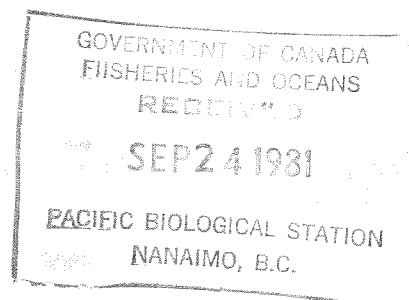


REPORT OF THE
TECHNICAL SUBCOMMITTEE OF THE
INTERNATIONAL GROUND FISH COMMITTEE

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



Twenty-First Annual Meeting

June 18-20, 1980

Petersburg, Alaska

Report of the Technical Subcommittee of the International Groundfish
Committee, Appointed by the Second Conference on Coordination of
Fisheries Regulations Between Canada and the United States

Date: June 18-20, 1980

Place: Petersburg, Alaska

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I. Call to Order

The 21st annual meeting of the Technical Subcommittee was called to order at 09:00 June 18, 1980 by Chairman Mr. T. Dark under instructions set forth by the Parent Committee in 1959.

II. Appointment of Secretary

Mr. P. Rigby, Alaska Department of Fish and Game, was appointed recording secretary.

III. Approval of Agenda

The tentative agenda circulated by Chairman Dark prior to the meeting was modified through suggestions from both national sections. These modifications were primarily additions or elaborations to previously listed items; the revised agenda adopted for the meeting is included as Appendix A.

IV. Terms of Reference of the Subcommittee

The Parent Committee during its November, 1978 meeting recommended new terms of reference which would join the Parent Committee and Subcommittee into a single committee and would emphasize the scientific and technical responsibilities of the committee. Approval for the new terms of reference has been requested from the respective governments. Since no comments specific to the new terms of reference have as yet been received, the Subcommittee is operating under the existing terms of reference as outlined below:

- (1) to review proposed changes in groundfish regulations affecting fisheries of common interest before they are implemented;
- (2) to review the effectiveness of existing regulations;
- (3) to exchange information on the status of groundfish stocks of mutual concern and to coordinate, wherever possible, programs of research; and
- (4) to recommend the continuance and further development of research programs in order to provide a basis for future management of the groundfish fishery.

V. Review of Agency Programs

A. Recent and Anticipated Studies

1. Canada

The Groundfish Program of the Marine Fisheries Division again devoted the majority of its efforts to research projects in support of fisheries management, during 1979. The most recent information was collated and the second comprehensive document presenting assessments of groundfish stocks in B.C. waters was produced. Research projects initiated during 1979/80 were designed to address problems arising from a lack of either biological or fisheries information on many species. A total of 27 research cruises were conducted, with the majority being directed to biomass estimation or tagging.

There are presently eight sub-programs within the Program concentrating on the following major species or research problems: (a) sablefish, hake, lingcod and dogfish; (b) flatfishes; (c) rockfishes; (d) Pacific cod; (e) hydro-acoustic surveys and walleye pollock; (f) ichthyoplankton surveys; (g) analytical techniques; and (h) international matters and albacore tuna. Activities of these sub-programs are outlined below:

a. The major study of sablefish biology initiated in 1977 was continued in 1979 through the tagging of both adults (15,000) and juveniles (15,000) bringing the total number of fish tagged to 52,000. The 2,400 recoveries to date indicate very little movement of adults; 80% of recoveries were made within 50 km of the release area. While only a limited number of juveniles have been recovered, results suggest a movement from inshore to the offshore areas where adults are more abundant.

Preliminary stomach analysis indicate that juvenile sablefish may have an important predatory relationship on herring and shrimp stocks. A new method of aging sablefish was developed and validation of the method is underway.

Little research activity is presently directed at Pacific hake, although a new fishery in the Strait of Georgia is being monitored. Observer and survey data indicate that offshore hake stocks may occur in the Canadian zone for up to six months, and that the movement of hake into the Canadian zone may involve primarily older fish.

Dogfish research was limited to the development of a population model and continuation of a tagging program to gain long-term information on movements and growth. Research on lingcod concerned a tagging program on the west coast of Vancouver Island; studies on spawning behavior and the factors controlling recruitment were continued.

b. Flatfish research concentrated on the application of surplus production models to the time-series of catch and effort information for rock sole in northern and middle Hecate Strait as well as for English sole in the former area. In addition, a tagging experiment on Dover sole in the northern Hecate Strait-Dixon Entrance area was conducted to examine the seasonal spawning movements of the species in this area.

c. Rockfish research in 1979 concentrated on biomass surveys; the development of growth, mortality and recruitment estimates for species with relatively short exploitation histories; and (in cooperation with two other sub-programs) the reconstruction of stock histories for heavily exploited stocks of Pacific ocean perch in order to simulate their dynamics using sequential population analysis. In late 1979 work also began on identification of recurrent species groupings among the shelf and slope rockfish.

Surveys were conducted in the Langara Island Spit area (Area 5E), the west coast of the Queen Charlotte Islands, Queen Charlotte Sound, and the southwest coast of Vancouver Island. The first and last surveys concentrated on Pacific ocean perch while the remaining two encompassed all rockfishes.

d. The principal objective of Pacific cod research is to determine the factors controlling the large fluctuations in abundance of this species. Field research involved the continuation of the tagging of juveniles to estimate pre-recruit mortality and growth; and the investigation of seasonal distribution and abundance of fish in Hecate Strait. Laboratory studies concentrated on the validation of an aging technique, a study of migration as evidenced by previous tagging studies and the resolution of fishing effort applied to Pacific cod in a multi-species fishery.

e. The hydroacoustic and pollock investigation completed three biomass assessment cruises in 1979. Two surveys in the Dixon Entrance area to determine seasonal patterns of abundance and one cruise to assess pollock potential off the southwest coast of Vancouver Island were conducted. A new dual-beam, integrator system was acquired in 1979 and when fully calibrated will permit estimation of in situ target strengths.

A method for aging walleye pollock using fin rays was developed and applied to samples from all areas. At least four stocks could be differentiated on the basis of growth; spawning characteristics indicate that stock structure may be even more complex.

f. The feasibility of using ichthyoplankton surveys to assess the spawning biomass of pollock and hake in the Strait of Georgia was examined during 1979. The main objectives were to determine the timing, duration and intensity of spawning, the distribution of eggs and larvae and the general aspects of spawning behavior. Fecundity and survival estimates were employed to prorate egg and larval abundance to spawning biomass. Broader application of this project will be determined by the results of the 1979 trial survey.

g. Research into the analytical methods during 1979 was primarily directed at two projects: the development of a technique to minimize the amount of information needed to accurately estimate the age composition of

a stock, and the development of a more generalized and mathematically rigorous sequential population analysis. The former project resulted in an automated procedure for predicting an age composition of a stock using a combination of aged and unaged fish, thereby reducing the number of aged fish required. This procedure is only appropriate for fish with relatively rapid growth. The second project is still underway with major effort being directed to the critical estimation of the relative and absolute magnitudes of errors in the data and the assumptions of the model.

In late 1979 work also began on a model needed to calculate relative fishing power and partition fishing effort in a multi-species fisheries.

h. This sub-program concentrated on completing the reconstruction of catch histories for Pacific ocean perch from all-nation catches in Queen Charlotte Sound; establishing a standard measure of abundance based on the domestic fishery performance; and attempting to resolve inconsistencies in the biomass estimates from this area. In addition, a project to validate the age of albacore tuna using fin ray sections was initiated.

The commercial fishery sampling unit continued to provide the Program with catch and effort information and biological samples from the fishery. Percent of landed weight for which trawl interviews (and thus effort) were obtained remained relatively high, averaging 89% of landed weight coastwide. Percentages of coverage by statistical area were: 4B-66%, 3C-76%, 3D-75%, 5A-97%, 5B-95%, 5C-90%, 5D-97%, and 5E-100%. The increase in the dogfish fishery in Area 4B, where there are a large number of unsampled landing sites, is the primary factor in the lower level of coverage in this area.

There were two foreign (non-North American) fisheries in Canadian waters during 1979; a sablefish longline fishery conducted by Japan, and a hake fishery involving Japan and Poland as well as domestic vessels delivering hake

to Polish and Soviet factory ships. In addition, United States vessels fished in the Canadian zone until June under the provisions of an interim reciprocal fishing agreement.

Twenty Japanese longliners fished a total of 203 vessel days; observers were aboard for 122 vessel days yielding 60% coverage. Fifty-eight percent of the landed catch was monitored by observers. In the 1979 hake fishery 3.4% of the 204 foreign vessel days were monitored and 4.1% of the 146 joint-venture vessel days. Percent coverage of landed catches was 4.7% for each.

2. United States

a. National Marine Fisheries Service (NMFS)

Groundfish research at the Northwest and Alaska Fisheries Center (NWAFC) continues to be conducted mainly by the Resource Assessment and Conservation Engineering Division. The Division is organized into a number of Tasks and Subtasks which provide for approaching problems on a regional or scientific discipline basis. A review of pertinent work by these Tasks and Subtasks during the past year is presented below.

MARMAP II: Multi-species, Bering Sea and NE Pacific Task - Bering Sea Groundfish Assessment Subtask

The most comprehensive survey of demersal fisheries resources ever conducted in the Bering Sea was carried out by Japan and the U.S. in the summer of 1979. Two Japanese and four U.S. research vessels used bottom trawls to survey demersal fish and invertebrate resources over the eastern Bering Sea continental shelf and slope, and midwater trawls and hydroacoustic techniques to assess the off-bottom portion of the walleye pollock (Theragra chalcogramma) population located over the outer shelf, slope, and Bering Sea deepwater basin. There were about 950 standard demersal trawl stations sampled, and 6,900 nautical miles of trackline surveyed hydroacoustically by U.S. and Japanese vessels during the survey.

