REPORT OF THE

TECHNICAL SUBCOMMITTEE OF THE

CANADA-UNITED STATES GROUNDFISH COMMITTEE

Appointed by

The Second Conference on Coordination

of Fisheries Regulations Between

Canada and the United States

Twenty-second Annual Meeting

June 10-11, 1981

Bend, Oregon

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Date: June 10-11, 1981

Place: Bend, Oregon

Participants:

Canada

Fisheries and Oceans Canada	Mr. A. Cass (Chairman) Mr. J. Thompson Mr. J. Westrheim Mr. R. Wowchuk, I.G.C. (Observer)

United States

California Department of Fish and Game	Mr. T. Jow
Oregon Department of Fish and Wildlife	Mr. R. Demory Mr. J. Robinson
Washington Department of Fisheries	Mr. J. Tagart
Alaska Department of Fish and Game	Mr. J. Blackburn Mr. P. Rigby
National Marine Fisheries Service	Mr. J. Balsiger Mr. T. Dark
Pacific Marine Fisheries Commission	Dr. J. Harville, I.G.C. (Observer)
International Pacific Halibut Commission	Mr. S. Hoag (Observer)

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I. Call to Order

The 22nd annual meeting of the Technical Subcommittee was called to order at 0910 June 10, 1981 by Chairman Mr. A. Cass under instructions set forth by the Parent Committee in 1959.

II. Appointment of Secretary

Mr. R. Demory, Oregon Department of Fish and Wildlife, was appointed recording secretary.

III. Approval of Agenda

The tentative agenda circulated by Chairman Cass 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 of this report.

IV. Introductions

Each participant introduced himself and stated his affiliation.

V. Terms of Reference of the Subcommittee

In November 1978 the Parent Committee recommended to their respective governments new terms of reference which would join the Parent Committee and the Technical Subcommittee into a single committee. A request was also made to change the name from the International Groundfish Committee to the Canada-U.S. Groundfish Committee. Approval of the name change is pending but the new terms of reference, approved in 1981, are listed below:

a. exchange information on the status of groundfish stocks of mutual concern and to coordinate, whenever possible, desirable programs of research;

b. recommend the continuance and further development of research programs having potential value as scientific basis for future management of the groundfish fishery;

c. review the scientific and technical impacts of existing or proposed management strategies and their component regulations relevant to conservation of stocks or other scientific aspects of groundfish conservation and management of mutual interest;

d. transmit approved recommendations and appropriate documentation to appropriate sectors of Canadian and U.S. governments and encourage implementation of those recommendations:

VI. Review of Agency Groundfish Programs

A. Recent and anticipated studies

1. Canada

Research by the Groundfish Program at the Pacific Biological Station continued its orientation to resource assessment and analysis of factors controlling dynamics of exploited stocks. Segregation of research efforts into various investigations remained as in previous years. Emphasis on biomass surveys was lower than in past, as research attention was directed toward establishment of some longer-term projects. In addition, activity was intensified in the area of analytical methods development. Summaries of investigation activities follow.

Flatfish research during 1980 concentrated on a survey of juvenile flatfish in Hecate Strait. This survey was the first in a series that will be used in forecasting recruitment of rock and English soles. Fishery reviews included: reconstruction of stock histories; growth studies; mortality and recruitment estimation; and construction of yield isopleths. In addition, surplus production models were used to update biological and fisheries parameters for rock sole and Dover sole in the 5C-5E areas.

Other activities involved the processing of tag recoveries to resolve stock boundaries of Dover sole in northern Hecate Strait and a cooperative survey of arrowtooth flounder biomass in Hecate Strait with the survey design/species interaction group.

A species interaction group was formed during 1980 to address the potential linkages among stocks of different groundfish species, as well as the impacts of groundfish species on associated resources such as juvenile salmonids and clupeids. In particular, the impacts of strong cohorts of sablefish and spiny dogfish on migrating juvenile salmonids or schools of juvenile herring in coastal waters received attention. Stomach contents of juvenile sablefish from Queen Charlotte Sound and Hecate Strait were examined as well as contents of some dogfish stomachs in Area 4B. Results indicate that juvenile sablefish may be active predators on juvenile herring at specific times of the year. Dogfish stomachs from fish taken incidental to the commercial salmon gillnet fishery in Area 4B did not evidence predation on salmonids, although the number of specimens examined was small.

This group also assisted in the design and execution of surveys of juvenile flatfish and arrowtooth flounder.

An intensive sampling of hake and pollock eggs and larvae in Area 4B was continued during 1980. Sampling extended from mid-January to late June and used Bongo samplers and MARMAP procedures. This project is aimed primarily at evaluating the feasibility of using ichthyoplankton survey techniques to estimate total egg production and hence spawning stock biomass, via fecundity and population structure considerations. Secondary objectives include estimation of egg to larval survival, short-term growth, and distribution dynamics over time. In the laboratory, fecundity estimates for these pollock and hake (Pacific whiting) stocks were obtained and fertilized eggs raised 15 days beyond hatching. Information was also obtained on morphogenesis, developmental dependence on temperature and some aspects of larval behavior.

An ichthyoplankton survey of the outer continental shelf off British Columbia was conducted during late winter and early spring. Localized concentrations of sablefish eggs and larvae were found over the outer continental slope. Spawning was estimated to occur from January-March with peak abundance of eggs occurring in February. Sablefish eggs appear to hatch in deep water (>300 m). The limited number of halibut eggs and larvae encountered endorse survey results by the IPHC from the 1930's.

Field research on rockfishes during 1980 concentrated on the development and application of methodology for successfully tagging trawl-caught rockfishes. Tagging of these species is especially critical to the validation of recent ageing techniques and delineation of stocks in the U.S.-Canada southern boundary area.

Techniques employed included: rapid anaesthesis of fish; treatment for barotraumatic effects of capture, consisting of swim bladder deflation; injection with oxytetracycline; holding in recovery tanks; and information collection on categories of injuries for released fish. Over 9,500 fish were successfully tagged and released. Capture depths ranged from 55-130 m and success was higher with fish caught using midwater trawls. Approximately 95% of the released fish were *sebastes flavidus*. Oxytetracycline is a calcium-specific agent used to provide a time mark on otoliths at time of tagging; recoveries will permit validation of ageing techniques.

Mortality incurred in the tagging operation was partitioned into pre-tagging mortality, immediate or traumatic tagging mortality and short-term mortality, as determined through overnight holding experiments. Pre-tagging mortality averaged 5.0% (0-13%); traumatic tagging mortality averaged 1.8% (0-4%); and overnight mortality averaged 4.3% (0-9.6%).

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Laboratory studies conducted or initiated during 1980 included a reanalysis of growth and mortality rates of rockfishes, based on recent advances in ageing techniques; determination of functional species associations among the shelf and slope rockfish complexes; development of indices of Pacific ocean perch abundance using domestic fishery data; development of reconstruction strategies for over-exploited stocks using sequential population analysis; and investigation of age-specific fecundity for major species.

An exploration of the Bowie, Cobb and Union seamounts was done in conjunction with the Fisheries Development Program of the Department. Commercial quantities of rockfishes were located on Bowie Seamount.

Three projects concerning Pacific cod were conducted during 1980. The first project was aimed at evaluating whether the fishery exerts significant effect on the stock dynamics of this species. In the course of this investigation, methods of allocating effort within a multi-species fishery were developed and a computerized method of age-determination using length frequencies was employed.

The second project involved the development of a set of criteria for identifying annuli on Pacific cod scales, in order to validate the present method of age determination. Final validation awaits application of criteria to scales of fish tagged as juveniles of known age and recovered as adults.

The last project undertaken during 1980 was the development of predictors of cod cohort strength. Physical parameters such as water temperatures, salinity and onshore drift are being investigated as determinants of the abundance of age 2 fish in Hecate Strait. In addition, the fluctuations of one major prey item (*Ammodytes hexapterus*) are also being investigated for their potential influence on Pacific cod dynamics.

Hydroacoustic investigations during 1980 were directed primarily toward estimation of offshore herring biomass off Vancouver Island. Some effort was expended, however, in the determination of pollock biomass in northern Hecate Strait-Dixon Entrance during June. While other cruises concentrated on herring, the biomass of species encountered with herring were also estimated; pollock, hake and rockfishes were the prime recipients of this attention.

An additional 30,000 sablefish were tagged on six research cruises during 1980. This brings the total number of fish tagged during this study (1978-1980) to 95,000. The majority of the fish tagged during 1980 were pre-recruit juveniles. Other projects conducted on sablefish were the development of escape devices for sablefish traps to alleviate the problem of 'ghost fishing' by lost gear. Both escape panels and escape rings are being investigated. Preliminary results of the escape ring tests indicate they are effective at reducing the incidence of juvenile and sub-legal fish.

Results of tagging and biological sampling were processed and detailed analysis initiated.

Tagging of spiny dogfish in Area 4B continued during 1980. Almost 8,500 fish were tagged with modified Petersen discs. The development of an effective, long-term tag for dogfish was continued; this development is necessary due to the longevity of this species, such that the tag must last for at least 20 years. Preliminary results of the modified Petersen tag using titanium wire are promising.

Two other projects involving spiny dogfish, a historical study of spine growth and annulus formation and an examination of age and size at first maturity, were conducted on fish from Area 4B.

A purse seine survey for juvenile lingcod was conducted in the inside waters of Area 4B during April-June 1980. This survey was a component of an ongoing study examining the factors affecting cohort strength in lingcod stocks.

Development of methods for the determination of accurate ages of fishes continued. Approximately 20,000 structures from 15 species of fishes were processed during 1980. New methods of ageing and validation were developed and continued for rockfishes, sablefish, flatfishes, albacore tuna, pollock, Pacific cod and dogfish.

Research into analytical methods during 1980 concentrated on publication of methods for analysis of age compositions using a more rigorous length frequency analysis and a generalized and more powerful method of sequential population analysis. In addition to these projects, improved methods of calculating fishing power of vessels and of assigning effort within multi-species fisheries were developed.

The commercial fishery sampling unit continued to provide the Program with catch and effort information and biological samples from the groundfish fishery. Percent of landed weight for which trawl interviews (and thus effort) were obtained, averaged 84% of landed weight coastwide.

The number of biological samples collected in 1980 by the sampling unit totaled 261.

2. United States

a. National Marine Fisheries Service

Groundfish resource assessment at the Northwest and Alaska Fisheries Center is conducted within two divisions: the Resource Assessment and Conservation Engineering (RACE) Division under the direction of Dr. Murray Hayes, and the Resource Ecology and Fisheries Management (REFM) Division

directed by Dr. Richard Marasco. These divisions are organized into a number of tasks and subtasks on regional or scientific discipline bases. A review of pertinent work during the past year is presented below.

Bering Sea Groundfish Assessment Subtask

During May 5-July 26, 1980, a two-vessel demersal trawl survey of the eastern Bering Sea continental shelf was conducted in order to obtain annual assessment data on the crab and groundfish resources of the region. Yellowfin sole and walleye pollock were by far the most abundant species encountered with Pacific cod and Tanner crab (*Chionoecetes opilio*), the next most abundant. The pollock population size seems to be stable while yellowfin sole and Pacific cod populations are increasing in size. Pacific ocean perch and sablefish populations remain small, but the 1977 sablefish year-class is beginning to reach marketable size.

