
| ___ ALL ROUND FISH | 58.0 |
| OTHER GROUND FISH | 74.7 |
| UNSP. GROUND FISH | 5.7 |
| ___ MISC. GROUND FISH | 80.4 |
| ALL GROUND FISH | 1390.4 |
| CALIFORNIA HALIBUT | 238.4 |
| PINK SHRIMP | 7.5 |

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. GROUND FISH LANDED CATCH (MTONS) FOR 1989 FOR UNKN INPFC AREA

| SPECIES | LONGLINE | POLE (COM) | UNKN-GEAR | OTHER NETS | OTHER POTS | BTM-TRAWL | OTH TRAWLS | ALL GEARS |
|----------------------|----------|------------|-----------|------------|------------|-----------|------------|-----------|
| DOVER SOLE | -- | -- | -- | -- | -- | -- | 4.0 | 4.0 |
| ENGLISH SOLE | -- | -- | -- | -- | -- | -- | 0.1 | 0.1 |
| PETRALE SOLE | -- | TR | -- | TR | -- | -- | TR | 0.1 |
| REX SOLE | -- | -- | -- | -- | -- | -- | 0.4 | 0.4 |
| OTHER FLATFISH | -- | TR | TR | TR | -- | -- | TR | 0.1 |
| UNSP. FLATFISH | -- | TR | 0.3 | 0.3 | TR | TR | TR | 0.7 |
| ALL FLATFISH | -- | 0.1 | 0.3 | 0.3 | TR | TR | 4.5 | 5.3 |
| BLACK ROCKFISH | -- | -- | -- | -- | -- | -- | 0.9 | 0.9 |
| BOCACCIO | -- | 1.0 | -- | -- | -- | -- | 1.6 | 2.6 |
| CANARY ROCKFISH | -- | 1.2 | -- | -- | -- | -- | 1.0 | 2.2 |
| CHILIPEPPER | -- | 0.3 | -- | -- | -- | -- | 1.4 | 1.7 |
| DARKBLOTCHED ROCKFIS | -- | -- | -- | -- | -- | -- | 4.3 | 4.3 |
| SHARPCHIN ROCKFISH | -- | -- | -- | -- | -- | -- | TR | TR |
| SPLITNOSE ROCKFISH | -- | TR | -- | -- | -- | -- | 0.2 | 0.2 |
| YELLOW EYE ROCKFISH | -- | 0.1 | -- | -- | -- | -- | -- | 0.1 |
| YELLOWTAIL ROCKFISH | -- | -- | -- | -- | -- | -- | 0.6 | 0.6 |
| OTHER ROCKFISH | -- | 4.1 | 0.1 | 0.1 | TR | -- | 0.9 | 5.2 |
| PACIFIC OCEAN PERCH | -- | -- | -- | -- | -- | -- | 0.1 | 0.1 |
| THORNYHEADS | -- | 3.0 | -- | -- | -- | -- | 9.5 | 12.5 |
| WIDOW ROCKFISH | -- | TR | -- | -- | -- | -- | 8.6 | 8.7 |
| UNSP. ROCKFISH | TR | 22.5 | 4.8 | 10.6 | 0.1 | TR | TR | 38.0 |
| ALL ROCKFISH | TR | 32.3 | 4.8 | 10.7 | 0.1 | TR | 29.2 | 77.1 |
| LINGCOD | -- | 0.4 | 0.1 | TR | TR | TR | 2.5 | 3.1 |
| PACIFIC WHITING | -- | 1.5 | TR | -- | -- | -- | -- | 1.6 |
| SABLEFISH | -- | 34.8 | TR | 0.6 | -- | -- | 4.3 | 39.8 |
| ALL ROUND FISH | -- | 36.8 | 0.1 | 0.6 | TR | TR | 6.8 | 44.4 |
| OTHER GROUND FISH | -- | 4.4 | 2.0 | 5.6 | 0.2 | -- | -- | 12.2 |
| UNSP. GROUND FISH | -- | -- | TR | TR | -- | -- | 0.5 | 0.5 |
| MISC. GROUND FISH | -- | 4.4 | 2.0 | 5.7 | 0.2 | -- | 0.5 | 12.8 |
| ALL GROUND FISH | TR | 73.5 | 7.3 | 17.3 | 0.3 | TR | 41.0 | 139.6 |
| CALIFORNIA HALIBUT | -- | TR | 4.9 | 2.4 | -- | -- | -- | 7.3 |
| PINK SHRIMP | -- | -- | -- | -- | -- | -- | 0.3 | 0.3 |

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

Appendix H. Biological samples of hagfish collected by the Oregon Department of Fish and Wildlife, 1988 and 1989.

| <u>Characteristic</u> | <u>Black hagfish</u> | <u>Pacific hagfish</u> |
|------------------------|----------------------|------------------------|
| | n=888 | n=844 |
| Length range, cm | 15-52 | 10-68 |
| mean length, cm | 35 | 40 |
| Length at maturity | | |
| Males, first/full | 28/41 | 32/42 |
| 50% | 34 | 35 |
| Females, first/full | 33/42 | 30/51 |
| 50% | 37 | 42 |
| Fecundity (eggs >20mm) | | |
| range | 2-24 | 3-43 |
| mean | 12.2 | 21.6 |

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