The purpose of the survey was to provide comprehensive estimates of the absolute abundance and biological condition of the principal commercial species of demersal fish and crabs over almost the entire range of these resources in the eastern Bering Sea. For the first time, these estimates included an assessment of the resources on the continental slope to depths of 1,000 m, and in the region from St. Matthew to St. Lawrence Islands. The overall pollock resource was also more completely assessed than in the past with the inclusion in the survey of a hydroacoustic assessment of the off-bottom portion of the population. Results of the survey will be used: (1) in scientific studies of the resources, (2) for status of stock reports that will be used by the North Pacific Fishery Management Council (NPFMC) for managing the resources, and (3) for planning future surveys to provide the most effective coverage of the resources in years when research vessel effort is reduced from that in 1979.

In July-August 1979, the NOAA Research Vessel Miller Freeman conducted a demersal trawl survey of the fish and shellfish resources of Norton Sound. A total of 115 sampling stations were successfully trawled. The results of this survey will be used in the management of the commercial king crab fishery in this region and to increase the knowledge of demersal resources prior to the leasing of oil sites.

In 1980, the eastern Bering Sea crab and groundfish resources will be assessed again, but with a less comprehensive survey than that conducted in 1979. The demersal trawl survey involving two research vessels will cover most of the eastern Bering Sea continental shelf north to the latitude of St. Matthew Island. The continental slope will not be surveyed in 1980, and the density of sampling on the shelf will be reduced from that in 1979 with approximately 320 stations trawled.

Gulf of Alaska Subtask

Two major resource assessment surveys were conducted in the Gulf of Alaska during 1979. The first survey was conducted in the Kodiak Island region to study the winter distribution and relative abundance of the important groundfish species with particular emphasis on the Pacific cod, walleye pollock, and Atka mackerel. A second survey was conducted in the western Gulf of Alaska from Marmot Gully to Unimak Pass to study the summer distribution and relative abundance of the rockfish species with particular interest in the Pacific ocean perch. Other data collected included growth, age, size and sex composition, length-weight relationships, and maturity.

During 1980, two resource assessment surveys are scheduled. A winter survey of the groundfish resources in the Kodiak Island region, primarily in the southern Kodiak Island-Shelikof Strait area. The second survey is a cooperative U.S.-Japanese survey of the groundfish resources of the Aleutian Islands and Bowers Bank.

Pacific Coast Subtask

The results of a March-April 1979 Pacific ocean perch survey conducted cooperatively by NMFS, Washington Department of Fisheries (WDF), and Oregon Department of Fish and Wildlife (ODFW) off Washington and Oregon are the basis of a nearly completed manuscript. The results of that survey supported findings of the 1977 rockfish survey which indicated that perch populations were still relatively small in the Vancouver and Columbia areas, and were only about 25% of the population level producing MSY.

Subtask personnel were also deeply involved in the development of the Pacific Fishery Management Council's (PMFC) groundfish management plan for the west coast. That plan was scheduled for adoption by the Council during the summer of 1980 and implementation in the spring of 1981.

Research plans for 1980 are embodied in a trawl/hydroacoustic survey off California, Oregon, and Washington during July-September. Primary objectives of the survey are to determine the distribution, abundance, and biological features of Pacific hake, canary and yellowtail rockfish. Secondary objectives are to determine the distribution and abundance of shortbelly rockfish between Monterey Bay and Point Arena, and to assess the behavior and abundance of widow rockfish in a small area off Newport, Oregon.

Latent Resources Task

During the past year, primary activity centered around consolidation of all divisions' sablefish research under the Latent Resource Assessment Task.

A sablefish abundance index program initiated in 1978 off Southeast Alaska was repeated in 1979 and two additional monitoring sites were established off the Washington coast and two off the Oregon coast. Analyses of the 1978-79 data off Southeast Alaska appears to indicate the research methodology is a valid and reasonable means to monitor changes in the relative abundance of the exploitable stock, year-class strength, and allocation of yield. The monitoring of index sites off Southeast Alaska, Washington, and Oregon will be repeated in 1980 and expanded into California waters. Extensive stock identification work employing biochemical/genetic studies was conducted in 1979 and will be completed in 1980. Tagging studies were conducted in 1979 and will also be expanded in 1980.

Additional sablefish research of an exploratory nature was completed during a 40-day June-July 1979 period on Gulf of Alaska seamounts. These seamounts (Dickens, Welker, Applequist, Durgin, Pratt, Surveyor, Giacomini, and Patten) rise precipitously from depths of 1,000 to 2,000 fms on the abyssal plain to within 90-400 fms of the ocean surface. The area on top of these seamounts ranges from approximately one square nautical mile (Applequist) to 70 square miles (Surveyor) and averages about 24 square nautical miles.

Trap gear set on the tops of all the above seamounts, except Applequist, produced substantial catches of sablefish. The largest catch of sablefish during the cruise was on Quinn Seamount when it was revisited for a second time in early July. The catch rate was much higher than that achieved with traps off Southeast Alaska during the 1978-79 abundance index surveys.

In April 1980, a meeting was held at NWAFC to formulate a cooperative state (Washington, Oregon, California, and Alaska), and Federal management council five-year research plan for sablefish. That plan is presently nearing completion and provides a detached 1980-84 research schedule for the west coast and Alaska management needs.

Hydroacoustic Assessment Task

The hydroacoustic program participated in the comprehensive Bering Sea survey during May-July 1979. Work was centered on the lower shelf and upper continental slope to assess walleye pollock distribution and abundance. Additional research was conducted over the Aleutian Basin to assess the "deep water" pollock population and to develop acoustic target strength values. Similar work was completed by Japanese researchers, and a comparison of the results will be the subject of an INPFC document.

A joint Washington Department of Fisheries, Environment Canada, and NMFS herring survey was completed off northern Washington during October 1979. Biological data were collected, and distribution and abundance estimated. The results of the work are forthcoming in a joint report.

During July-September 1980, the Hydroacoustic Assessment Task will participate in the Pacific hake resource assessment. Special effort will be directed toward studies of the distribution, abundance, and behavior of short-belly rockfish off northern California, and widow rockfish off central Oregon. Evaluation of dual and split beam approaches to target strength estimation is also scheduled.

b. Alaska

The Alaska Department of Fish and Game (ADF&G) presently has two groundfish biologists who are responsible for research and management programs in the Westward (western Gulf and Bering Sea) and Southeastern Regions. They are stationed in Kodiak and Petersburg. A coordinator position located in Juneau is responsible for interaction with other agencies and development of the Department's statewide groundfish program. Additionally, a new position for the Central Region (Cook Inlet and Prince William Sound) is planned for the latter part of this year.

The ADF&G groundfish program can be divided into seven tasks: catch reporting, observer-port sampling, logbook interview, resource assessment, regulation development, management action and log-fish ticket correlation. In general, research and management are conducted on a regional basis. For the groundfish fishery the groundfish staff is attempting to standardize sampling methods and cooperate on a statewide basis within the present organizational structure. Each region functions independently but will cooperate on particular projects.

(1) Southeastern Region

Activities of the Southeastern groundfish staff include catch data collection; dockside and on-board catch sampling; logbook interview and collection; sablefish tagging; information dissemination; the opening and closing of fisheries for pollock, flounder and sablefish; and regulation development including cooperation with the NPFMC as a Gulf groundfish planning team member and reports and presentations before the Alaska Board of Fisheries and advisory committees.

Three on-board sampling trips were made in 1979 during the winter flounder fishery, and dockside sampling of sablefish and rockfish occurred

during 1980. During the new fiscal year dockside sampling will be expanded with samplers in each major port.

The logbook program is presently limited to the few vessels of the inside flounder and pollock fisheries and to all vessels fishing sunken gill nets. Vessels engaged in the State-funded fishing demonstration projects were also to have maintained accurate fishing logs. Data compilation is all "by hand".

The NMFS has developed a longline/pot logbook and DP system but has had poor response from Southeastern Alaska sablefish fishermen. The groundfish staff feels the program could be made viable if the Department and NMFS developed a working agreement to allow ADF&G samplers to collect and correct the logs from fishermen at dockside. Such a cooperative program may begin this year.

In addition, ADF&G may begin to develop a statewide trawl logbook-fish ticket correlation system similar to those of Washington, Oregon, and California.

Over 6,300 sablefish (mostly juveniles) were tagged near Ketchikan between June and December 1979. Additional tagging was conducted in June 1980. The tagging program will provide insight into juvenile migrations and the contributions of nearshore rearing areas to the commercial fisheries besides basic biological data, e.g. growth, age class strength, and food habits. Future tagging may include other species such as starry flounder and cooperative cruises with the NMFS.

Catch data (fish tickets) collection is done in Petersburg. A three-fold increase in the number of groundfish landings was noted in 1979, and assistance to handle this increased workload is now available with a new seasonal technician and just recently data processing assistance from the Department's Computer Services Section.

Management activities include on-board sampling of the winter flounder fishery and observation flights of the fishing fleet during the Chatham Strait sablefish season. The flounder fishery was closed both on January 12, 1979

and January 23, 1980 when poor CPUE and age and sex composition were observed. The Chatham Straits sablefish fishery set a record catch in record time when 1.1 million pounds were taken in only 34 days. This catch exceeded the quota for the new northern area by over 200,000 pounds, and because of the extreme increase in effort this fishery will have to be intensively monitored during the 1980 season.

(2) Westward Region

Activities of the Westward Region (Kodiak) groundfish program also include catch data collection, information dissemination, regulation development and as a primary activity the domestic trawl observer program. The domestic observer program has sampled trawl vessels from Southeastern to the Bering Sea with the greatest sampling effort centralized near Kodiak. Catch per unit of effort, species composition, prohibited species incidence, and other biological data have been obtained. A final draft report for the first two years of the program has been completed.

Because of the critical importance of assessing crab and halibut incidence within the expanding groundfish fishery and because of the programs' value in obtaining biological data prior to sorting and discard on the grounds, the Department intends to continue the observer program either with State and/or Federal funds. The Department also intends, if money is available, to expand the program to include longline and pot vessels.