During February 2-27, 1981, a demersal trawl survey of the outer continental shelf and slope of the southeast Bering Sea was conducted to assess incidental catch rates of Pacific halibut during the winter in an area currently closed to foreign trawling but open to domestic trawling on an experimental basis. The survey also provided the first data on distribution and abundance on all groundfish and crab in this area during winter.

A two-vessel demersal trawl survey of the eastern Bering Sea continental shelf to obtain annual assessment data on the crab and groundfish resources of the region will occur between May 20-August 5, 1981. This will be a cooperative effort with the Fishery Agency of Japan, who will provide a third vessel to comprehensively survey continental slope waters (200-1000 m) as well as other shelf waters (100-200 m). A fourth vessel, also from Japan, will cooperate in the crab research aspects of the survey by surveying Tanner crab stocks.

Gulf of Alaska-Aleutian Islands Groundfish Assessment Subtask

In the summer of 1980 the Gulf of Alaska Aleutian Islands Subtask participated with Japan in a resource assessment survey of the Aleutian Islands from Unimak Pass (165^{o} W long.) to Attu Island (172^{o} E long.). Vessels taking part in the survey were the NMFS charters Half Moon Bay and Ocean Harvester and the Japan Fisheries Agency charter vessel Hatsue Maru No. 62. American scientists were stationed on the Hatsue Maru No. 62 during the survey of the Aleutian Islands.

A preliminary analysis of the catch results from the two U.S. vessels indicates that their catches were dominated by walleye pollock, Pacific cod, Pacific ocean perch, and Atka mackerel. Analysis of the Japanese part of the survey will be supplied at a later date by the Japan Fisheries Agency.

In November 1980, the NOAA research vessel Miller Freeman carried out a survey of the relative abundance of rockfishes in the outside waters of Southeastern Alaska near Cape Ommaney. Fishing depths ranged from 102-403 m (56-220 fm). The more prominent species in the catches were arrowtooth flounder, walleye pollock, sablefish, Pacific ocean perch, shortspine thornyhead, spiny dogfish, and Dover sole.

During March-May 1981, the subtask was engaged in a series of studies on the walleye pollock aggregations spawning in Shelikof Strait. These investigations employed the RV Miller Freeman, which conducted hydro-acoustic surveys using the echo-integrator system to estimate the biomass. The spawning area was surveyed three times during the period from March 3 to April 10. Four ichthyoplankton surveys were conducted in Shelikof Strait from March through May to describe the space-time distribution of pollock spawning. One of the two plankton samples collected at each station

was exchanged later with Soviet scientists on the vessel Shantar, which was occupying additional plankton stations according to a prearranged plan.

A total of 59 trawl hauls was madein Shelikof Strait during the period of spawning to monitor the sex ratio, size, age, and sexual maturity composition of the pollock population. Most of the adult pollock appear to have left Shelikof Strait before the beginning of the third ichthyoplankton survey on 26 April.

During April-May, 1981, a bottom trawl survey aimed at Pacific cod and Atka mackerel distribution and abundance was conducted aboard the Miller Freeman between Chirikof Island (156° W long.) and Kiavak Gully (152° 15' W long.) and at depths between 50 and 135 fathoms. The most prominent species in trawl catches was walleye pollock followed by arrowtooth flounder, rex sole, Pacific cod, Pacific halibut, sablefish, and Dover sole. Atka mackerel were not found at their usual locations of past years, and only a handful were captured during the survey.

In May, 1981 a bottom trawl survey was conducted jointly by Soviet and American scientists in the area southeast of Kodiak Island to assess the distribution and abundance of rockfish. The Miller Freeman and the Soviet vessel Shantar occupied a number of bottom trawl and ichthyoplankton stations. Soviet data has not been received, but U.S. catches were mainly walleye pollock, arrowtooth flounder, Pacific ocean perch, sablefish, rex sole, Dover sole, and shortraker rockfish.

Anticipated Research

Beginning in late May 1981, the NMFS charter vessels Pat San Marie and Ocean Harvester will conduct trawl surveys in conjunction with a Soviet research vessel. The U.S. vessels will survey rockfish resources in the Yakutat and Cape Ommaney areas of the eastern Gulf of Alaska from

May 22 through June 30. The Soviet research vessel Mys Yonony is to survey in the Middleton Island area from July 16-30. From July 31 to August 15, the Mys Yonony and the Ocean Harvester will return to the Yakutat area for a replicate of the earlier survey. Late in August and in early September 1981, the Korean vessel Ito Kuten is to survey for rockfish in the Shumagin Islands area and in the Kodiak Island area. U.S. personnel will be aboard both the Soviet and Korean research vessels during these trawl surveys.

Pacific Coast Groundfish Assessment Subtask

A trawl/hydroacoustic survey was conducted from Monterey Bay, California to Kyoquot Sound, Vancouver Island during July-September 1980. Primary objectives were to determine the distribution, abundance, and biological features of Pacific hake, canary, and yellowtail rockfish. Secondary objectives were 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 (*Sebastes entomelas*) in a small area off Newport, Oregon.

Hake biomass was estimated to be about 1.5 million mt, 46% of which occurred in the INPFC Monterey Area. That unusual abundance in the southern portion of the survey area appears to be mainly due to the presence of a relatively large 1977 year-class. Yellowtail and canary rockfish biomass estimates are generally quite low and are being evaluated. Shortbelly rockfish concentrations were found mainly between Santa Cruz and Half Moon Bay, California, and biomass was estimated to be 158,000 mt; about 140,000 mt less than the 1977 estimate. Only three days were available for the widow rockfish behavior study, during which large midwater aggregations were not detected. Systematic bottom trawl sampling resulted in very small, widow rockfish catches and suggests that large schools, usually observed at

night, do not disperse over the bottom during the day.

Investigation of widow rockfish behavior, distribution, and abundance continued in 1981 when four major fishing grounds off Oregon were surveyed by trawl and hydroacoustically. Preliminary results suggest that typical nighttime aggregations do not disperse with the coming of dawn, but instead rise in the water column and often leave ridges and other bottom prominences to form dense schools over adjacent deep water. The species appears to lend itself to hydroacoustic assessment because it consistently inhabits readily definable "grounds", it gathers in easily identifiable schools, and those schools are usually separate from other midwater species.

Additional widow rockfish assessment and survey design studies were completed during March 1981 by the University of Washington under an NMFS contract.

Anticipated Research--During the early spring of 1982, the subtask plans to mount a Pacific ocean perch survey off Washington and Oregon, similar to that completed in 1979. A second survey is planned to conduct a comprehensive study of widow rockfish distribution and abundance in the Washington-California region.

Ecological Processes Subtask

The subtask is involved in three studies of juvenile groundfish biology. The juvenile biology of common Bering Sea gadids (walleye pollock, Pacific cod, saffron cod, and Arctic cod) is being described based upon 1971-1980 NMFS trawl survey data. Included are evaluations of geographical distributions of size and age groups, interspecific relationships, recruitment patterns, and year-to-year variations in distributions and apparent abundance. The juvenile biology of the twelve common species of Bering Sea pleuronectids is being described, following the same objectives and methods as the above study.

A large-scale, 550 sample, demersal trawl survey was conducted during summer 1980 in the bays, inshore waters, and mid-continental shelf areas of the northwestern Gulf of Alaska to evaluate the distributions and relationships of juvenile groundfish. These data are now being used to identify nursery and juvenile areas, to evaluate the potential value of different geographical areas for possible indexing of annual juvenile abundance, to evaluate the positions and roles of different juvenile fish populations within the Gulf of Alaska food web, and to evaluate patterns of recruitment to fisheries.

The subtask is studying two demersal fish communities. The physical environment, benthic fish fauna, and commercial fisheries of the eastern Bering Sea continental slope province are being described based upon 1979 trawl survey and commercial fisheries data. The physical and biological environments of three seamounts in the Gulf of Alaska (Patton, Giacomini, and Quinn) are being described, based upon observations obtained in 1979 using a modified free vehicle photographic system.

One subtask scientist has been working with ecological models. A numerical simulation model of pollock population dynamics in a simplified ecosystem has been developed. The model is now being used for explorations of the changes resulting from different combinations of a few parameters of special interest, such as changes in the fishery yield resulting from different combinations of fishing mortality, age of recruitment, and amount of cannibalism.

A number of species are being subjected to stock identification analyses. The first three studies are under contract to outside specialists. Biochemical genetic variation was described in Pacific and Atlantic herring based upon Mendelian variation at 26 loci. These data were then used to resolve the essential features of the structure of Pacific herring populations

in the Bering Sea and North Pacific Ocean. The biochemical genetic population structure of Atlantic herring was then also described, then compared to the previous results to evaluate evolutionary divergence between Atlantic and Pacific herring populations. A study describing electrophoretic variation in yellowfish sole and the genetic population structure in the eastern Bering Sea and Gulf of Alaska is underway. Another study investigating stock relationships of Pacific ocean perch in the northeastern Pacific, and electrophoretic characterization of species in the genus *Sebastes* is in progress. Tissue collections have been made for investigations of the genetic population structure of Pacific cod in the northeastern Pacific and Bering Sea, and to clarify the taxonomic status of the genus *Atheresthes* in the northeastern Pacific.

Latent Resources Subtask

Sablefish abundance indexing occurred at sites off S.E. Alaska, Washington, Oregon, and California in 1980 and will continue in 1981. Results from that work suggest that the abundance of marketable-size sablefish has decreased off S.E. Alaska since indexing began in 1978-79. Relatively strong 1976 and 1977 year-classes could increase the size of the commercially important segment of the population beginning in the summer of 1981.

Catch per unit effort at index sites was relatively stable off Washington between 1979 and 1980. Washington landings of nearly 2400 t from August 1979-July 1980 apparently did not adversely affect the stock. Landings decreased sharply in 1980 and this, coupled with a 10% increase in prerecruitment sablefish between 1979 and 1980, suggests that, precluding an unforeseen sharp increase in landings, Washington stocks will improve during the next 1-2 years.

A trawl survey to determine Pacific cod distribution and abundance and delineate spawning concentrations in the western Gulf of Alaska was conducted during April-May 1981. The study area extended from Kodiak Island to Unimak Pass between the 50-150 fm isobaths.

The joint U.S.-Japan sablefish/Pacific cod survey was conducted in 1980 and will continue in 1981. Sablefish densities increased in the INPFC Yakutat and Southeastern areas and decreased in the Chirikof area. The increases appear to be due to the presence of young sablefish at almost all depth ranges. As in past surveys, the densities of Pacific cod were high in the western Gulf of Alaska and low in eastern areas. Increases in densities were observed in the Shumagin and Chirikof areas and a decrease was noted in the Yakutat area.

Pacific Hake Studies

REFM scientists are conducting studies of the biology and fisheries management of Pacific hake. The study was initiated in January 1981 and consists of several parts; a species synopsis, a detailed analysis of growth based on observer data, a cohort analysis based on fishery data for 1973-80, and construction of an age specific/INPFC Area specific simulation model of the whiting population and fishery. The model will be used to: evaluate the potential for management based on prior knowledge of year-class strength, assess various methods of representing growth and mortality in a simulation model on estimates of whiting trophic demands, and evaluate the impact of a hypothesized relationship between population age structure and spawning distribution on the dynamics of fishery production.