Management action in the Westward Region has been limited to fishery observation. No closures have been needed as yet. Dockside sampling is not currently conducted since the trawl observer program samples a substantial portion of the catch within the Westward Region. Catch data is compiled on a monthly basis by the minicomputer of the Computer Services Section. Hand tallies are also done in order to provide the Regional NMFS office and the NPFMC with timely catch reports.

c. California

The Department's programs on groundfish are conducted by Marine Resources Branch, the Marine Resources Region, and the Planning Branch.

Marine Resources Branch is carrying out studies of rockfish biology in southern and central California. Age and growth, movements and migrations, and taxonomic relationships are carried out on species important in nearshore fisheries.

The Marine Resources Region is engaged in monitoring and assessments of commercial and recreational groundfish fisheries throughout the State. Fisheries for flatfish, sablefish, lingcod, and rockfish received major emphasis. Sampling of commercial and recreational catches of groundfish was continued. The level of sampling was slightly below that of 1979; a compilation of samples is not available at this time. Logbook data were collected for trawl, pot, and commercial passenger fishing vessel (CPFV) fisheries. The timeliness of groundfish data has not improved since the last meeting. A soft-data system is planned to provide 1980 preliminary data on a current basis.

Sablefish tagging in area IA is planned for this summer and fall to determine stock relationships and migrations.

Considerable effort was devoted to the preparation of the Pacific Fishery Management Council's Pacific Coast Groundfish Plan.

The Department's Planning Branch has the responsibility of processing fishery data. Groundfish data for 1978 is near completion and 1979 data is estimated to be available in late summer.

d. Oregon

The Marine Region staff, headed by a Regional Supervisor is responsible for management and research on ocean foodfish not including anadromous fishes. It also participates in national and international issues involving these resources and fisheries, especially groundfish, shellfish (including shrimp),

pelagic fish (albacore) and baitfish. Many personnel changes occurred during 1979 due to retirement, transfer, and additions. The staff at this time is complete.

Major activities in 1979 include continued collection of age, sex, and size composition data for petrale, Dover, and English sole and selected rockfish species including Sebastes alutus. Collection of rockfish species composition was a major activity. Collection of biological data from the very large sablefish fishery began. In all, 274 biological samples were taken in 1979, compared to 265 in 1978. A sablefish longline-pot fishery logbook was drafted and circulated in early 1980. Those used in 1979 were found to be unsatisfactory for these fisheries. The new logbook developed is much more usable.

Sablefish samples were taken largely for the purpose of assessing age and size at maturity by market category. Personnel limitations and workload did not permit as expanded an effort in 1979 for this very fast developing fishery as the staff would have liked.

An "exploding" shrimp fishery in 1977-79 also created additional need for sampling by the Marine Region staff. This fishery also lands a substantial amount of groundfish, a fact which made for increasing controversy in 1979 subsequent to the mid-year declines in the groundfish market. The collection, coding, data entry, and error-checking of trawl catch data was a major task, as usual. Such data are eventually entered onto mag tapes at the Oregon State University's Computer Center; summary reports from the Cyber unit there are the result.

Participation in Pacific Fishery Management Council and North Pacific Fishery Management Council activities including the Scientific and Statistical Committee and Management Plan development teams for groundfish, also occupied much staff time. The groundfish FMP was tentatively adopted by the PFMC at its May 1980 meeting. Implementation is scheduled for 1981.

A Marine Recreational Fishery Survey coastwide was begun by the National Marine Fisheries Service in July 1979. Pacific Marine Fisheries Commission-hired personnel worked under direction of ODFW scientists to gather creel, demographic, and biological data on bottomfish in Oregon. Survey data were gathered and summarized in 2-month "waves". By year's end, three "waves" were completed in Oregon. Angler intercept (creel census) interviews totaled 4,412 angler interviews during July 1-December 31, 1979. Workup of these data is still underway.

e. Washington

The staff of the Marine Fish Program, headed by an assistant director, is responsible for research, management, and enhancement of non-anadromous finfish resources, and participates in national and international issues relating to marine fish. Four units within the program deal with groundfish.

Extended Jurisdiction Unit

Established in 1977, the Extended Jurisdiction Unit handles all issues requiring interstate, regional or international cooperation for management, conservation, or protection of marine fish resources in coastal waters not under sole authority of the State of Washington. Unit responsibilities include: (1) participation in the development of Groundfish and Herring Fishery Management Plans for the Pacific Fishery Management Council, (2) U.S.-Canada marine fish negotiations, (3) administration of activities related to U.S.-Canada fishery agreement, (4) membership in the Scientific and Statistical Committee of the North Pacific Fishery Management Council, and (5) stock assessment and management of groundfish stocks in the Fishery Conservation Zone (3-200 miles) adjacent to Washington. Major accomplishment during the past year has been the gaining of tentative approval of the Groundfish Fishery Management Plan by the Pacific Fishery Management Council.

Groundfish Management Unit

During the past year the work of this unit has been directed toward research on groundfish resources and management of the fisheries for those resources important to Washington State. Work included systematic biological sampling of 27 species/area strata (20,000 + fish), with concurrent aging of collected age structures. Emphasis was placed on increasing fishery data from trawl, set line, line fisheries, and recreational fisheries for groundfish. Biological samples collected from trawl catches in 1979 totaled 171, compared to 92 samples taken during 1978. In addition, rockfish species composition samples were obtained for 173 landings. Other work performed by the unit included administration and implementation of Washington's participation in the National Recreational Fisheries Survey.

Technical Services Unit

The "Stock Assessment Unit" has been reorganized and renamed "Technical Services", which is now comprised of a biometrician, two hydroacousticians, and a data management specialist. Biometric studies were carried out on the problem of hydroacoustic survey design; and a stock assessment performed on the Central Puget Sound population of Pacific hake. Hydroacoustic-midwater trawl surveys for herring were carried out in the Strait of Juan de Fuca, but no fish were found. Data Management has supplied information to Canada under an agreement that has allowed U.S. trawl fishing in Canadian waters.

Marine Fish Enhancement Unit

This unit has been involved with implementing capital budget funds for construction of artificial reefs, and fishing piers. During 1979 one fishing pier was brought on line with excellent participation by sport fishermen. A second fishing pier is under construction and expected to be completed some time within the year. Two artificial reefs, identified by marked buoys and

accessible by boat, have been constructed in Puget Sound. Projects to enhance lingcod populations in Puget Sound continue with emphasis on collection and short-term pen rearing of juvenile lingcod. Success of this project will be monitored through the recapture of coded-wire tagged lingcod.

f. International Pacific Halibut Commission

Research activity by the International Pacific Halibut Commission (IPHC) in 1979 was similar to that of 1978. A survey of juvenile halibut utilizing trawl gear was conducted at index stations in the Gulf of Alaska and the Bering Sea. A survey of adult halibut with set line gear was conducted at index stations off Kodiak Island, although Hecate Straits stations were not fished in 1979. IPHC continued to monitor the commercial fishery and assess the condition of the halibut resource. Other research activities includes tagging of British Columbia halibut to study transboundary movements and the tagging of 20,000 to 30,000 age 2-4 halibut to determine recruitment.

B. List of Reports Published

A list of publications by agency is included in Appendix C.

VI. Review of Northeastern Pacific Groundfish Fisheries

A. Canada-United States Commercial Fisheries in 1979

1. Commercial Fisheries: Trends and Notable Changes Since 1978

a. Total Landings

Canadian and United States trawl landings, excluding joint ventures, in 1979 were 31,839 mt and 87,888 mt respectively for a total of 119,727 mt. This 1979 catch represents a 21% increase over the total 1978 trawl catch. Total trawl effort cannot be estimated at the present time; however, the combined trawl effort for Canada, Washington, and Oregon increased by 30% from 129,459 hr in 1978 to 168,906 hr in 1979 (Table 1).

The 1979 Canadian trawl landings were up 17% from the 1978 landings and 61% above the 1969-78 mean. Canadian trawl effort in 1979 was 15% greater

than in 1977. Non-trawl landings were 6,767 mt, which represents a 49% increase from those of 1978. Longline accounted for 3,929 mt; handline/troll, 1,297 mt trap, 1,487 mt; and shrimp trawl, 53 mt.

The United States trawl landings in 1979 were up 20% from landings in 1978. Total trawl effort cannot be estimated but effort was up 28% in Washington and 47% in Oregon. Non-trawl landings were about 25,721 mt, 68% greater than the 1978 non-trawl landings.

b. Dover Sole

The 1979 trawl catch of Dover sole was 18,954 mt, a 17% increase over the 1978 catch of 16,138 mt. Incidental catch by other gears was 49 mt.

(i) Canada

The 1979 catch was 861 mt, a slight increase over 1978 but 10% below the 1969-78 mean. The primary area of production was Area 5D.

(ii) United States

California-Washington - Trawl landings of Dover sole in 1979 were 18,092 mt, an increase of 17% over 1978 and 48% greater than the 1969-78 mean catch of 12,259 mt. Dover sole remains the principal species in California landings. Landings of this species by other gear types, primarily trawl, was 49 mt.

Alaska - Almost all landings of Dover sole are included in the other flatfish category.

c. English Sole

Canadian and U.S. trawlers in 1979 landed 5,722 mt of English sole, an 8% increase above the 5,259 mt catch of 1978. Areas 1B, 3A, 4A, and 5D were the leading catch areas.

(i) Canada

Canadian landings of English sole in 1979 were 1,070 mt, an increase of 33% from 1978. Northern Hecate Strait (5D) continued to be the primary area

of production.

(ii) United States

California-Washington - Trawl landings of English sole in 1979 were 4,645 mt, a 4% increase over 1978 but 21% greater than the 1969-78 mean landing of 3,833 mt.

Alaska - See Dover sole.

d. Petrale Sole

Canada and U.S. petrale sole landings in 1979 were 3,224 mt, a 5% decrease from the 1978 catch which was below the past 10-year average. Declines occurred in Canada, Washington, and California while Oregon catches increased slightly.

(i) Canada

Landings of petrale sole (203 mt) continued to decline and were 48% less than the 1969-78 mean. Area 3C was again the main area of catch.

(ii) United States

California-Washington - Trawl landings of petrale sole in 1979 were 3,022 mt, 5% less than in 1978 and 9% less than the 1969-78 mean landings of 3,312 mt. Landings by other gear types were 7 mt.

Alaska - See Dover sole.

e. Rock Sole

Total rock sole landings in 1979 were 2,117 mt, a 41% increase over 1978, and a 12% increase above the previous 10-year mean.

(i) Canada

Rock sole landings in 1979 increased 43% from the previous year to 1,875 mt. Areas 5C and 5D accounted for 70% of these landings.

(ii) United States

California-Washington - Trawl landings of rock sole were 241 mt, most of which was caught in inland waters of Washington State.

Alaska - Dover sole.

f. Lingcod

Trawl landings of lingcod in 1979 were 4,356 mt, an increase of 34% from 1978. Landings by other gears totaled 1,925, 31% of the total 1979 catch of 6,281 mt.

(i) Canada

Total landings of lingcod during 1979 were 2,095 mt, a slight increase (5%) from 1978 landings. Fifty-five percent (1,160 mt) of the lingcod was landed by trawl gear, over half of which came from Area 3C.

(ii) United States

California-Washington - Trawl landings of lingcod in 1979 were 3,196 mt, an increase of 36% over 1978 and 17% greater than the 1969-78 mean landing of 2,743 mt. Catch by other gear types was 957 mt, an increase of 56% over 1978.

Alaska - No trawl landings of lingcod were reported, 33 mt were taken by other gear.

g. Pacific Cod

In 1979, Canadian and United States trawlers landed 14,880 mt, an increase of 27% above 1978 (11,726 mt).

(i) Canada

Pacific cod continued to be the major species (30%) in the trawl landings. The 1979 landings of 9,501 mt were 42% above those for 1978 and 32% more than the 1969-78 mean. Principal areas of production were Hecate Strait (5C-5D, 4,695 mt); the southwest coast of Vancouver Island (3C, 1,672 mt); and the Strait of Georgia (4B, 1,197 mt). Landings from Areas 5C-5D were more than double the 1978 level and the CPUE increased 25% to 0.639 mt/hr. Area 3C landings increased 24% from 1978 but remained 24% below the mean for the previous 10-years. CPUE increased 11% to 0.513 mt/hr.

California-Washington - Trawl landings of Pacific cod were 3,951 mt in 1979, a decrease of 11% from the 1978 landing and 4% greater than the 1969-78 mean.

Alaska - Trawl landings of Pacific cod in Alaska were 1,428 mt, 11% greater than the 1978 catch of 678 mt. Other gears accounted for 144 mt.

h. Pacific Ocean Perch

Canadian and United States landings of Pacific ocean perch in 1979 were 5,201 mt, down 17% from 1978 and 6% from the 1969-78 mean.

(i) Canada

Landings of Pacific ocean perch in 1979 were 2,819 mt, a 27% decrease from 1978 but remained 37% above the 1969-78 mean. The major areas of production were Queen Charlotte Sound (48%) and the west coast of the Queen Charlotte Islands (38%).

(ii) United States

California-Washington - Trawl landings of Pacific ocean perch were 2,278 mt in 1979, a decrease of 9% from 1978 and 16% less than the 1969-78 mean catch. Landings from other gears amounted to 98 mt, most of which was incidental to the pink shrimp fishery.

Alaska - Trawl landings of Pacific ocean perch were 104 mt.

i. Other Rockfish

Total 1979 Canadian and United States trawl landings were 34,832 mt up 21% over 1978.

(i) Canada

The trawl landings (5,574 mt) of rockfish other than Pacific ocean perch decreased 9% from 1978 but remained 184% above the 1969-78 mean. The main areas of trawl production were Queen Charlotte Sound (5A-5B, 2,786 mt) and the west coast of the Queen Charlotte Islands (5E, 817 mt). The main rockfish

trawl landings were comprised of Sebastes flavidus (37%), S. brevispinis (20%), S. pinniger (10%) and S. reedi (8%). Non-trawl landings of rockfish totaled 512 mt, most of which were caught by handline/troll and longline gear.

(ii) United States

California-Washington - Trawl landings of other rockfish in 1979 were 29,252 mt, a 28% increase over 1978 and a 98% increase over the 1969-78 mean landing of 14,739 mt. The greatest increase in catch occurred in Oregon and Washington. Landings by species is not yet available.

The catch of rockfish by other gear types was 5,681 mt, an increase of 26% over the 1978 catch of 4,505 mt.

Alaska - Trawl landings of other rockfish in Alaska were negligible, although 241 mt were taken by other gears.

j. Sablefish

Canadian and U.S. trawl landings of sablefish in 1979 were about 5,031 mt, 22% greater than the 1977 trawl landings. Non-trawl landings were 17,080 mt. Total sablefish catches in 1979 were 22,112 mt, which is up 77% from the total 1978 catch of 12,510 mt.

(i) Canada

Total landings of sablefish in 1979 were 2,031 mt, an increase of 144% from 1978. Trawl landings of sablefish at 277 mt were more than double those of the previous year but about the same as the 1969-78 mean. The main area of trawl production was Area 3C (112 mt). Non-trawl landings of sablefish in 1979 totaled 1,754 mt, 84% of which was caught by trap gear. The 1979 sablefish trap landings of 1,477 mt were more than twice the amount caught in 1978. Area 5E produced 758 mt (51%) of the trap landings.

(ii) United States

California-Washington - Trawl landings of sablefish amounted to 4,705 mt, an increase of 18% over the 1978 catch of 3,973 mt. The catch of sablefish

by fixed gear was 13,055 mt, an increase of 107% over 1978.

Alaska - The 1979 catch of sablefish in Alaska of 2,320 mt was an increase of 99% above the previous year, with 2,271 mt taken by fixed gear in 1979.

k. Dogfish

Total landings in 1979 were 8,963 mt, a 53% increase over 1978. Trawl landings in 1979 accounted for 29% (2,643 mt).

(i) Canada

Dogfish landings in 1979 totaled 4,758 mt, 52% greater than in 1978. This fishery was centered in Area 4B in 1979 which produced 91% of the landings. Longline landings accounted for 73% (3,450 mt).

(ii) United States

California-Washington - During 1979, trawl landings of dogfish were 1,368 mt. Non-trawl landings (2,837 mt) accounted for 67% and contributed to a total 1979 catch of 4,205 mt. This catch was an increase of 53% over 1978 (5,859 mt).

Alaska - No landings recorded.

l. Pacific Whiting

Total trawl landings in 1979 were 1,343 mt, an increase of 250% above 1978 and a 386% increase over the 1969-78 mean. No landings from Canada or Alaska were reported. The greatest catches occurred in California and Washington.

m. Halibut

The total commercial catch in 1979 was 10,200 mt, 227 mt more than the 1978 catch of 9,970 mt. Canadian vessels took 30% of the catch in 1979 (39% in 1978) and United States vessels took 70% (61% in 1978). This shift in the distribution of the catch resulted from agreements reached between the

Table 1. Trawl landings (mt) from the northeastern Pacific by Canadian and United States vessels in 1978 and 1979 and means for 1969-78.

Species	1978					1979					Mean 1969-78 ^{e/}		
	B.C.	WA	OR	CA	AK	Total	B.C.	WA	OR	CA		AK	Total
English sole	807	1,586	1,041	1,825	-	5,259	1,070	1,307	1,413	1,925	7	5,722	4,773
Rock sole	1,309	157	12	3	18	1,499	1,875	232	5	4	-	2,117	1,885
Petrale sole	226	903	1,000	1,275	-	3,404	203	723	1,042	1,257	1	3,224	3,702
Dover sole	732	1,461	3,374	10,570	1	16,138	861	2,410	5,067	10,615	1	18,954	13,210
Rex sole	102	225	642	945	-	1,914	204	416	734	910	-	2,264	1,553
Starry flounder	73	396	489	505	699	2,162	296	566	284	500	279	1,925	1,030
Arrowtooth flounder	2,318	222	170	a/	2	2,542 ^{b/}	1,823	546	319	a/	6	2,694	a/
Other flatfish	25	280	394	835 ^{a/}	106	1,810	53	395	569	860 ^{a/}	43	1,920	2,058 ^{a/}
Pacific cod	6,668	3,982	398	-	678	11,726	9,501	3,549	402	2,380	-	14,880	10,990
Lingcod	908	700	445	1,200	-	3,253	1,160	1,390	686	1,120	-	4,356	4,132
Sablefish	131	681	958	2,340	-	4,110 ^{b/}	277	831	1,494	2,380	49	5,031 ^{b/}	3,007
Whiting (hake)	b/	1	383	305	-	384 ^{b/}	-	424	129	790	-	1,343 ^{b/}	276
Pollock	2,407	589	b/	b/	1,061	4,362 ^{b/}	3,384	488	-	-	2,030	5,902 ^{b/}	-
Pacific ocean perch	3,861	1,851	486	60	4	6,262	2,819	1,360	848	70	104	5,201	5,507
Other rockfish	6,147	9,367	4,388	9,000	1	28,903	5,574	11,177	8,450	9,625	6	34,832	16,799
Misc. species	165	38	185	170	240	798 ^{b/}	1,009	102	187	225	274	1,797 ^{b/}	480
Dogfish	941	679	56	-	-	1,676	1,275	1,329	39	-	-	2,644	717
Animal food	112	1,026	3	-	-	1,141	214	700	-	-	-	914	2,386
Reduction	302	852	-	-	-	1,154	241	3,766	-	-	-	4,007	2,533
Total	27,234	24,996	14,424	29,033	2,810	98,498	31,839	31,711	21,668	30,281	4,228	119,727	74,978
Percent of total	27.7	25.4	14.6	29.5	2.8	26.6	26.5	18.1 ^{d/}	25.3	3.5	100.0		
Total hours	33,198	57,814	38,447	c/	-	38,297	74,165	56,444 ^{d/}	c/	-	-		
CPUE, mt/hr, (excludes dogfish)	0.792	0.421	0.374	c/	-	0.798	0.410	0.366 ^{d/}	c/	-	-		

a/ Some arrowtooth and other commercial flatfish species landings included with other flatfish landings.
 b/ Some whiting (hake) and pollock landings included with miscellaneous species.
 c/ California effort data not available.
 d/ Excludes pelagic trawl effort.
 e/ Excludes Alaska.

governments of Canada and the United States, restricting the Canadian catch from waters in which the United States claims exclusive fisheries jurisdiction, to not more than 2 million pounds in 1979. The actual catch was 1.8 million pounds.