A small program is also focusing on the feeding behavior and food consumption of hake and rockfish as an important element of trophic dynamic analysis.

Pacific Ocean Perch Studies

The Pacific Ocean perch stocks from the Gulf of Alaska and Bering Sea are believed to be at depressed levels of abundance and in a weakened state. Assessments of these stocks have traditionally been accomplished with landed CPUE as an index of relative abundance. However, rapid developments in technology and an increased variability in the perch fishery itself, since the mid and late 1960's, have led to increased difficulty in the interpretation of catch and effort statistics. To provide stock assessments independent of CPUE, cohort analysis techniques have been developed.

A study is currently ongoing to reassess the depleted perch stocks from the Gulf and Bering Sea using cohort analysis techniques. The results from the cohort analysis will be compared with previous stock assessments derived from past CPUE analyses, and the errors and relative merits of each method will be examined.

This study will culminate with a comprehensive report on the past and present perch stock conditions in the region and should be useful in the development of future perch fishery regulations.

Multi-species Modeling

Most available population dynamics models are number based. This usually requires that each species must be divided into age groups to which initial numerical strength must be assigned and separate continuous bookkeeping for each age group must be carried out in the model. The distribution of numbers in juvenile stages is, however, usually unknown. Furthermore, there must be frequent conversion between numbers and weight (biomass), as growth rate is highly age dependent. In addition, predation is a highly predator-prey size dependent process.

The Andersen-Ursin multi-species model is essentially a number based model and is applicable to areas where basic input data on species is readily available (e.g. the North Sea). Considering the data available on groundfish complexes in the northeast Pacific, a biomass based model for marine ecosystem simulation was developed. The Dynamical Numerical Marine Ecosystem model (DYNUMES) is a gridded model which allows detailed computation of dynamics. All computations are carried out at each grid intersection (grid point) at each time step (week or month).

Predation has been included traditionally in the all-encompassing term "natural mortality", of which predation constitutes the major portion in most species. In order to remedy this shortcoming, the predation mortality is computed within ecosystem models in great detail, using data on food requirements for growth and maintenance and space- and time-variable food composition.

DYNUMES has been applied to groundfish communities in the eastern Bering Sea and initial trials have been conducted for the Kodiak region of the Gulf of Alaska. The benefits derived from the application of DYNUMES can be grouped into two main categories:

(A) Investigative formulations that permit quantitative biological resource evaluations, including:

--Synthesis (analysis) of available information, such as quantification of descriptive data (e.g. migrations, feeding habits, etc.) and quantitative summarization of exploratory studies.

--Quantitative determination of the effects of environment and inter-species interactions and other natural fluctuations on the distribution and abundance of biotic components of the system.

(B) General management guidance and information on the effects of exploitation, including:

--Determination of the magnitude or status of the exploitable resources, their past and expected future fluctuations as response to ecosystem internal factors, such as reproductive capacity, or to external factors, such as fisheries.

--Determination of the effects of varying fishing intensity (including spatial and temporal changes in distribution of fishing effort) on the resources, and determination of the effects of proposed regulations.

--Establishment of research priorities, i.e., for obtaining of missing data or for better quantification of available essential information.

Among the initial scientific uses of the model have been the study of the effects of environmental anomalies (e.g. temperature--through the effects on growth, basic food availability, and partial population movements in relation to optimum environmental conditions) on the abundance and distribution of single species as well as on the changes of the ecosystem as a whole. Furthermore, the model has been used for determination of the "carrying capacities" of given regions and for the study of natural fluctuations of abundance of species as caused by various ecosystem internal factors (e.g. cannibalism).

Movement of Sablefish in the Northeast Pacific

From 1971 to 1976, 34,640 sablefish were tagged in the northeastern Pacific to differentiate stock units and movement among units. Through December 1980, 1,362 (3.9%) of these tags were recovered. Analysis of the returns by International North Pacific Fisheries Commission (INPFC) statistical areas revealed a low percentage of sablefish movement or migration. Of the 969 tags for which precise recovery site was known, 65% were recovered within 100 km of the release site, 24% recovered between 100-500 km, 8% between 500-1000 km, and 3% at greater than 1000 km.

Examined by season and size category, the data revealed that fish tagged in the spring and fall showed the most movement with no significant differences between size group. A slight significant correlation was found between time at large and distance traveled.

The conclusions drawn from the study include:

(A) Most sablefish do not undertake large scale movements and interchange among areas is small;

(B) Sablefish can be divided into management units (i.e. southern Calif. Wash-Oregon, eastern Gulf of Alaska);

(C) There is no obvious pattern of movement by size, but some weak relationship between time at liberty, season and movement.

(b) California

Groundfish work is performed by the Marine Resources Region, the Marine Resources Branch, and the Planning Branch.

Monitoring, surveillance, and assessments of commercial and recreational fisheries were accomplished by Regional personnel. Basic to assessment of stocks are the biological sampling programs at major groundfish centers of the state. Age, size, sex, and species composition for groundfish were sampled in 1980. A soft data system to provide groundfish data on a timely basis was implemented in 1980. In Southern California, 6,376 sablefish were tagged aboard the NOAA vessel Chapman for the Pacific Fishery Management Council.

Marine Resources Branch programs deal with groundfish important to recreational fisheries. Among these species are rockfishes and lingcod. Life histories, ecology and fishery impacts are under study in southern and central California. A considerable number of inshore rockfish were tagged in 1980 and tagging will continue in 1981.

Planning Branch is involved with processing of groundfish data and also provides biometrical assistance.

c. 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.

Market and at sea sampling efforts were directed at continuing the data base collection of age, sex, maturity and size composition on petrale, Dover, and English sole, as well as selected rockfish species including *Sebastes Alutus* and *Sebastes entomelas*. Considerable sampling effort was made to collect biological data from the burgeoning midwater trawl fishery for widow rockfish. Only a few samples were collected from sablefish landings. Although the sablefish fishery was quite large in 1979, catches declined substantially in 1980, as Japanese demand for the product softened. As a result there was a decrease in the opportunity to sample for biological statistics. Monitoring of the POP trip limit required maintenance of a high level of sampling effort for rockfish species composition.

There were 287 biological samples taken in 1980, compared to 274 in 1979.

Collection, coding, data entry, and error-checking of trawl catch, effort and area of catch data continued to be a major portion of our efforts. In addition, the staff has been working with the Agency's Biometrics Section staff at our Portland headquarters to produce the software and personnel support changes necessary to accommodate data reporting to the Fishery Information Network(FIN). FIN is through a

committee and run by the National Marine Fisheries Service (NMFS) to provide current fishery statistics during the season. The system should be fully operational in 1982 at the proposed time the Pacific Coast Groundfish Fishery Management Plan (FMP) is implemented. Specific activities directed toward making FIN operational were assisting in the error checking of fishticket data files for Biometrics, developing species composition data collection forms and testing of data entry/data summary programs developed by the Department's Biometrics staff.

Logbook and fishticket data continued to be entered on the Oregon State University Cyber computer to produce the summaries used in this report. One major accomplishment during 1980 was the conversion of existing computer programs to accommodate the LORAN C radio navigation system. The new conversion allows LORAN C (or old LORAN A) logbook readings to be interpreted directly at state and Pacific Marine Fisheries Commission (PMFC) statistical locations. It is expected that this system will operate in parallel for a time with new systems that may be created as a result of the implementation of the Groundfish FMP and subsequent development of a coastwide uniform logbook.

Pacific Fishery Management Council and North Pacific Fishery Management Council activities continued to occupy much of the staff's time.

d. Washington

The staff of 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 divisions within the program deal with groundfish.

Extended Jurisdiction Division.

Established in 1977, Extended Jurisdiction Division 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 Fisheries 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 accomplishments during the past year have been: (1) gaining of final approval of the Groundfish Fishery Management Plan by the Pacific Fishery Management Council, (2) completion of a draft Pacific Herring Fisheries Management Plan, (3) evaluation of alternative trip limits for the Pacific ocean perch fishery, and (4) a review of the estimated landings by species from 1967-1979 in Washington's coastal trawl rockfish fishery.

Groundfish Management Division

During the past year, the work of this division has been directed toward research and management on Washington groundfish resources, and their fisheries.

Monitoring work included collection of biological samples of landings from several commercial and recreational gears. Biological samples collected in 1980 totaled 382, compared to 171 taken in 1979. In addition to the ongoing fishery interview system for trawl vessels, set line, set net, bottomfish troll, and jig fisheries were also monitored.

State participation in the National Recreational Fisheries Survey has yielded valuable information on species composition, catch and effort by private boat, charter boat, and shore fishermen. A charter boat log book project was begun.

Investigations were made which concerned: (1) development of methodology for monitoring sport fisheries in state waters, (2) an assessment of the sport fishery for Pacific cod in Agate Pass, (3) a comparison of catches by trawl, set net and set line gear in Hood Canal, (4) the ability to identify bottomfish species by different types of recreational fishermen, (5) incidental catch of bottomfish by shrimp trawl gear, (6) assessment of the Pacific whiting stock in Port Susan, (7) assessment of the walleye pollock stock in the Gulf of Georgia, and (8) relationship of mesh type to the rate of incidental salmon catch by set net gear in Port Townsend Bay.

Technical Services Division

Catch per unit effort analysis by Dr. D. Kimura was carried out on Pacific ocean perch stocks in U.S. and Canadian waters. Computer simulation was used to study the effects of schooling on the variability of hydroacousitc biomass estimates. Results from this study will be published in CJFAS.

A new Biosonics integrator was purchased to go with our Biosonics echosounder. We now have the capability for real time analysis of hydroacoustical data. Hydroacoustical surveys to assess abundance were conducted for herring populations throughout Puget Sound and the Strait of Georgia. Hydroacoustic estimates of biomass were also made on a pollock population in the U.S.-Canada boundary region and on Pacific hake in central Puget Sound.

Major modifications were made to the computer systems which process trawl fishery data. These changes will allow data to be available

on a monthly basis. Catch statistics were supplied to Canada under an agreement which allowed U.S. trawl fishing in Canadian waters.

Marine Fish Enhancement Division

During 1980, the Enhancement Division continued with primary emphasis on habitat enhancement (artificial reefs) and access for metropolitan recreational fisheries, and enhancement of lingcod (*Ophiodon elongatus*) stocks in Puget Sound. Construction on the Elliot Bay Public Fishing Pier was completed and the facility was opened early in 1981. This pier is the second in the Department's program to provide access for shore-bound anglers in metropolitan areas. Fishing reefs for boat anglers were completed at Blake Island in the Seattle-Bremerton area, and at Gedney Island near Everett. Eight more boat angler reefs are under development and will provide metropolitan fishing locations from Olympia to Whidbey Island.

The lingcod enhancement project has developed technology necessary to utilize wild stock lingcod juveniles to bolster depressed stocks in Puget Sound. These technologies involve short-term pen rearing, microwire tagging, and release of juvenile lingcod captured in areas of abundance in Juan de Fuca Strait and coastal harbors.

e. Alaska

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

The ADF&G groundfish program can be divided into six tasks: catch reporting, observer-port sampling, resource assessment, regulation development, management action, and logbook collection and analysis. In general, research and management are conducted on a regional basis. The groundfish staff is continuing the standardization of sampling methods, and the regional staff cooperates on statewide projects.