2. Recreational Fisheries

Recreational fisheries for groundfish are expanding rapidly and are harvesting substantial quantities of rockfish and lingcod. Estimated recreational landings in 1979 totaled 3,050 mt with Oregon landings approximately 600 mt. Catch data for Alaska, British Columbia, Washington, and California are presently unavailable.

B. Joint Fishing Ventures

1. Canada

The hake cooperative arrangement, undertaken as a pilot project in 1978, was expanded in 1979 as a joint venture program involving Canadian trawlers and foreign factory vessels. Eight Canadian trawlers participated in the fishery catching 4,235 mt during 146 days of fishing time in August and September. They delivered to two Polish vessels and one USSR vessel. Preliminary results indicate that the operation was successful and plans are now being organized for the 1980 cooperative arrangement for hake.

Two joint squid fishing ventures took place in 1979 to determine the abundance of squid and the feasibility of a viable fishery. While on charter, two Japanese fishing vessels captured 16,475 k of squid from sets made off the west coast of Vancouver Island.

2. United States

The United States was involved in joint fishing ventures with other nations in the Gulf of Alaska and the California-Washington Region during 1979. In the Gulf of Alaska a U.S./USSR company operated one processing vessel (Soviet) and one catcher vessel (U.S.) during July and August. In 14 days 138 mt of

bottomfish, primarily pollock, were delivered to the processor. A U.S./Korean joint venture involving two processors and 3-5 catcher vessels operated in the Gulf during April-September. About 1,400 mt consisting mainly of pollock and Pacific cod were delivered. Catches (mt) are presented below:

<u>Pollock</u>	<u>Cod</u>	<u>Flounder</u>	<u>POP</u>	<u>Other Rockfish</u>	<u>Sablefish</u>	<u>Other Fish</u>	<u>Total</u>
581	709	71	67	22	18	39	1,507

Off California-Washington a U.S./USSR joint venture fishery was conducted for Pacific hake during June-October, utilizing as many as eight processors at a time and seven catcher vessels. Slightly in excess of 8,800 mt were delivered, leaving 26,200 mt of the allocation unharvested. Similar joint venture efforts are anticipated during 1980 and there are indications that as many as 15 catcher vessels may be delivering to five processing vessels. This represents a significant increase in U.S. involvement over that in 1979. A reserve of 28,000 mt of Pacific hake has been set aside for the current joint venture fishery.

C. Non-North American Fisheries

1. Canada

All non-North American commercial fisheries in Canadian waters operated under quotas during 1979; and except for sablefish, catches were substantially below allocations. Catches are outlined in Table 2.

2. United States

In 1979, the USSR and Poland fished for Pacific hake in the California-Washington region. The number of vessels was up slightly from 1978, with a maximum of 38 (seven joint-venture Soviet) and 11 Polish vessels participating in the fishery. The USSR took 96,837 mt, and Poland harvested 18,073 mt of Pacific hake (Table 2). The fishery was terminated about two weeks before the end of the season (October 31), when the allowed incidental catch of sablefish was exceeded.

Japan licensed 40 trawlers and 22 longline/gill-netters for operation in the Gulf of Alaska in 1979, about the same number as in 1978. The USSR effort in 1979 was similar to that of 1978, with the majority of the vessel days expended in the Kodiak area. Little effort occurred off Southeastern Alaska. Mexico deployed a small number of stern trawlers to the Gulf of Alaska which fished most intensively in the Shumagin and Kodiak areas. The Republic of Korea mounted a larger fishing effort than in 1978, with at least 15 trawlers and two longliners fishing mainly in the Shumagin and Yakutat areas. Poland sent a larger fleet also, with as many as 13 stern trawlers operating mainly in the Chirikof area. Catches are presented in Table 2.

D. Canada-U.S. Groundfish Management and Regulations

1. United States

(a) Preliminary Management Plans

Two preliminary management plans (PMP's) were in effect governing foreign fishing in the northeastern Pacific Ocean during 1979, the Sablefish Fishery of the Eastern Bering Sea and Northeastern Pacific and the Trawl Fisheries of Washington, Oregon, and California. The sablefish PMP establishes a 7,000 mt total allowable catch (TAC) off the west coast and identifies no surplus for foreign allocation.

The trawl fishery PMP, implemented in 1977 and amended in 1978-79 set a 1979 hake TAC of 198,900 mt, of which 50,000 mt was initially held for domestic use, 39,780 mt held as a reserve, and the remainder 109,120 mt allocated to foreign fishermen. Incidental catches were set at 0.738% of the hake allocation for rockfish, Pacific ocean perch .062%, sablefish 0.1%, flounders 0.1%, jack mackerel 3%, and others 0.5%.

The 1980 PMP establishes a hake TAC of 175,000 mt. Incidental catch limits remain the same as in 1979 with the exception of sablefish which was

Table 2. Northeast Pacific Catches (mt) by Non-North American Nations in 1979

	GULF OF ALASKA						CANADA			CALIF.-WASH.		
	Japan		U.S.S.R.		Poland	R.O.K.	Mexico	Japan	U.S.S.R.	Poland	U.S.S.R.	Poland
Pollock	31,920	17,300	19,551	25,739	8,677	--	--	--	--	--	--	--
Pacific cod	10,429	835	127	844	939	--	--	--	--	--	--	--
Sablefish	5,919	152	0	759	55	1,029	--	--	--	--	--	--
Atka mackerel	567	10,264	0	80	36	--	--	--	--	--	--	--
Pacific ocean perch	7,397	1,065	5	825	457	--	--	--	--	--	46	8
Other rockfish	1,092	122	19	185	7	--	--	--	--	--	790	149
Flounders	12,370	369	19	604	113	--	--	--	--	--	0	12
Pacific whiting	0	0	0	0	0	3,637	0	4,263	96,837	18,073		
Jack mackerel	0	0	0	0	0	--	--	--	710	316		
Squid	259	1	9	143	13	--	--	--	--	--	--	--
Other fish	2,271	939	14	757	101	--	--	--	156	32		
TOTAL	72,224	31,047	19,744	29,936	10,398	4,666	0	4,263	98,539	18,590		

increased to 0.173% of the hake allocation. A recent U.S. policy precluding new allocations to Soviet fleets may result in a substantial underharvest of the resource in 1980.

(b) Fishery Management Plans

The current draft of the Pacific coast fishery management plan (FMP) is scheduled to be accepted by the Pacific Fisheries Management Council during the summer of 1980. The draft FMP provides for resource allocations, gear restrictions and reporting requirements and provides as an option non-numeric optimum yields (OY's) for various species groups except that special numeric OY's as proposed will be assigned to Pacific whiting, shortbelly rockfish, Pacific ocean perch, sablefish, and widow rockfish. Points of Concern have been drafted which are a series of resource status indicators to be monitored in-season and will be used as management guidelines for in-season time and area closures, gear restrictions, etc.

The Gulf of Alaska Groundfish Fishery Management Plan, originally approved in April 1978, documented the management regime for the Gulf groundfish fishery including species group OY's by management area, with allocations for foreign and domestic fleets. The protection of the Pacific halibut resource is a major management objective. Since approval, the plan has been amended seven times to adjust OY's, make the U.S./foreign allocations procedures more flexible, and change the regulatory area and domestic reporting requirements.

(c) State Regulation Changes

The California sport lingcod limit has been lowered from 10 to five and legislation has been introduced to separate recreational and gill net fishermen partially based on depth. Oregon has enacted a 20,000 pound trip limit for Pacific ocean perch and now requires a biodegradable cotton seam or panel as an escape mechanism in all sablefish traps. Also all longline and

pot fishermen are required to keep logbooks. On this issue a discussion ensued, with Mr. Leaman and Dr. Harville stating that it is often better to receive less but better quality data from a voluntary logbook program.

The State of Washington made no permanent changes to its commercial groundfish regulations between June 1979 and June 1980. Some sport fish regulations for lingcod and for Puget Sound were modified, and the Puget Sound hake fishery was closed for the first time by emergency regulation when the fishery reached the 4,000 mt quota.

In Alaska sablefish guideline harvest ranges have been established for separate northern (Chatham Strait) and southern (Clarence Strait) areas in 1980, respectively 500,000 to 900,000 pounds and 125,000 to 500,000 pounds. In 1979 the northern area had a quota of 850,000 pounds and no quota was assigned to the southern area.

In 1980 all sablefish vessel operators intending to fish the northern area must register prior to fishing in Southeastern Alaska.

2. Canada

No regulation changes were made during the previous year. For 1980 a Pacific Coast Groundfish Management Plan was adopted and will serve as a guideline to the industry. Principle objectives of the Plan are to rehabilitate stocks of "traditional" species (Pacific cod, lingcod and flatfishes), to rehabilitate stocks overexploited by foreign fleets, and to increase the harvest of non-traditional species. A combination of yearly quotas on declining stocks and time/area closures will be used to regulate the fishery. In addition, because of the multi-species nature of the fishery, incidental species trip limits will be established at the time of closure of a directed fishery.

In-season closures during 1979 include 3C, which was closed for the protection of Pacific cod and lingcod, and 5E, which was closed for all rockfish in order to protect Pacific ocean perch.

E. International Fisheries Agreements

1. Canada-U.S. Agreement

A reciprocal fishing arrangement, which extends Canadian fishing for halibut in U.S. waters for the two years 1979 and 1980 in exchange for U.S. fishing of groundfish in Canadian waters during this period, is continuing. Also by mutual agreement, the International Pacific Halibut Commission will continue to manage the halibut resource, although the national fisheries will be conducted independently after 1980.

VII. Groundfish Research

A. Stock Assessments

1. Pacific Cod

Mr. Westrheim reviewed Canada's recent efforts on Pacific cod. Current stock assessments suggest that only one stock may be endangered by the current fishery. This stock is located in Area 3C. The winter fishery has been closed as a precautionary measure while stock abundance is at a cyclic low level. Adverse winter temperatures in Area 3C during the spawning season may be prolonging the low level of abundance.

A major problem in stock assessment is assigning effort to each species in a multi-species fishery. A study of this problem which deals with the Pacific cod/rock sole/English sole complex on the Two Peaks-Butterworth Ground, in northern Hecate Strait is nearing completion. Briefly, all-species effort was calculated by 10 fm depth interval for the Two Peaks and Butterworth Grounds for April-June and July-September. Similar allocations were then made by 10 fm depth intervals for each of the three species. All-species effort was assigned by depth interval and accordance with the depth distribution of the landings of each species, on a ranking basis. A parallel analysis, ignoring depth, was performed using the conventional 25% qualification level for assigning effort. For

Pacific cod, the two methods yielded similar results, but for rock sole and English sole, the conventional qualification method yielded substantially smaller estimates of fishing effort. A report on the study is in preparation.

Limited work on pre-recruits has been done but needs to be expanded. Industry and management needs a forecast of age class strength. Dr. Stokes stated that we must be able to detect the beginning of natural declines, but that presently used indicators are not adequate. Mr. Westrheim commented that in one related study Pacific cod have been shown to feed heavily on sand lance; and since this species fluctuates greatly in abundance, a correlation between sand lance and cod abundance may exist.

2. Pacific Whiting (hake)

Mr. Dark reported that NMFS has not conducted a survey of the commercially available hake resource since 1977. Assessments have been based on egg and larval surveys conducted by the Southwest Fisheries Center (SWFC) in cooperation with the USSR and on catch/effort statistics from the Soviet hake fleet. A trawl/hydroacoustic survey is scheduled for 1980.

For the Strait of Georgia, Dr. Beamish reported that an egg and larval survey was conducted in 1979 and a major repeat survey for pollock and hake in 1981 is scheduled. Hake quotas in Canada have been based primarily on NMFS estimates and annual catches within the U.S. zone. Dr. Beamish commented that population estimates based on ichthyoplankton and hydroacoustic surveys have been very high and compared with other estimation procedures. Mr. Dark stated that ichthyoplankton surveys usually produce estimates one and a half to two times that of other procedures.

3. Sablefish

Mr. Dark reported that the NMFS initiated in 1978 a program to determine trends in relative abundance of sablefish off Southeast Alaska. Additional indexing sites have been established off Washington, Oregon, and probably

California in 1980. An overall 31% increase in CPUE was observed for the Alaska survey between 1978 and 1979. The significance of the increase is not fully understood. Some index catches reflected the presence of unusually large proportions of 3- and 4-year old fish. Other catches contained large numbers of recently spawned or ripe females suggesting that sablefish may have been highly aggregated for spawning. Investigators tend to attribute much of the increase in CPUE not to substantial new recruitment, which should have been detected in 1978, but to increased availability created by a set of circumstances which led to heavy concentrations of spawners. Because pre-recruits are usually distributed in shallow water, the relative strengths of the 1975 and 1976 year-classes cannot be determined from the available indexing data.

The NMFS continues to use Japanese CPUE data for areas of the Central and Western Gulf, where they are still allowed to fish, and also to use the results of the Japan/U.S. cooperative sablefish survey for stock assessment.

Dr. Beamish stated that with the withdrawal of the Japanese from Canadian waters Canadian scientists will need to develop alternate resource indices, and that Canadian scientists are reviewing the use of domestic CPUE information. The tagging program is continuing, and attempts to estimate sablefish abundance will be made. Canadian tagging results indicate that sablefish movement in general is not extensive. To date 26,000 juvenile sablefish have been tagged, and further analysis of tag returns for these fish may indicate extensive movement by younger fish.

Mr. Bracken related Alaska's recent tagging experiments in 1979 and early 1980 in which a total of over 7,600 sablefish, both juvenile and adults, were tagged. Pot gear was used to take the fish, some of which showed hemorrhage of the fins and other soft tissue. Some initial testing of surface time and descent rates and depth of fish returned to the water in pots was done to

determine methods which will lower capture and tagging mortality. Results were not conclusive, although an anomaly was indicated in that over 50% of the fish lowered and held at 50 fm died compared to much lower mortality in pots suspended at 10 fm, 100 fm and 250 fm. Also, greater surface time appeared correlated to higher mortality. Concerning these experiments, Dr. Beamish commented that he had attempted lowering tagged fish to reduce mortality and discarded the technique because of high mortalities; but he has been able to retain fish at the surface in live tanks with very good results.

Both Mr. Robinson and Mr. Leaman stated that a comprehensive review of coastwide tagging results should be done and that an inventory of these results would be very helpful. The TSC agreed that tagging methodology and inventories in general should be reviewed.

4. Gulf of Georgia Pollock

Mr. Milliken reported that the U.S. did not conduct an assessment survey in this area during 1980, although the small fishery was monitored. Dr. Beamish reported that Canada did conduct ichthyoplankton and hydroacoustic surveys and estimated the pollock biomass at approximately 20,000 mt. Because the spawning time of Gulf of Georgia pollock is one month different than for pollock in other areas these fish have tentatively been considered a separate stock, although their seasonal distribution has not been determined. In 1981 ichthyoplankton and hydroacoustic surveys are to be combined with biological sampling to determine biomass. Dr. Stokes commented that ichthyoplankton estimates are very sensitive to fecundity, which varies with time; therefore, regular fecundity samples must be obtained.

5. Pacific Halibut

Mr. McGregor reported that IPHC is continuing its virtual population analysis; however, at this time IPHC continues to use CPUE and fishery trends to set quotas. In 1979 CPUE decreased west of Kodiak Island and increased

greatly in the eastern Gulf including Southeastern Alaska, while in British Columbia CPUE continued to decline. Recent very high CPUE in the eastern Gulf is an unexplained anomaly, but because CPUE over a broad area has increased, the total Gulf halibut resource is considered to be increasing.

6. Hydroacoustic Assessment of Alaska Pollock

Alaska's new effort on pollock was briefly reviewed by Mr. Bracken. Annual hydroacoustic surveys for pollock in the inside waters of Southeastern Alaska began in 1978 in a cooperative effort with the herring hydroacoustics program which pays for processing the recordings by NMFS. Survey estimates indicate that the pollock resource in the areas surveyed is being harvested at a rate of 10% or less in 1978 and 1979. Plans for 1980 include trawl sampling to provide verification.

7. Flatfish Research - Canada

As a method of determining age class strength and recruitment Dr. Stocker used six models for the analysis of CPUE and historical catch and age data. Single species data were analyzed separately for the multi-species trawl fishery. Unmodified CPUE and standardized CPUE using the least effective gear as a base and accounting for gear types, vessel tonnage, single and double drums, etc. were both used. Standardized CPUE significantly reduced the variance for the predicted catches calculated. Other areas and species will be included in future analyses. Additionally, sequential population analysis was used to estimate the number of recruits. Reports of these analyses will be available within approximately six months.

B. Special Studies

1. Age Determination Studies

Dr. Beamish initiated this discussion by commenting on the effects of aging errors, both precision and accuracy, on the detection of cohort strength. These errors tend to smooth age frequency distributions and masks recruitment.

Dr. Fournier of Fisheries and Oceans has theorized that when age reading errors are properly compensated for the highs and lows will be emphasized, and he has developed models to account for these errors.

Mechanical aging of sablefish using the break and burn technique for otoliths is considered the most reasonable method developed to date according to Dr. Beamish. Very old fish to 45 years have been sampled and little if any growth has been determined for older sablefish. These assigned ages are much greater than for those determined by scale reading, which is considered by the Nanaimo staff to be a very misleading means of age determination for sablefish. Validation studies for this technique are continuing, including comparisons of growth patterns between young known age fish and older specimens and the use of oxytetracycline marking.

For Pacific cod, which in Canadian waters is relatively short-lived, both scale reading and length frequency analysis are useful methods, and the results can be compared with one another to determine their accuracy for the younger age classes. As an indication of accuracy for rockfish ages assigned by the break and burn technique, Mr. Leaman stated that the mid-range age classes can be followed through the fishery. For dogfish Dr. Beamish indicated that the use of spine sections was not appropriate because the spines grow from the base; and therefore, the bands are not representative of the fishes' true age.

A general discussion of sample size ensued when Mr. Dark commented that the NMFS aging lab was overwhelmed with samples. Since most statisticians recommend higher sample sizes than is generally feasible everyone agreed as a general consensus that each agency must examine their own sampling strategy and subsample for ages as is logistically feasible. Mr. Tagart reviewed Dr. Kimura's work which indicated that 10 samples or less yielded an extreme variance, that between 25 and 35 samples appeared optimum, and that increasing samples beyond 35 produced a very slow gain in precision.