Activities within the Southeastern Region groundfish 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.

Catch data (fish tickets) editing is done in Petersburg and computerized monthly summaries are now available. During the new fiscal year, dockside sampling will be expanded with samplers in each major port especially for sablefish, rockfish, and flounders. The logbook program, presently limited to the few vessels of the inside flounder and pollock fisheries and to vessels fishing sunken gill nets, will be expanded statewide to include all trawl and longline vessels. Additional sablefish tagging was conducted in June 1980 near Ketchikan. 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 rockfish. An assessment of the nearshore rockfish complex is ongoing. Management activities included on-board observation of the winter flounder fishery and observation

flights of the fishing fleet during the Chatham Strait sablefish season. Registration of vessels participating in the Chatham Strait fishery was initiated during 1980.

Activities of the Westward Region groundfish program also include catch data collection; information dissemination; regulation development; and resource assessment; 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. 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 and expand the program in the Bering Sea. A final draft report for the first two years of the program has been completed.

As part of the regional assessment program a trawl survey of Shelikof Strait was conducted during July of 1980. The regional groundfish biologist participated as a member of the Bering Sea groundfish plan development team. 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 in Kodiak using the minicomputer of the Computer Services Section. Head tallies are also done in order to provide the Regional NMFS office and the NPFMC with timely catch reports.

B. List of Publications

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

VII. Review of Northeast Pacific Groundfish Fisheries

A. Canada-United States Fisheries in 1980

1. Commercial fisheries

Canadian and United States commercial fisheries (excluding Alaska) by all gear types in 1980 landed 145,400 mt, a three percent increase over the 1979 landings of 141,442 mt. As in previous years the trawl fisheries accounted for most of the commercial catch. In Canada, trawl landings totaled 32,791 mt, a three percent increase over 1979. Trawl landings by United States vessels were 92,948 mt, 11% greater than the 1979 landing of 83,403 mt. In 1980, as in recent years, the major trawl species were rockfish, Pacific cod, and Dover sole. Significant in 1980 were rockfish landings that increased 41% to 56,341 mt from 40,033 mt in 1979. The 1980 rockfish landings were also 133% greater than the 10-year mean of 24,200 mt (Table 1). Widow rockfish was the leading species in rockfish landings as the pelagic trawl fishery off the U.S. became further developed (Table 2).

Non-trawl landings in Canada in 1980 totaled 6,354 mt, a decrease of six percent from the 1979 landing of 6,767 mt. Non-trawl landings in 1980 by United States vessels totaled 19,661 mt, a 25% decrease from the 1979 total of 26,202 mt. The decline was mostly due to depressed markets for sablefish, the primary target species of the non-trawl fisheries.

a. British Columbia

Trawl landings of groundfish by Canadian fishermen in 1980 were 32,791 mt, a 3% increase over the 1979 catch of 31,839 mt, but 55% greater than the 10-year mean catch of 21,214 mt.

Table 1. Trawl landings (mt) from the northeastern Pacific by Canadian and United States vessels in 1979 and 1980 and mean for 1970-79. Joint venture catch by Canadian and U.S. vessels is excluded.

Species	1979						1980						Mean
	B.C.	WA	OR	CA	AK	Total	B.C.	WA	OR	CA	AK	Total	1970-79[e]
English sole	1,070	1,307	1,413	1,925	7	5,722	1,244	1,112	718	2,043	-	5,117	4,805
Rock sole	1,875	232	5	4	-	2,116	1,843	149	13	-	46	2,051	1,742
Petrale sole	203	723	1,042	1,257	1	3,226	223	599	850	1,027	-	2,699	3,723
Dover sole	861	2,410	5,067	10,615	1	18,954	1,274	2,010	4,008	7,762	-	15,054	14,134
Rex sole	204	416	734	910	-	2,264	145	186	524	820	-	1,675	1,627
Starry flounder	296	566	284	500	279	1,925	118	608	193	290	-	1,209	1,154
Arrowtooth flounder	1,823	546	319	[a]	6	2,694	1,448	375	188	[a]	-	2,011	[a]
Other flatfish	53	395	569	860[a]	43	1,920	51	278	427	868	-	1,624	2,449
Pacific cod	9,501	3,549	402	-	1,428	14,880	8,667	5,704	156	-	2,601	17,128	11,723
Lingcod	1,160	1,390	686	1,120	-	4,356	1,311	1,324	652	1,161	6	4,454	4,166
Sablefish	277	831	1,494	2,380	49	5,031	334	430	1,026	2,902	16	4,708	3,383
Whiting	-	424	129	790	-	1,343[b]	606	123	257	44	-	1,030	232
Pollock	3,384	488	-	-	2,030	5,902[b]	2,201	425	-	-	-	2,626	[b]
Rockfish	8,393	12,537	9,298	9,695	110	40,033	9,444	15,064	16,482	15,346	5	56,341	24,200
Misc. species	1,009	102	187	225	274	1,797[b]	292	190	92	278	1,521	2,373	744
Dogfish	1,275	1,329	39	-	-	2,643	2,871	828	23	-	-	3,722	981
Animal food	214	700	-	-	-	914	191	1,165	-	-	-	1,356	1,663
Reduction	241	3,766	-	-	-	4,007	528	4,230	-	-	-	4,758	2,487
Total	31,839	31,711	21,668	30,281	4,228	119,727	32,791	34,800	25,609	32,541	4,195	129,936	79,213
Percent of total	26.6	26.5	18.1	25.3	3.5								
Total hours	38,297	74,165	56,444[d]	[c]	[c]		46,924	66,072	46,605	[c]	[c]		
CPUE, mt/hr *(excluding dogfish)*	0.798	0.410	0.366[d]	[c]	[c]		0.638	0.514	0.362	[c]	[c]		

[a] *Included with other flatfish*
[b] *Some whiting and pollock included with miscellaneous species*
[c] *Not available*
[d] *Excludes pelagic trawl effort*
[e] *excludes Alaska*

Trawl effort, excluding joint venture, was 46,924 hrs, 23% greater than in 1979 and 51% greater than the 10-year mean of 31,157 hrs.

Trawl landings of rockfish were 9,444 mt, a 13% increase over 1979 and 103% greater than the 1970-79 mean catch. Pacific ocean perch comprised 56% of the rockfish catch (Table 2).

Table 2. Landings (mt) of major rockfish species taken by Canadian and United States trawlers in 1980.

Species	BC	WA 1/	OR	CA	AK
Bocaccio *(S. paucispinis)*	139.1	175.3	408.6		
Canary rockfish *(S. pinniger)*	612.6	1,262.5	2,037.1		
Darkblotched rockfish *(S. crameri)*	0.1	98.9	294.4		
Pacific ocean perch *(S. alutus)*	5,290.1	825.7	1,127.9		
Redbanded rockfish *(S. babcocki)*	201.4	128.3	2/		
Redstriped rockfish *(S. proriger)*	130.6	172.5	2/		
Silvergray rockfish *(S. brevispinis)*	1,104.6	811.3	2/		
Widow rockfish *(S. entomelas)*	19.9	6,634.5	8,931.1	3,707.0	
Yellowmouth rockfish *(S. reedi)*	536.6	254.9	140.0		
Yellowtail rockfish *(S. flavidus)*	695.2	4,362.1	2,818.6		
Other rockfish	714.6	205.7	724.5		
Total	9,444.8	14,931.7	16,482.2	15,346.0	3/ 4/

1/ Excludes Puget Sound landings
2/ Included in other rockfish
3/ Except for widow rockfish, species composition not available
4/ Not available

Trawl landings of Pacific cod were 8,667 mt, 9% less than in 1979 but 13% greater than the 10-year mean catch of 7,687 mt. Pacific cod continued to be the leading species of the Canada shore based trawl fishery.

Trawl landings of flatfish in 1980 were 6,346 mt, nearly the same as in 1979 but 25% greater than the 10-year mean. Major species were rock sole, arrowtooth flounder, Dover sole and English sole.

The catch of groundfish caught by other gear types in 1980 was 6,354 mt. Trap and longline catches accounted for most of the catch. Sablefish was the most important species caught by the other gear types.

b. California

Trawl landings in 1980 were 32,541 mt, a 7% increase over 1979 and 26% greater than the 1970-79 mean landing of 25,767 mt. Effort data for 1980 was not available.

Trawl landings of rockfish were 15,346 mt or 47% of the trawl catch. Widow rockfish, caught by pelagic trawl, comprised 24% of the rockfish catch and 11% of the total trawl catch.

Flatfish comprised 12,810 mt or 39% of the trawl catch of which Dover sole was the leading species. Dover sole accounted for 61% of the flatfish catch and 24% of the total trawl catch and continues to be the most important species in the trawl fishery.

The groundfish catch by other commercial gear was 5,000 mt, most of which was rockfish caught by gill nets and hook and line gear.

c. Oregon

Trawl landings in 1980 were 25,609 mt, an increase of 18% over 1979 and 131% greater than the 10-year mean landing of 11,090 mt. Trawl effort (excluding pelagic trawl effort) decreased by 17% from 56,444 hrs in 1979 to 46,605 hrs in 1980.

Rockfishes were the leading component of the landed trawl catch amounting to 16,482 mt, or 64% of the trawl landings. Widow rockfish accounted for 54% of the trawl caught rockfish and 35% of the total trawl catch. Nearly all of the widow rockfish catch was caught by pelagic trawl.

The trawl catch of flatfish was 6,916 mt, or 27% of the trawl catch. Dover sole was the most important species of this group and comprised 58% of the flatfish catch.

Landings of groundfish caught by other gear types totaled 3,324 mt. The incidental catch by shrimp trawls, mostly rockfish, accounted for nearly 40% of the catch caught by miscellaneous gear types.

d. Washington

The trawl catch in 1980 was 34,800 mt, an increase of 10% over 1979 and 58% greater than the 10-year mean catch of 22,011 mt. Trawl effort in 1980 declined from 74,165 hrs in 1979 to 66,072 hrs in 1980, but effort was 34% greater than the 10-year mean of 49,488 hrs.

Rockfishes comprised 15,063 mt or 43% of the trawl catch in 1980. Widow rockfish landings were 6,635 mt and comprised 44% of the trawl rockfish catch and 19% of the total trawl catch. The catch of yellowtail rockfish was 4,362 mt or 29% of the rockfish catch.

Pacific cod landings in 1980 were 5,704 mt, an increase of 61% over the 1979 landings of 3,551 mt. Cod comprised 16% of the total trawl catch.

Trawl landings of flatfish were 5,317 mt in 1980, a decline of 19% from 1979. Dover sole was the most important species comprising 38% of the flatfish landing.

The groundfish catch by other gear types was 4,983 mt. Set line gear accounted for 45% of the catch for non-trawl gears.

e. Alaska

Development of the non-joint venture groundfish fisheries were severely set back with a 60% reduction in sablefish prices and by the bankruptcy of a major fish processor. A large domestic catcher-processor added significantly to the 1980 catch.