2. Growth and Mortality of Rockfishes

A general review was presented by Mr. Leaman for various species of rockfish including Sebastes alutus, S. aleutianus, S. flavidus, S. brevispinis, S. proriger, and S. reedi. For most species the majority of fish sampled were between 10 and 30 years of age. Sebastes aleutianus had the oldest specimen at 104 years, S. brevispinis showed extreme variability in recruitment, while S. proriger stocks follow five-year cycles of abundance. For Pacific ocean perch, natural mortality estimates may be revised downward to 0.05; and estimates for other species may be reduced by as much as one order of magnitude based on new age analysis. This work indicates that rockfish stocks in British Columbia may be substantially overharvested.

3. Tagging Techniques

As a means of validating aging techniques for rockfish, Fisheries and Oceans tagged 6,500 yellowtail rockfish in 1979. Mr. Leaman reviewed the techniques. Midwater trawl gear was used to capture the large yellowtail off-bottom. The swim bladders were deflated immediately and the fish were placed in a live tank and anesthetized. The fish were then tagged and injected with oxytetracycline or diluted ringers solution as a control. A mortality of 1.93% was observed from capture to release. To date no injected fish have been recovered; because of the distribution of larger fish, a lower rate of recovery by bottom trawl gear is expected.

4. Domestic Vessel Observer Program

Originally funded by the North Pacific Fishery Management Council to develop methods and implement an initial program to monitor prohibited species, the Alaska Department of Fish and Game has continued and expanded the observer program on U.S. trawl vessels. Data collected includes catch per unit effort, species composition, lengths, discard estimates, and depth and area of catch.

Trips observed are selected on a random basis, with 32 trips observed during 1978 and 1979. Mr. Blackburn presented this review and discussed several methods used to determine the precision of the prohibited species estimates.

5. Pacific Hake Population Modeling

According to Mr. Dark the NMFS is supporting work on the population dynamics of Pacific hake (Dr. Bernard, OSU) and Pacific hake recruitment (Mr. Bailey, U.S.).

Dr. Bernard's study is in progress and involves yield per recruit modeling to estimate the effects of varying age at first entry to the fishery, exploitation rates, and seasonally variable growth and mortality or yield. Preliminary results indicate that ages at entry which produce maximum yield per recruit vary between 2 and 5 years. Growth parameters over those of Efimov (1974) resulted in an average 57% increase in yield per recruit over those of Efimov (1974) when differences between cells of like natural mortality and seasonal variation were compared. As natural mortality was increased from 0.3 to 0.5, maximum yield per recruit decreased on the average 45% when differences between like cells of growth and seasonal variation were normalized and compared. Seasonal variation in growth and mortality was incorporated, assuming that in early spring just after spawning, hake are in poorest condition, and seasonal growth is slowest while natural mortality is highest. It is assumed that growth increases and mortality decreases during the summer and reach their maximum and minimum, respectively, in late fall. Seasonal variation in growth and natural mortality were antagonistic. Employing seasonal variation in natural mortality resulted in decreasing maximum yield per recruit almost 12% over maximum yield per recruit when no seasonal variation was assumed. Conversely, seasonal variation in growth increased maximum yield per recruit slightly over 3%. When seasonal variations in growth and natural mortality were combined, the effect was about an 8% decrease in maximum yield per recruit.

The timing of the fishing season was varied from May 1-September 30 to June 1-October 31 and July 1-November 30. Maximum yield per recruit tended to increase slightly as the season was postponed.

A progress report, has presented preliminary results from Mr. Bailey's recruitment studies.

Larval hake have been successfully reared at several temperature and two food regimes. Experiments designed to examine starving time indicate that immediate availability of food to hake larvae (13 days to starvation), after yolk sac absorption, is not as critical to survival as it appears to be for anchovy (4 days to starvation).

The vertical distribution of larvae was examined, and they were found to be most abundant in or below the thermocline. Implications for recruitment are that: (1) in deep, cold water, metabolism and food requirements are relatively low, and (2) Ekman transport of larvae offshore probably affects hake larvae less than those of other California current fishes which are distributed in surface layers.

The geographic distribution of larvae was analyzed and found to have decreased in recent years, with a lower incidence in the southern portion of the range off Mexico. This change in distribution may be related to environmental factors or increased predation of eggs-larvae and adults by anchovy and marine mammals, respectively. Mr. Bailey submits that the most likely explanation is that the removal of large hake by the fishery has had an impact, because larger individuals may spawn mainly in the south. In addition, hake may be multiple spawners, and thus, as spawning schools progress south, the percentage of eggs contributed by larger fish may increase because smaller fish are not developing further broods.

The effects of predation were evaluated, and it was concluded that marine mammals are a major source of mortality. By considering consumption rate and the duration of mammal-hake distribution overlap, it was estimated that marine mammals consume annually about 140,000 mt of hake.

The migration of hake to and from the Pacific Northwest appears to be related to ocean currents, and particularly, upwelling. As upwelling indices become positive in the spring feeding, hake begin to appear, and they leave in the late fall as upwelling indices become negative.

Recruitment is correlated with sea temperature and upwelling indices during egg and larval stages.

6. Ichthyoplankton Studies

Canada's ichthyoplankton studies targetting specifically on sablefish were briefly reviewed by Dr. Beamish. Four cruises were completed in 1980 covering the west coast of Vancouver Island, Dixon Entrance, and the inside waters. Few eggs or larvae were found in inside waters. Attempts to rear sablefish from eggs were made but few ripe females were obtained; however, this work will again be attempted next year.

C. Cooperative Research

1. U.S.-Japan Pacific Cod-Sablefish Survey

A U.S.-Japan cooperative survey of the sablefish and Pacific cod resources of the Gulf of Alaska was initiated in 1978 and will be continued in 1980. Objectives are to determine the geographic and bathymetric abundance of sablefish and Pacific cod and the effect of varying number of hooks per hachi, soaking time, and bait on catch rates.

Sablefish abundance in 1979 in depths greater than 400 m was greatest in the INPFC Southeastern Area and lowest in the Aleutian Area. In depths less than 400 m, highest catch rates were off Southeastern Alaska and decreased to the west.

Pacific cod densities were highest in Area 1 of the Bering Sea and north of the Aleutian Islands, and lowest in the Southeastern Area. Highest densities were generally highest in depths of 100-200 m.

The number of hooks per hachi and catch were almost proportional, but the catch rate per 10 hooks was somewhat better with hachis having fewer hooks.

Soaking time appeared to have no influence on catch rates.

Squid, Pacific saury, sandfish, and pollock were tested as baits, and relative effectiveness is represented by the order listed. The catch rate for squid was about 2.5 times larger than that for pollock.

Over 16,000 sablefish were tagged and released during the survey, primarily in the Yakutat and Southeastern Areas.

2. U.S.-U.S.S.R. Hake Egg and Larvae Survey

Cooperative U.S.-U.S.S.R. hake/anchovy egg and larvae assessments have been conducted for a number of years in the CALCOFI Area. Preliminary assessment of the 1980 collections indicate that the hake spawning range is still compressed to the northward, and that the spawning biomass is about the same magnitude as that observed in the last three years.

VIII. Progress on 1979 Recommendations

A. The Technical Subcommittee (TSC)

1. Recreational Groundfish Statistics Workshop

Originally recommended during the 1978 TSC interim meeting, this workshop was held March 19-20, 1980, in Monterey, California. The workshop was hosted by the California Department of Fish and Game and fulfilled the earlier recommendation of the TSC. A review of the meeting by Mr. Jow indicated that there is much overlap between commercial and recreational species, there is a lack of basic biological data for many recreational species, and a standardized data base does not exist. No recommendations were made during

the workshop. The Subcommittee did not have adequate time to discuss recommendations formulated by Mr. Mark Pedersen, WDF, but emphasized the need for recommendations on which to base future work. A final workshop report will be presented by Mr. Jow during the interim meeting of the TSC. A work group will then formulate recommendations to be included in the final recreational groundfish workshop report. PMFC will provide a summary report of the National Recreational Survey.

2. Improvement in Reporting of Rockfish Species in Status Reports

The inclusion of an additional table in the Status Reports by species and area was completed by Canada and Oregon. Washington will provide the information by the interim TSC meeting, and California and Alaska are attempting to comply with this new request.

B. Parent Committee

1. Promotion of Cooperative Research on Transboundary Stocks

Dr. Harville explained that no specific action had been taken and that there was a need to prioritize and define cooperative research needs. He also stated that the efforts of the IGC were supported by the fishery management councils. The ensuing discussion resulted in TSC recommendation A.1. for 1980.

2. Change of Boundary Between International Statistical Areas 1A and 1B and INPFC Statistical Areas, Conception and Monterey

The proposal would change both boundaries to conform to a new line at 36°00' N, better define stocks and present fisheries, and simplify reporting. Dr. Harville forwarded the Subcommittee's recommendation to the INPFC; however, it was provisionally rejected for want of more detailed information. Mr. Jow will submit a detailed request to INPFC. If the request is accepted, PMFC will also change the 1A/1B boundary to coincide.

IX. Other Business

A. Functional or Management Groupings of Rockfish

Because rockfish species are intermixed in trawl catches with several species, it would be very helpful to develop a management scheme which is effective for a group or assemblage of rockfish and especially a scheme which could be based on the catch of a primary or target species. Mr. Leaman reviewed Fisheries and Oceans work with this concept. Species composition data was analyzed, with a determination that those groups of rockfish species previously considered as associated are fairly ephemeral. For example, widow rockfish almost always occur in catches with yellowtail; however, the opposite is not always the case. Also, Pacific ocean perch and canary rockfish appear to be associated, except that there are major seasonal shifts in catch composition of these two species throughout the year.

Various analytic techniques are being considered. Cluster analysis would require a large amount of detailed information; and although a report will be finalized by the end of the year, it does not appear that the yield of one species can be predicted by knowing the yield of another.