Total catch was 6,287 mt in 1980, 12% less than in 1979. Trawl landings were 4,195 mt, about the same as 1979, but catch by other gears, 2,092 mt, was 28% less than in 1979. Pacific cod and sablefish accounted for most of the non-joint venture catch.

f. International Pacific Halibut Commission

The 1980 halibut catch was 9,798 mt, 590 mt over the 9,208 mt catch limit. The catch in Area 2 was 3,946 mt, 272 mt below the 4,219 mt catch limit. The Canadian Area 2 catch was 2,449 mt, 318 mt below the 2,767 mt catch limit. The U.S. catch from Area 2 was 1,497 mt, 45 mt over the 1,452 mt catch limit.

The Area 3 catch was 5,534 mt, 998 mt over the 4,536 mt catch limit. Canadian vessels took 862 mt, 318 mt over the 544 mt allocated to them under the new protocol.

The Area 4 catch was 318 mt, 136 mt under the 454 mt catch limit.

A noteworthy feature of the 1980 halibut fishery was a sharp reduction in the average ex-vessel price paid for halibut from $2.13 in 1979 to $0.99 in 1980. Also, the 1980 fishing season in the U.S. part of Area 2 lasted only 10 days, compared with 23 days in 1979. Similarly, the length of the fishing season in Area 3 was only 20 days, compared with 32 days in 1979. These short fishing seasons are attributed to increased fishing capacity of the fleets in those areas and in Area 3 to an increase in the catch per unit of effort.

Area 3 posed another problem when at the end of the first fishing period only 318 mt remained to be taken out of the 4,536 mt quota. Based on the number and size of vessels expected to participate, the Commission decided that 4 fishing days would be required to take the catch limit.

The Area 3 fleet actually took 1,179 mt, nearly four times as much catch as the Commission expected. This overage resulted from far more vessels entering the fishery than the Commission expected and an exceptionally high catch per unit of effort in the Area.

The fleet requested that the regulations be modified so Area 4 would open 10 days after the final closure in Area 3 instead of the 20 days specified in the regulations. The Commission agreed to this modification and the change was approved by both governments. Based on the number and size of vessels participating in the Area 4 summer fishing, the Commission decided that 23 days of fishing would be needed to take the catch limit and the closure on August 23 was announced. Due to poor fishing the catch reached only 318 mt. By the time the total catch was known, the season could not be extended.

Another dilemma that confronted the Commission during 1980 was the shortfall in the Canadian catch in Area 2. In part this was due to the long closed period between the first and second fishing periods and to bad weather encountered during the early and late fishing periods. In an effort to allow the Canadian fishermen to take the remainder of the quota, the Commission extended the Canadian fishing season by 10 days from October 27 to November 5, a change which was quickly approved by the two governments. Unfortunately, the vessels encountered severe storms during the extended period and the catch amounted to less than 45 mt. This resulted in severe hardship for some of the vessels who, after incurring large outfitting bills, were unable to fish during the 10-day opening.

Nearly all of the Area 3 catch during the 1980 halibut fishing season came from grounds between Cape Spencer and the south end of Kodiak Island. The lack of biological information from the grounds west of Kodiak Island posed a serious problem to IPHC in assessing the condition

of the resource. The Commission chartered two vessels for research fishing in western Area 3 and the resulting information has been helpful in assessing the condition of the resource.

2. Recreational fisheries

a. Canada

The catch of groundfish by recreational fishermen was not available.

b. United States

The catch of groundfish by recreational fishermen was estimated at 4,881 mt, most of which was taken off California (3,000 mt). The Oregon and Washington catch was 481 mt and approximately 1,400 mt respectively. The primary species of the recreational fishery was rockfish.

B. Joint fishing ventures

1. Canada

The 1980 British Columbia hake cooperative fishery involved the utilization of Canadian midwater trawl vessels which delivered their catch to foreign processing ships. Thirteen Canadian trawlers participated in the fishery, catching 12,215 t of hake and 995 mt of other, by caught species during August-October 15, 1980. They delivered to three Polish vessels, four USSR vessels, and one Greek vessel.

2. United States

U.S.-U.S.S.R. and U.S.-Korea joint ventures operated in the Bering Sea in 1980. Target species were pollock, Pacific cod, yellowfin sole, and Atka mackerel. The 1980 catch was 10,652 mt of pollock, 8,456 mt of Pacific cod, 9,623 mt of yellowfin sole, and 264 mt of Atka mackerel. This catch was taken by 7 catcher vessels delivering to U.S.S.R. processors and 5-6 vessels delivering to Korean processors.

The same companies also fished in the Gulf of Alaska where they targetted on pollock (1,135 mt) and Pacific cod (465 mt).

In the Washington-California region, U.S.-U.S.S.R. and U.S.-Poland joint ventures fished for Pacific hake and took 26,553 mt and 984 mt respectively. Sixteen U.S. vessels fished for U.S.S.R. processors and one fished for a Polish processor.

C. Foreign Fisheries

1. Canada

A foreign fishery for hake took place in 1980 involving four Japanese vessels, seven Polish vessels, and two from the U.S.S.R. The total foreign national catch of hake was 5,351 t.

An exploratory squid fishery took place in July-August 1980, with two Japanese longliners fishing off the west coast of Vancouver Island. The total squid catch was 132 t. In return, these Japanese boats were alloted a 200 t quota of sablefish, of which they caught 199 t.

2. United States

Foreign fisheries operated in the U.S. Fishing Conservation Zone (FCZ) in 1980 from California to the Bering Sea. Total catch by all foreign nations was 1,349,339 mt.

Japan, Republic of Korea, Poland, Taiwan, U.S.S.R. and West Germany all fished in the Bering Sea primarily for pollock (1,006,129 mt), Pacific cod (37,319 mt), Atka mackerel (20,224 mt), yellowfin sole (77,768 mt), and a variety of other flounders (88,529 mt). Pollock catches were up slightly in 1980 from 1979, but all other catches were down, especially yellowfin sole which was down by 23%.

In the Gulf of Alaska, fleets from Japan, Republic of Korea, Poland, and the U.S.S.R. fished mainly for pollock (112,996 mt), Pacific

cod (34,243 mt), Atka mackerel (13,162 mt), Pacific ocean perch (12,446 mt), and flounders (15,496 mt) (Table 1). Catches of all species were slightly greater than in 1979.

In the Washington-California region, only Poland fished for Pacific hake, as the U.S.S.R. was excluded. The foreign hake (whiting) catch was 44,023 mt (Table 1), a 62% reduction from the 1979 catch, and 76,000 mt under the final TALFF.

D. Canada-United States Groundfish Management and Regulations

1. Canada

A license limitation program for the sablefish trap and longline fishery was announced in 1980 whereby only vessels with a previous history of substantial landings during the period January 1, 1978 to October 5, 1979, or with substantial expenditures towards gear and equipment during the same time period, would be licensed to take part in the sablefish fishery after February 1, 1981. This has limited the present fleet to 41 vessels. Again with sablefish, a size limit was in place of 55 cm in fork length, or 39 cm as measured from the origin of the dorsal to the fork of the tail. The need to include a second measurement was due to the various cuts employed in dressing the fish for either the domestic markets or the Japanese markets.

For 1980, the Pacific coast groundfish management plan proved effective in its use as a guide to fishermen and industry for the harvesting of groundfish and an information source as to the concerns over the present status of the traditional species of groundfish (Pacific cod, lingcod and flatfishes). The plan included the use of annual quotas on declining stocks and time-area closures to regulate the fishery and during the year the following measures were applied:

In-season closures during 1980 included Area 3C for the protection of Pacific cod, Areas 3C, 3D and 4B for the protection of lingcod, the western portion of Hecate Strait (5C) for rock sole, and principal fishing locations off the west coast of the Queen Charlotte Islands (5E) for all trawling to protect Pacific ocean perch.

2. United States

a. Preliminary Management Plans

Two preliminary management plans (PMP's) were in effect governing foreign fishing in the northeastern Pacific Ocean during 1980, for the Sablefish Fishery of the Eastern Bering Sea and Northeastern Pacific and the Trawl Fisheries of Washington, Oregon, and California. The sablefish PMP established a 7,000 mt total allowable catch (TAC) off the west coast and identified no surplus for foreign allocation.

The trawl fishery PMP, implemented in 1977 and amended in 1978-80, set a 1980 hake TAC of 175,000 mt, of which 20,000 mt was initially held for domestic use, 35,000 mt held as a reserve, and the remaining 120,000 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%.

b. Washington

During February 1981, the following changes to commercial groundfish regulations became effective:

--The percentage of Pacific ocean perch allowed per vessel trip was reduced from 25 to 10 percent of the total landing weight.

--Trawlers will be allowed to use 3-inch mesh, instead of 4-inch mesh in net codends during March 1-April 15 in the Gulf of Georgia pollock fishery, but must discard sole under 12 inches in length when using 3-inch mesh.

--The current closed season of December 1-March 31 for lingcod in northern Puget Sound was extended to April 14.

--Hood Canal was opened to set line and pot gears during the winter (December-March).

--Testing of commercial line gears will be allowed in trawl testing areas.

--Several time-area changes were made to Puget Sound set net regulations.

During April 1981, permanent regulations were established for bag limits and fishery restrictions off the Seattle Public Fishing Pier.

c. Oregon

Continued concern over escalating demand for and catch of Pacific ocean perch in 1980 resulted in PFMC action, creating a task force to assess the status of POP stocks and recommend management measures to the PFMC. Using the findings of the POP Task Force, PFMC recommended that a rebuilding of stocks be attempted and that a 10,000 lb (4.5 mt) or 10% of catch trip limit be imposed on draggers to achieve this goal. Since Pacific Coast Groundfish FMP has not been implemented, the states of Washington and Oregon followed the recommendations of the PFMC and implemented such a limit effective January 1, 1981.

The PFMC's Groundfish Plan regulations will affect Oregon's regulation recommendations. Most likely subjects of change due to FMP implementation, will be mesh size of trawl gear, area-time closures for sablefish fisheries, other regulations on sablefish fixed gear, and adjustments in definitions of trawl gear, all to effect compatibility and/or enforceability between ODFW and Federal FCZ regulations. A catch quota of 17,500 mt of widow rockfish has been proposed by the PFMC. By-catch limitations on shrimp trawl catches are proposed to be 1,500 lb per day, effective

at the time the groundfish FMP is implemented (scheduled for early 1982).

d. California

There were no regulation changes made in 1980.

e. Alaska

No information was supplied.

E. International Fishery Agreements

1. Canada

A reciprocal fishing agreement, which extended 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, continued through 1980. The agreement expired March 31, 1981 and beyond that time there were no reciprocal fishing privileges for groundfish in 1981.

By mutual agreement, the International Pacific Halibut Commission continued to manage the halibut resource, although the national fisheries in 1981 will be conducted independently.

2. United States

The reciprocal fishing agreement with Canada expired March 31, 1981.

VIII. Groundfish Research

A. Stock Assessments

1. Pacific cod

a. Canada

Mr. Westrheim reported that Pacific cod stock assessments and results differed among the four cod-producing regions of British Columbia--Hecate Strait, Queen Charlotte Sound, S.W. Vancouver Island, and Georgia Strait.

In Hecate Strait (Areas 5C & 5D), which produces the most Pacific cod, a rather sophisticated stock assessment is underway because of the

relatively good time series for landing statistics and age composition (based on length-frequencies). Compilation of data is now complete, and a number of analytical models will be employed. Meanwhile, landing records and year-class mortality rates ($\bar{Z}$) suggest that fishing effort may now be sufficient to produce recruitment overfishing.