B. Rockfish Mesh Size

Mr. Demory introduced the question as to whether mesh size regulation is an effective management measure for rockfish fisheries, and reported that the Oregon Department of Fish and Wildlife is planning mesh size studies for the summer of 1980. Although minimum mesh sizes for flatfish were effective in reducing small fish in trawl catches, the 3-inch minimum mesh for rockfish required by Oregon and Washington produces high incidental catches in the Oregon fishery; and gilling of small rockfish is a problem. Mr. Millikan and Mr. Jow reviewed the rockfish fisheries in Washington and California. Neither felt that discard was a problem within their areas and that most discard was of species

with no viable market. Mr. Westrheim concurred and stated that the few years in which discard was a problem within Canada's fisheries coincided with strong recruit classes of Pacific ocean perch.

Dr. Harville commented that the present mesh regulations were not well-justified by scientific evidence, and that more work on mesh and gear selectivity is badly needed. An attempt should be made to standardize gear restrictions and much better estimates of discard by species and size are also needed. The Sub-Committee concurred and indicated that the issue of gear selectivity should be addressed in detail at a later date.

X. 1980 Technical Subcommittee Recommendations

A. Technical Subcommittee

1. The TSC recommends its member agencies and scientists review and prioritize their respective groundfish research needs and programs. All involved recognize that our respective resources are limited and demands are large. Each agency should summarize and prioritize its own and any interagency research programs/needs for substantive discussion at the fall 1980 meeting of the Parent Committee. In particular, the relative priority of research on transboundary stocks should be identified.

Further, it is recommended that short discussion papers be circulated by all concerned prior to the interim meeting for the more effective use of discussion time.

2. In view of the concern for declining lingcod stocks in British Columbia, Southeastern Alaska, and the interior waters of Washington, it is recommended that a workshop be convened to examine lingcod biology, stock assessment methodologies, and rehabilitation strategies. Mr. Cass will act as the coordinator of the workshop, with a proposed meeting time of February 1981 in Nanaimo, B.C.

3. Although a formal recommendation was not made, a working group of Mr. Cass and Mr. Bracken was appointed to develop a primary agenda for a tagging workshop. Special tagging problems and agenda items will be discussed and a tentative agenda prepared during the 1980 interim TSC meeting in Vancouver should the Subcommittee decide upon a workshop for 1981.

B. Parent Committee

1. No recommendations were made to the Parent Committee.

XI. Schedule of Future Meetings

A. TSC: An interim meeting of the TSC will be held on November 18 and 19, 1980 in Vancouver, B.C. The next annual meeting of the TSC will be the third week in June 1981 in Oregon. The Oregon delegation will communicate to the Chairman the exact location and time.

B. IGC: The Parent Committee will hold its annual meeting November 19, 1980 in Vancouver, B.C.

XII. Election of Chairman

Mr. A. Cass was elected chairman for 1981 and 1982.

XIII. Adjournment

The meeting was adjourned at 11:30 on June 30, 1980.

APPENDIX A

Tentative Agenda for the
Twenty-First Annual Meeting
of the Technical Subcommittee of
the International Groundfish Committee
Petersburg, Alaska
June 18-20, 1980

- I. Call to Order
- II. Appointment of Secretary
- III. Approval of Agenda
- IV. Terms of Reference of the Subcommittee
- V. Review of Agency Groundfish Programs
 - A. Recent and Anticipated Studies
 - B. Publications
- VI. Review of Northeast Pacific Groundfish Fisheries
 - A. Canada - U.S. Fisheries in 1979
 - 1. Commercial Fisheries: Trends and Notable Changes since 1978
 - 2. Recreational Fisheries
 - B. Joint Fishing Ventures
 - C. Non-North American Fisheries
 - D. Canada - U.S. Groundfish Management and Regulation
 - 1. United States
 - (a) Preliminary Management Plans
 - (b) Fishery Management Plans
 - (c) State Regulation Changes in 1979 and Changes Under Consideration

2. Canada
 - (a) Management Plans
 - (b) Regulation Changes in 1979 and Changes Under Consideration

E. International Fishery Agreements

1. Canada - U.S. Agreements
2. International Pacific Halibut Commission
3. Others

VII. Groundfish Research

A. Stock Assessments

1. Pacific Cod
2. Pacific Hake
3. Sablefish
4. Gulf of Georgia Pollock
5. Pacific Halibut
6. Hydroacoustic Assessment of Alaska Pollock
7. Flatfish Research Canada

B. Special Studies

1. Age Determination Studies
2. Growth and Mortality of Rockfishes
3. Tagging Techniques, Associated Problems, and Present Studies
4. Pacific Hake Population Modeling and Analysis of 1977-79 Observer Data
5. Alaska Domestic Observer Program

C. Cooperative Research with Other Nations

1. U.S. - Japan Pacific Cod/Sablefish Survey
2. U.S. - U.S.S.R. Hake Egg and Larvae Study
3. Ichthyoplankton Studies

VIII. Progress on 1979 Recommendations

A. The Technical Subcommittee

1. Recreational Groundfish Statistics Workshop
2. Improvement in Reporting of Rockfish Species in Status Reports

B. Parent Committee

1. Promotion of Cooperative Research on Transboundary Stocks
2. Change of Boundary Between International Statistical Areas 1A and 1B and INPFC Statistical Areas, Conception and Monterey

IX. Other Business

A. Functional or Management Groupings of Rockfish

B. Rockfish Mesh Size

X. 1980 Technical Subcommittee Recommendations

A. Technical Subcommittee

B. Parent Committee

XI. Schedule of Future Meetings

XII. Election of Chairman

XIII. Adjournment

APPENDIX B

Distribution of the Report of the Technical Subcommittee

Technical Subcommittee

Canada:	R. Beamish, A. Cass, B. Leaman, J. Westrheim	5
United States:		
	NMFS - T. Dark	3
	California - T. Jow	2
	Oregon J. Robinson	2
	Washington J. Tagart	2
	Alaska P. Rigby	4

International Groundfish Committee

Canada:	R. Wowchuk	4
United States:	J. Harville	4

Advisors and Others

Canada:	K. Ketchen	4
United States:	C. Fullerton, J. Baxter - California	3
	J. Donaldson, J. Golden, R. Demory - Oregon	3
	R. Schmitten, A. Millikan - Washington	3
	R. Skoog, J. Clark, J. Blackburn,	
	B. Bracken - Alaska	5

APPENDIX C

List of Reports Published by
Technical Subcommittee Member Agencies
For the Period May 1, 1979 - April 30, 1980

Canada - Department of Fisheries and Oceans

- Barner, L.W., F.H.C. Taylor, D.M.A. Bennett, and S. Farlinger. 1979. Midwater and bottom trawl tows and catches made by M/V BLUE WATERS BW78-3, Queen Charlotte Sound, October 3-23, 1978. Fish. Mar. Serv. Data Rep. 138: 73 p.
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- Beamish, R.J., C. Houle, C. Wood, and R. Scarsbrook. 1979. A summary of sablefish tagging and exploratory trapping studies conducted during 1978 by the Pacific Biological Station. Can. Data Rep. Fish. Aquat. Sci. 162: 113 p.
- Bennett, D.M.A., and M. Stocker. 1980. Length and age composition of English sole (Parophrys vetulus) in commercial landings from north Hecate Strait, British Columbia, 1973-1979. Can. Data Rep. Fish. Aquat. Sci. 190: 22 p.
- Chilton, D.E., M. Stocker, and J. Fargo. 1979. Length and age composition of rock sole (Lepidopsetta bilineata) from commercial landings from the Butterworth-Warrior area of Hecate Strait, 1973-1978. Can. Data Rep. Fish. Aquat. Sci. 177: 17 p.
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- Ketchen, K.S. 1979. An overview of the Strait of Georgia winter trawl fishery, 1951-52 to 1977-78. Fish. Mar. Serv. MS Rep. 1511: 63 p.
- Ketchen, K.S. (editor). 1980. Assessment of groundfish stocks off the west coast of Canada (1979). Can. Data Rep. Fish. Aquat. Sci. 185: 213 p.
- McCarter, P.B. 1980. Exploratory fishing by the automated longliner M/V VIKING STAR off the west coast of the Queen Charlotte Islands, September 1979. Can. Data Rep. Fish. Aquat. Sci. 193: 45 p.
- Smith, J.E. 1979. Catch and effort statistics of the Canadian groundfish fishery on the Pacific coast in 1978. Fish. Mar. Serv. Tech. Rep. 891: 82 p.
- Stocker, M., J. Fargo, and D.M.A. Bennett. 1980. Dover sole tagging, eastern Dixon Entrance, September 18-29, 1979. Can. MS Rep. Fish. Aquat. Sci. 1565: 50 p.

- Thompson, J.M., and R.J. Beamish. 1979. An examination of the biology and distribution of walleye pollock in Dixon Entrance, Hecate Strait, the mainland inlets off Queen Charlotte Sound, and in the Strait of Georgia during March 14-April 21, 1978. Can. Data Rep. Fish. Aquat. Sci. 173: 188 p.
- Westrheim, S.J. 1980. The trawl fishery in the Strait of Georgia and vicinity, 1945-77. Can. MS Rep. Fish. Aquat. Sci. 1563: 130 p.
- Westrheim, S.J., R.P. Foucher, W.R. Harling, and W. Shaw. 1980. G.B. REED Groundfish cruise no. 79-4, June 26-July 13, 1979. Can. Data Rep. Fish. Aquat. Sci. 179: 73 p.
- Westrheim, S.J., R.P. Foucher, W.R. Harling, and W. Shaw. 1980. G.B. REED Groundfish cruise no. 79-6, September 6-21, 1979. Can. Data Rep. Fish. Aquat. Sci. 191: 64 p.

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- Dark, T., M.O. Nelson, J. Traynor, and E. Nunnallee. (In press.) The distribution, abundance, and biological characteristics of Pacific hake (Merluccius productus) in the California to British Columbia region during July-September, 1977.
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- Parks, N.B., and H. Zenger. 1979. Trawl survey yields poor prospects. Alaska
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off Washington and Oregon during March-April, 1979. Unpub. manus.
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