In Queen Charlotte Sound (Areas 5A & 5B), only Canadian data are currently available, and the Canadian portion of the total production was minor prior to 1976. However, Canada-U.S. landings exhibit no trend for the last 24 years, and total fishing effort (extrapolated from Canadian data) has been declining over the last 5-6 years. There is no evidence of overfishing.

Off southwest Vancouver Island (Area 3C), a winter closure has been in effect since 1978, hopefully to prevent recruitment overfishing while Pacific cod are at a low level in their cyclic abundance. As with Queen Charlotte Sound, sophisticated analyses await receipt of U.S. landing statistics. Adverse environmental conditions (warm water during spawning season) may be preventing an increase in cod abundance.

In Area 4B (Georgia Strait and vicinity), no detailed analyses have been undertaken, but all-area landings continue to fluctuate without trend. There has been a shift in location of production. Nanoose Bay production has declined steadily, but production has increased in minor Area 18 (Gulf Islands) and 19 (Juan de Fuca Strait).

b. United States

Mr. Tagart stated Washington Department of Fisheries has abandoned use of bony structures for age determination of cod.

2. Rockfish

a. Canada

Mr. Westrheim reported on Canadian stock assessment of Pacific

ocean perch and noted the contrasting assessments and regulatory measures employed for the four principal stocks--West Queen Charlotte Islands; South Hecate Strait; Queen Charlotte Sound; and southwest Vancouver Island.

Off West Queen Charlotte Islands (Area 5E), the stock lying north of 54°N. lat. is severely depleted, and a small quota is imposed. South of 54°N. lat., the exploited stock consists almost entirely of fish older than age 20. No juvenile or young adult fish have been located. A modest quota and area-time closures have permitted selected harvesting of Pacific ocean perch and yellowmouth rockfish (also commercially abundant).

In South Hecate Strait (Area 5C), a fishery began in 1980 on a moderate-sized Pacific ocean perch stock "discovered" and mapped in 1973, and assessed for biomass in 1974 and 1978, by PBS staff. The stock is probably the last unfished stock of Pacific ocean perch in the Pacific Ocean. Management policy will be conservative, in light of the overfishing which occurred in all other areas of the Pacific Ocean. A small quota has been imposed for 1981, pending results of a biomass survey conducted in June 1981. At least 20% of the marketable stock is older than 20 yr.

In Queen Charlotte Sound, Pacific ocean perch stocks are moderately overfished. A sophisticated analysis is underway to develop, if possible, a rehabilitation strategy. A fairly good data base is available.

Off southwest Vancouver Island (Area 3C), the Pacific ocean perch stock is severely depleted, but rehabilitation has been temporarily deferred in order to test various stock parameters. Recommendation to management is to permit moderate overfishing (assuming M = 0.05, and biomass = 6,000 t) for three years. Biomass estimates will be undertaken at the beginning and end of the period, and landings will be monitored for size and age composition.

b. United States

Shelf rockfish -- Shelf rockfish resources present a special assessment problem due to the very contagious distribution of schools and the extremely variable availability of those schools. The NMFS and the University of Washington (NMFS contract) have recently been evaluating sampling designs for trawl/hydroacoustic assessment methods. Designs have ranged from high density standard area-swept bottom trawl surveys to line intercept-line transect methods.

Two shelf rockfish study areas were incorporated into the 1980 NMFS west coast survey; one between Cape Blanco and Cape Perpetua, Oregon and the other between the Columbia River and Point Grenville, Washington. Tracklines were 3 miles apart with 2-8 stations located along each trackline depending on its length. Analyses are not complete, but preliminary results indicate that even sampling of that intensity may be inadequate. Replicate sampling was achieved in a portion of the Washington study area with a two-week interval between surveys and resulting biomass estimates differed by a factor of 16.0 for yellowtail rockfish and a factor of 3.3 for canary rockfish. These differences are too great to be explained as a result of normal sampling error and likely reflect a change in availability between surveys. Such variability in availability emphasizes the need to pursue accommodating design modifications.

The U. of W. has completed a second year of evaluating line transect and line intercept methods of assessing shelf rockfish. Detection of yellowtail and canary rockfish has been difficult and consequently, most work has been conducted on widow rockfish. Both methods employ sector-scanning sonar as well as echo-integration systems and both show promise as assessment tools, especially for species such as widow rockfish which

present readily identifiable acoustic targets. This study will continue through October 1981, when a final report is due.

Widow rockfish -- Line transect methodology was used by NMFS to study the distribution and abundance of widow rockfish on 4 major "grounds" between Newport and Cape Blanco, Oregon during April 1981. Bottom trawls were made in a systematic fashion around one "ground" to determine if widow rockfish, which form dense aggregations in midwater, disperse over the bottom at times during the day or night. Trawl results were similar to those from an identical survey conducted in 1980 and indicate that dispersion over the bottom does not occur. Widow rockfish usually occur in dense, vertically oriented schools over reefs or sharp breaks in the seabed (i.e. the edge of the continental shelf). They are most noticeable during the late-night hours, but are observed during the day, often high in the water column and over deep water. Such schools are usually segregated, easily identifiable, and inhabit definable areas. These characteristics all suggest that the species would be a good candidate for a comprehensive hydroacoustic assessment program.

The year long program of rockfish assessment on Hecata Bank was successfully completed by Oregon Department of Fish and Wildlife in January 1981. Field work consisted of echosounding over predetermined tracklines, combined with on-bottom trawl hauls and some midwater trawl hauls. Objectives of the project were to examine factors effecting abundance and distribution of selected rockfish species and attempt abundance estimation, using electronic aids correlated with fish signs observed. The species of primary concern was canary rockfish.

The survey on Hecata Bank fell short of outlining an acceptable methodology for stock assessment surveys of rockfish species. However, by

examining one fishery ground over an entire year, some insight has been given to the problems associated with present survey methodology.

Accurate survey methodology for canary rockfish cannot rely solely upon expansion of trawl catches. Catches were often low, not because fish were not present in the survey area, but because they remained over untrawlable bottom terrain. Catch rates changed dramatically as schools of fish occasionally moved to trawlable areas. The fishing expertise of the skipper and familiarity with the grounds were also extremely important in determining catch. These short term changes in availability of canary rockfish appeared to be more prevalent than long term seasonal fluctuations in availability. The environmental parameters measured could explain only a small portion of the variability in fish abundance and distribution.

The electronic fish locating gear used for this survey was unable to provide quantitative measures of rockfish abundance for the survey area. A rough index of abundance was established from chart recordings for each transect and trawl haul. These acoustic abundance estimates of tows were significantly correlated to the actual catch rate for the same tow. However, they explained only 25 to 28 percent of the variability in the canary rockfish and total rockfish catch rate. More sophisticated electronic aids may provide better resolution. However, accurate abundance estimates using electronic equipment may remain difficult for species such as canary rockfish. These fish were often found scattered on the bottom and mixed with other small fish and/or feed that also registered on the chart recordings.

Washington Department of Fisheries evaluated rockfish species composition sampling by time/area/depth strata. A report is forthcoming.

Mr. Jow announced that ecological studies of inshore rockfish continues, including taggings of several species in California.

3. Sablefish

a. Canada

Prior to 1980, stock assessments and predicted MSYs were based on the 1968-79 Japanese longline fishery. General production modeling of catch and CPUE for this fishery resulted in a recommended quota of 3,500 t for the Canadian zone. The complete changeover from the foreign longline fishery to a domestic trap fishery has resulted in discontinuity of the data base that has created a problem in assessment of sablefish stocks, based on catch and effort statistics. The absence of an adequate time series of age composition data precludes a more comprehensive stock assessment at this time. There is no evidence of strong positive or negative trends in stock size from the available data. The observed strong 1977 year-class may create a situation of high abundance upon full recruitment. However, the stock should not necessarily be fished heavily because of its presence.

b. United States

The National Marine Fisheries Service will again fish index sites of Southeast Alaska, Washington, Oregon, and California.

4. Flatfish

a. Canada

Mr. Westrheim reported that most flatfish stocks were considered to be in satisfactory condition. Single exception seems to be rock sole in Hecate Strait. An area-time closure and landing limit, both suggested by industry, were imposed in 1981 as an experiment, subject to review in December 1981, with the option of continuing the regulations in 1982.

b. United States

Work on flatfish was limited to fishery monitoring.

5. Whiting (hake)

a. Canada

The domestic Pacific whiting fishery in the Strait of Georgia began in 1979. Commercial fishery statistics and results from hydroacoustic surveys conducted in 1979 indicate stocks are large and capable of sustaining a commercial fishery. From preliminary estimates of virgin biomass (B_0), MSY based on Gulland's (1970) formula (MSY = 0.5 x M x B_0) ranged from 10,000 to 38,000 t. However, studies of the biology and abundance of Pacific whiting using ichthyoplankton, hydroacoustic and swept-volume techniques, are currently in progress in the Strait of Georgia. Biomass estimates from these methods are needed to increase the confidence in estimates of MSY.

Commercial offshore stocks migrate from the U.S. into the Canadian zone. There is good evidence to indicate the timing in and out of the Canadian zone is variable, but it does appear that a commercial fishery of 4-6 mos could be sustained annually. Biological studies in 1979 indicate larger whiting of any particular year-class undergo more extensive migrations and tend to migrate into the Canadian zone. The predominance of females in the population and the presence in general of larger members of any cohort in the Canadian zone, suggest tha extent of migration is size dependent. The effect of over-harvesting of older and predominantly female fish on recruitment is unknown. However, older individuals within a population may be needed to sustain recruitment during periods of unfavorable environmental conditions. The size of the Pacific whiting stocks and the allowable catch are presently determined by U.S. scientists. The quota of 35,000 t in the Canadian zone is established, based on the U.S. biomass estimate and an estimate of the proportion of Pacific whiting that move into the Canadian zone.

b. United States

The Pacific whiting resource can be characterized in a number of

ways. On one hand, two relatively strong year-classes, 1970 and 1973, which have been major contributors to the population in recent years, are much less so in 1981. It is estimated that those two year-classes contributed 68% of the biomass in 1977, 65% in 1978, 48% in 1979, and well below 40% in 1980. The diminishing contribution of these year-classes is also reflected in Polish CPUE which decreased from 37 mt/vessel day on the grounds in 1978 to 28 mt/vessel day on the grounds in 1980. In addition, 1981 egg and larvae surveys conducted by the NMFS Southwest Fisheries Center produced preliminary results which indicate that the size of the 1981 hake spawning population was smaller than average and that spawning occurred mainly off southern California over a significantly smaller area than in most years. These indicators all suggest a decreasing adult population during the past 2 years. On the other hand, the estimated biomass has increased from 1.2 million mt in 1977 to over 1.5 million mt in 1980. This apparent increase is largely due to a strong 1977 year-class. An unusual proportion (46%) of the total biomass was found in the INPFC Monterey area and it was comprised mainly of 3-year old fish. While the 1980 survey did not produce unusual catches of young-of-the-year whiting, commercial groundfish and shrimp fishermen reported an extraordinary abundance of 8-12 cm fish off northern California. The annual California Department of Fish and Game anchovy survey conducted during late 1980-early 1981 resulted in the highest incidence young-of-the-year and yearling whiting in catches that has ever been observed. Finally, the Soviet research vessel Poseidon just recently completed some trawling off central California and reported large quantities of 1-year-old hake in that region. These signs all point toward a strong 1980 year-class.

In summary, as two strong year-classes leave the population, one and perhaps two new relatively large year-classes are entering the population.

The large 1977 year-class will be partially recruited to the fishery in 1981, and should the 1980 year-class prove to be large, it should make notable contributions to the population in 1984-85. The Pacific whiting stock appears to be healthy with a promise of good commercial production for the next several years. The 1981 amendment to the Preliminary Management Plan for the Washington, Oregon, and California Trawl Fisheries established a TAC of 175,000 mt which is consistent with the Pacific Fishery Management Council's OY for Pacific whiting.

6. Dogfish

a. Canada

The assessment of dogfish stocks in the Canadian zone is based on a discrete-time, deterministic 'age-structure' model incorporating information on growth and reproduction (Wood et al. 1978). An estimate of marketable biomass was in the order of 120,000-150,000 t. Because of the unique biological features of dogfish, an estimated MSY of only 8,000-10,000 t was obtained. Presently it is not possible to assess the impact of the recently intensified longline fishery in the Strait of Georgia because of an absence of an adequate time series of data. However, there was not substantial change in CPUEs between 1979 and 1980.

b. United States

There are no stock assessments ongoing. Fishery monitoring continues in the Puget Sound set net fishery.

7. Pollock

a. Canada

The pollock fishery in Canada began to expand in 1976, when midwater trawls came into general use and favourable markets were found for the fillets and roe. Landings were so low prior to 1976 that no stock assessment was conducted before then. Research into the biology of pollock

off Canada began in 1974, on unexploited or lightly exploited stocks, but no time series of catch and effort or other abundance information was available to employ modeling approaches.

Much effort was spent developing the fin ray method of ageing. Catch curve analysis indicates a high rate of natural mortality (M = 0.6), and variable recruitment. Growth in length was found to vary among locations: the largest-growing pollock were found in Queen Charlotte Sound, and the smallest in the Strait of Georgia. Pollock in Dixon Entrance grew to intermediate sizes. Age at first spawning occurs at age 5 where the growth curves begin to flatten (growth rate decreases). Age of entry to the fishery coincides with age at first spawning because juveniles do not school with adults and are not presently valued by the industry. These results are in general agreement with results obtained elsewhere by the otolith and scale methods, but no ageing method has been properly validated for pollock and a close comparison of the three methods has not been conducted.

Spawning was found to occur in the midwater in the strait of Georgia, Dixon Entrance, and inlets on the east coast of the Queen Charlotte Islands, during March-April. Ichthyoplankton surveys have mapped the distribution of eggs in the Strait of Georgia and Dixon Entrance. Other areas have not been explored.

A study of parasites in pollock showed significant separation between stocks north and south of the north end of Vancouver Island. Further study by this method of the relationship between pollock in the Strait of Georgia and offshore in 3C is in progress. Growth curve analysis, length frequencies, hydroacoustic surveys and the discovery of spawning grounds throughout the coast indicate that several biologically discrete stocks are present, but important stock identity problems in the trans-boundary fisheries on the Alaskan and Washington borders have not been solved.

Preliminary estimates of unexploited abundance were made by hydroacoustic, swept-volume and ichthyoplankton survey techniques for the major fisheries. These estimates of B_0 were used along with natural mortality (M) estimates to predict MSY from Gulland's formula ($MSY = 0.5MB_0$), on which TACs were based. Subsequent stock assessments utilized space-time patterns in age composition to modify the recommended TACs. For example, five years of age data for Dixon Entrance (5D) showed very low recruitment in 1978 and 1979 relative to the recruitments which resulted in abundant large adults for the 1976-78 fishery. The TAC, which had been calculated from estimates of B_0 made in 1978, was lowered because it was not known whether current low abundance is closer to the long term average for the region. Another example: age sampling in the Strait of Georgia (4B) showed that the Canada-U.S. roe fishery off Point Roberts in the south end of the Strait exploits older pollock (on average) than the Canadian roe fishery further north in the Strait. Current analysis of the 1980 combined hydroacoustic, swept-volume and ichthyoplankton survey results is directed at determining whether the earlier (1975-76) biomass estimates were accurate, and whether the separation of age groups requires a new management strategy, since older females are more fecund per individual than younger females.

b. United States

The state of Washington continues to work with Canada on management of Pollock in Washington area 28 and Canadian area 18.

8. International Pacific Halibut Commission

Assessment of halibut stocks in 1980 was based on a variety of techniques and relied on several sources of data. CPUE, catch, and age composition data from the setline fishery were used, as well as results from IPHC surveys and estimates of incidental catches from other fisheries.

The IPHC staff is continually attempting to upgrade the assessment of stocks by using new methods as they are developed. The new techniques will improve our understanding of the halibut resource, although they still depend on accurate data and knowledge of the fish and the fishery. Obviously, estimates of stock condition vary somewhat depending on the technique and source of data being used, and the staff may have overemphasized the variability and differences among various estimates when presenting stock assessment results. Although opinions may vary on the interpretation or validity of a particular analysis, there is little disagreement on the general condition and management needs of the resource.

In general, the results indicate an increase in abundance in Area 3 and little change in abundance in Area 2. Information on the Bering Sea stocks is limited, but does not indicate any major change.

Abundance of Adult Halibut

In Area 2, abundance has been relatively stable since the early 1970's. The estimates of biomass averaged about 100 million pounds in 1980, well below the 200 million pound peak level of the 1950's. CPUE in the commercial fishery increased in the late 1970's, but the increase appears to be due to a higher availability of fish, not necessarily greater abundance. IPHC's adult halibut survey in Hecate Strait indicated a slight increase in abundance in 1980, but overall the trend has been relatively level since the surveys began in 1976.

In Area 3, abundance has increased since the early 1970's. The estimates of biomass in 1980 averaged about 113,400 mt, and were generally higher than the biomass estimated for the early and mid-1970's (about 90,720 mt), but well below the peak level of the 1950's and 1960's (158,759-204,119 mt). CPUE of the commercial fishery increased sharply in 1979 and 1980. However, one analysis suggests that most of the increase was due to

higher availability of fish rather than higher abundance. Conversely, availability may have been below normal during the mid-1970's, making stock abundance appear lower than it was. IPHC's adult halibut survey indicates modest increase in abundance since the mid-1970's.

Data from the commercial fishery continues to indicate a low abundance of adult halibut in the Bering Sea.

Equilibrium Yield

Equilibrium yield is difficult to predict because it depends on many factors which are constantly changing. In our best judgement, EY is about 10 million pounds in Area 2, 9,072 mt in Area 3, and between 454 and 907 mt in the Bering Sea. The equilibrium yields are calculated directly from our estimates of biomass. For example, stocks in Area 3 are increasing at a rate of about 3,629 mt a year at a time when the setline catch has been about 5,443 mt. The 3,629 mt increase added to the present 5,443 mt harvest means that 9,072 mt could be taken in Area 3 without reducing stocks. However, a 9,072 mt harvest in Area 3 would not allow for any further increase in stocks. Also, negative factors such as poor survival of young, or incidental catches by other fisheries also are operating and could reduce the equilibrium yield available to the fishery.

Juvenile Halibut

The estimated number of juvenile halibut has been relatively stable in recent years, but data from IPHC's juvenile surveys and from the commercial fishery indicate that juvenile abundance has increased. The survey data show that the catch of juveniles in the Gulf of Alaska was the highest in any year since the survey began in 1963, and well above the low recorded in 1976. Catches in the Bering Sea were the highest since 1966.

In the commercial fishery, the CPUE of fish less than 10 years of age has increased in both Areas 2 and 3 since the mid-1970's, although the increase may be partly due to availability rather than abundance.

Incidental Catches

The most recent estimates of incidental catch are about 3,447 mt in the Bering Sea and 4,990 mt in Areas 2 and 3 combined. The highest catch occurs in the foreign trawl fisheries, followed closely by the domestic crab fisheries. The total incidental catch for all areas is nearly as high as the directed catch by the setline fishery. Although the total incidental catch has declined moderately from the peak level of the 1960's and early 1970's, the proportion of the total removals attributed to incidental catches has increased.

9. Lingcod

a. Canada

In the Strait of Georgia lingcod are harvested mainly by the commercial handline and troll fisheries and the recreational fisheries including spear (SCUBA) fishing methods. Presently the impact of recreational fishermen on stocks is unknown but preliminary results of a sports fishing creel census indicates removals may equal that of the commercial fisheries. Landings by commercial handline/troll methods have declined a pronounced 70% between the 1951-62 and 1975-80 periods despite relatively high prices paid per pound to fishermen for lingcod during most years. Recent evidence indicates stock condition has deteriorated. Since 1979 the existing December 1-March 1 all gear fishing closure was extended to cover the November 15-April 15 period. This was considered necessary to provide greater protection during the reproductive phase in order to ensure a higher survival rate during the egg stage and to reduce the catch at a period of high vulnerability to exploitation.

Offshore lingcod stocks have undergone marked fluctuations in abundance during 1954-80 as a result of periodic surges in recruitment. These surges have occurred more frequently in the southern portion of the Canadian zone. Presently, lingcod stocks in all areas appear to be at low levels of abundance. A winter fishing closure similar to that recommended for the Strait of Georgia was recommended for waters off the west coast of Vancouver Island.

10. Multi-species considerations

Mr. Westhreim reported that the methodology to derive species specific effort in a multi-species fishery is undergoing a critical review. Errors of 100% were observed when effort was assigned at a threshold level.

Mr. Tagart reported that rockfish species composition sampling by Washington Department of Fisheries has undergone a critical review. Catch of rockfish estimated by species composition sampling was shown to be highly variable.

B. Related Studies

1. Tagging Studies and Techniques

a. Canada

By the end of a cruise currently underway Canada will have tagged nearly 100,000 sablefish.

b. United States

The National Marine Fisheries Service will continue to tag sablefish during the index fishing in 1981. Alaska is also tagging sablefish.

California continues to tag inshore rockfish.

Oregon continues to receive English sole tagged in 1977 and lingcod tagged in 1978. Most lingcod recoveries still come from the area of tagging. Inshore-offshore exchange has still not occurred to any significant degree.

2. Hake Stock Assessment and Joint Management

A discussion ensued about joint management of whiting stocks. Mr. Dark proposed that the TSC consider a workshop to discuss assessment and management, particularly in view of increased domestic use of this stock by joint venture fisheries.

3. Joint Research

Age determinations were again discussed, particularly with regard to validation studies. Work performed by Canada has cast doubt on some previous aging methodology.

4. Review of Recreational Fisheries

A brief discussion was held. Dr. Harville reported on the U.S. national marine recreational survey. A preliminary report is due soon.

5. Other

Mr. Demory reported on an analysis of CPUE. Analysis indicates that CPUE has very wide variability, especially for rockfish. It was urged by Mr. Demory that the use of CPUE be critically reviewed by member agencies.

C. Cooperative Research with Other Nations

NMFS recently completed joint research with the USSR on the southern California egg and larval survey.

IX. Progress on 1980 Recommendations

A. The Technical Subcommittee

Mr. Cass reported that a report on the lingcod workshop is under preparation. The workshop was highly successful.

X. 1981 Technical Subcommittee Recommendation s

A. Technical Subcommittee

1. The TSC recommends that each participating agency provide an update of its tagging inventory, covering the last 10 years

(since 1970), including the following information: (1) species tagged, (2) location of release-PMFC area, (3) date tagged, (4) type of tag, (5) tag number series and total tagged fish released, and (6) the name of a contact person for further information.

2. The TSC recommends formation of a working group to identify points of agreement, review areas of disagreement and review potential impacts of alternative management strategies on the status of the western Vancouver Island stock of Pacific ocean perch. Mr. J. Tagart was recommended as lead person with Mr. B. Leaman representing Canada and one person (unnamed) from Oregon Department of Fish and Wildlife. The working group is to meet in January or February 1982. A report is to be prepared by the 23rd annual meeting of the TSC.

B. Parent Committee

1. In view of increased domestic interest in both Canada and the U.S. in more complete utilization of the Pacific whiting resource and an agreed increasing need for consideration of approaches to joint management, the TSC recommends that the Parent Committee support a Pacific whiting workshop to be held at the NWAFC, Seattle during early 1982. The purpose of the workshop would be to convene U.S. and Canadian scientists/managers engaged in Pacific whiting research and management to consolidate and review the results of recent studies and to consider a range of viable joint management schemes.

XI. Other Business

The forthcoming Western Groundfish Conference at Salishan, Oregon in November 1981 was discussed. IGC members discussed scheduling the annual IGC meeting with this worthwhile meeting to reduce members' travel expenses.

XII. Schedule of Future Meetings

The 1982 meeting will be held in Washington during the second or third week of June. Mr. Tagart will suggest a meeting site at a later time.

The IGC will meet on November 17 at Salishan, Oregon.

XIII. Adjournment

The TSC expressed gratitude to Mr. Robinson for his efforts in arranging the meeting and choice of location.

The meeting was adjourned at 1400 hrs. on June 11, 1981.

APPENDIX A

AGENDA

for the

22nd ANNUAL MEETING OF THE

TECHNICAL SUBCOMMITTEE OF THE

INTERNATIONAL GROUNDFISH COMMITTEE

Bend, Oregon

June 10-11, 1981

I. Call to Order

II. Appointment of Secretary

III. Approval of Agenda

IV. Introductions

V. Terms of Reference of the Subcommittee

VI. Review of Agency Groundfish Programs

A. Recent and Anticipated Studies

B. Publications

VII. Review of Northeast Pacific Groundfish Fisheries

A. Canada-U.S. Fisheries in 1980

1. Commercial Fisheries: Notable changes since 1979

i. landing trends

ii. resource trends

iii. market trends

2. Recreational Fisheries

B. Joint Fishing Ventures

(Dark; Cass)

C. Foreign Fisheries

(Dark; Cass)

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

Changes since 1979 or changes under consideration

1. United States

2. Canada

E. International Fishery Agreements

1. Canada-U.S.

2. International Pacific Halibut Commission

3. Others

VIII. Groundfish Research

A. Stock Assessments

1. Pacific Cod (Westrheim, Tagart)
2. Rockfish (Westrheim, Dark)
3. Sablefish (Cass, Dark)
4. Flatfish
5. Hake (Thompson, Dark)
6. Dogfish (Westrheim)
7. Pollock (Thompson)
8. Pacific Halibut (Hoag)
9. Lingcod (Cass)
10. Other (i.e. multi-species considerations, Westrheim)

B. Related Studies

1. Tagging Studies and Techniques

2. Hake stock assessment and joint management

3. Suggestions for joint research

4. Review of recreational fisheries

5. Other (any suggestions)

C. Cooperative Research with Other Nations

IX. Progress on 1980 Recommendations

A. The Technical Subcommittee

1. Lingcod workshop

B. Parent Committee

X. 1981 Technical Subcommittee Recommendations

A. Technical Subcommittee

B. Parent Committee

XI. Other Business

XII. Schedule of Future Meetings

XIII. Adjournment

APPENDIX B

Distribution of the Report of the Technical Subcommittee

Technical Subcommittee

Canada:	A. Cass		
	J. Thompson		
	J. Westrheim		5
United States:			
	NMFS	T. Dark	3
	California	T. Jow	2
	Oregon	J. Robinson	2
	Washington	J. Tagart	2
	Alaska	P. Rigby	2

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, W. Hublou - Oregon	2
	A. Milliken - Washington	2
International Pacific Halibut Commission - S. Hoag		1
Spare Copies		5
		41

REPORT OF THE

TECHNICAL SUBCOMMITTEE OF THE

CANADA-UNITED STATES GROUNDFISH COMMITTEE

Appointed by

The Second Conference on Coordination

of Fisheries Regulations Between

Canada and the United States

Twenty-second Annual Meeting

June 10-11, 1981

Bend, Oregon

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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 10-11, 1981

Place: Bend, Oregon

Participants:

Canada

Fisheries and Oceans Canada	Mr. A. Cass (Chairman) Mr. J. Thompson Mr. J. Westrheim Mr. R. Wowchuk, I.G.C. (Observer)

United States

California Department of Fish and Game	Mr. T. Jow
Oregon Department of Fish and Wildlife	Mr. R. Demory Mr. J. Robinson
Washington Department of Fisheries	Mr. J. Tagart
Alaska Department of Fish and Game	Mr. J. Blackburn Mr. P. Rigby
National Marine Fisheries Service	Mr. J. Balsiger Mr. T. Dark
Pacific Marine Fisheries Commission	Dr. J. Harville, I.G.C. (Observer)
International Pacific Halibut Commission	Mr. S. Hoag (Observer)

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I. Call to Order

The 22nd annual meeting of the Technical Subcommittee was called to order at 0910 June 10, 1981 by Chairman Mr. A. Cass under instructions set forth by the Parent Committee in 1959.

II. Appointment of Secretary

Mr. R. Demory, Oregon Department of Fish and Wildlife, was appointed recording secretary.

III. Approval of Agenda

The tentative agenda circulated by Chairman Cass 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 of this report.

IV. Introductions

Each participant introduced himself and stated his affiliation.

V. Terms of Reference of the Subcommittee

In November 1978 the Parent Committee recommended to their respective governments new terms of reference which would join the Parent Committee and the Technical Subcommittee into a single committee. A request was also made to change the name from the International Groundfish Committee to the Canada-U.S. Groundfish Committee. Approval of the name change is pending but the new terms of reference, approved in 1981, are listed below:

a. exchange information on the status of groundfish stocks of mutual concern and to coordinate, whenever possible, desirable programs of research;

b. recommend the continuance and further development of research programs having potential value as scientific basis for future management of the groundfish fishery;

c. review the scientific and technical impacts of existing or proposed management strategies and their component regulations relevant to conservation of stocks or other scientific aspects of groundfish conservation and management of mutual interest;

d. transmit approved recommendations and appropriate documentation to appropriate sectors of Canadian and U.S. governments and encourage implementation of those recommendations:

VI. Review of Agency Groundfish Programs

A. Recent and anticipated studies

1. Canada

Research by the Groundfish Program at the Pacific Biological Station continued its orientation to resource assessment and analysis of factors controlling dynamics of exploited stocks. Segregation of research efforts into various investigations remained as in previous years. Emphasis on biomass surveys was lower than in past, as research attention was directed toward establishment of some longer-term projects. In addition, activity was intensified in the area of analytical methods development. Summaries of investigation activities follow.

Flatfish research during 1980 concentrated on a survey of juvenile flatfish in Hecate Strait. This survey was the first in a series that will be used in forecasting recruitment of rock and English soles. Fishery reviews included: reconstruction of stock histories; growth studies; mortality and recruitment estimation; and construction of yield isopleths. In addition, surplus production models were used to update biological and fisheries parameters for rock sole and Dover sole in the 5C-5E areas.

Other activities involved the processing of tag recoveries to resolve stock boundaries of Dover sole in northern Hecate Strait and a cooperative survey of arrowtooth flounder biomass in Hecate Strait with the survey design/species interaction group.

A species interaction group was formed during 1980 to address the potential linkages among stocks of different groundfish species, as well as the impacts of groundfish species on associated resources such as juvenile salmonids and clupeids. In particular, the impacts of strong cohorts of sablefish and spiny dogfish on migrating juvenile salmonids or schools of juvenile herring in coastal waters received attention. Stomach contents of juvenile sablefish from Queen Charlotte Sound and Hecate Strait were examined as well as contents of some dogfish stomachs in Area 4B. Results indicate that juvenile sablefish may be active predators on juvenile herring at specific times of the year. Dogfish stomachs from fish taken incidental to the commercial salmon gillnet fishery in Area 4B did not evidence predation on salmonids, although the number of specimens examined was small.

This group also assisted in the design and execution of surveys of juvenile flatfish and arrowtooth flounder.

An intensive sampling of hake and pollock eggs and larvae in Area 4B was continued during 1980. Sampling extended from mid-January to late June and used Bongo samplers and MARMAP procedures. This project is aimed primarily at evaluating the feasibility of using ichthyoplankton survey techniques to estimate total egg production and hence spawning stock biomass, via fecundity and population structure considerations. Secondary objectives include estimation of egg to larval survival, short-term growth, and distribution dynamics over time. In the laboratory, fecundity estimates for these pollock and hake (Pacific whiting) stocks were obtained and fertilized eggs raised 15 days beyond hatching. Information was also obtained on morphogenesis, developmental dependence on temperature and some aspects of larval behavior.

An ichthyoplankton survey of the outer continental shelf off British Columbia was conducted during late winter and early spring. Localized concentrations of sablefish eggs and larvae were found over the outer continental slope. Spawning was estimated to occur from January-March with peak abundance of eggs occurring in February. Sablefish eggs appear to hatch in deep water (>300 m). The limited number of halibut eggs and larvae encountered endorse survey results by the IPHC from the 1930's.

Field research on rockfishes during 1980 concentrated on the development and application of methodology for successfully tagging trawl-caught rockfishes. Tagging of these species is especially critical to the validation of recent ageing techniques and delineation of stocks in the U.S.-Canada southern boundary area.

Techniques employed included: rapid anaesthesis of fish; treatment for barotraumatic effects of capture, consisting of swim bladder deflation; injection with oxytetracycline; holding in recovery tanks; and information collection on categories of injuries for released fish. Over 9,500 fish were successfully tagged and released. Capture depths ranged from 55-130 m and success was higher with fish caught using midwater trawls. Approximately 95% of the released fish were *sebastes flavidus*. Oxytetracycline is a calcium-specific agent used to provide a time mark on otoliths at time of tagging; recoveries will permit validation of ageing techniques.

Mortality incurred in the tagging operation was partitioned into pre-tagging mortality, immediate or traumatic tagging mortality and short-term mortality, as determined through overnight holding experiments. Pre-tagging mortality averaged 5.0% (0-13%); traumatic tagging mortality averaged 1.8% (0-4%); and overnight mortality averaged 4.3% (0-9.6%).

APPENDIX B

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APPENDIX C

List of Reports Published by Member Agencies for the Period May 1, 1980-April 30, 1981

Canada - Department of Fisheries and Oceans

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