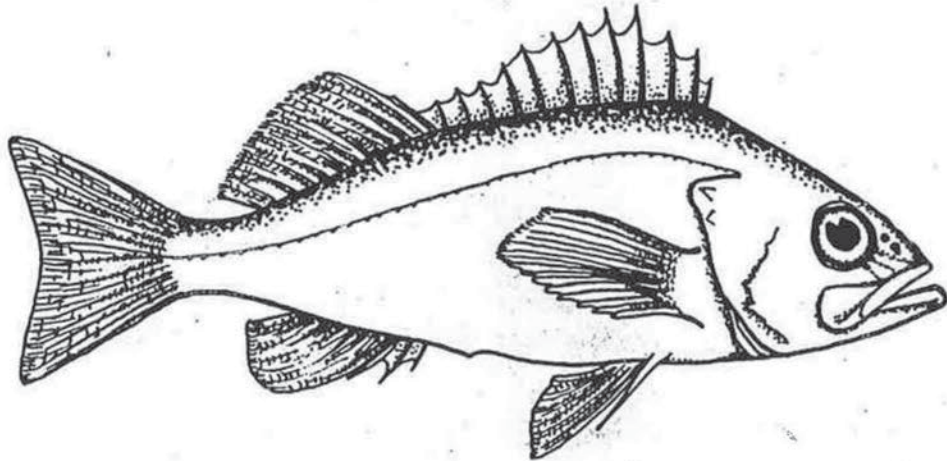


NORTHWEST FISHERIES CENTER
PROCESSED REPORT
MAY 1976

PROCEEDINGS OF THE
1st ROCKFISH SURVEY WORKSHOP
JANUARY 20-22, 1976



PREPARED BY DONALD GUNDERSON, Rapporteur



Prepared by:
Northwest Fisheries Center
National Marine Fisheries Service
2725 Montlake Boulevard E.
Seattle, Washington 98112

NOTICE

This document is being made available in .PDF format for the convenience of users; however, the accuracy and correctness of the document can only be certified as was presented in the original hard copy format.

Inaccuracies in the OCR scanning process may influence text searches of the .PDF file. Light or faded ink in the original document may also affect the quality of the scanned document.

Proceedings of the
1ST ROCKFISH SURVEY WORKSHOP

Held during January 20-22
at the Northwest Fisheries Center
Seattle, Washington

Prepared by Don Gunderson, Rapporteur

ROCKFISH SURVEY WORKSHOP

Rationale

Recent changes in the structure of fisheries management responsibilities have made it obvious that detailed information on stock abundance and potential yield of commercially important species will be required from U.S. and Canadian management agencies in the near future. Current reliance on catch and CPUE information from commercial fisheries has opened up a wide variety of questions on sources of bias in such data, particularly in multispecies trawl fisheries.

Nowhere is the problem more acute than with the Pacific rockfishes. This group was once a dominant part of the demersal fish community from the Bering Sea to California, but foreign fishing activities during the 1960's reduced its biomass substantially in most of these areas. Relatively detailed information and analysis is available for S. alutus (one of the dominant species in this group), and suggests that stock sizes have declined 50-60 percent from virgin stock levels throughout its range. Despite this, disagreements over the interpretation of CPUE information have thwarted many international groups in their attempts to reach agreement on the status of these stocks.

As one proceeds south from Dixon Entrance, more and more species are involved in the rockfish community, and the problem becomes even more acute. Here landings of rockfish species other than Pacific ocean perch are reported and analyzed in the aggregate, and it isn't possible to examine effort or CPUE information for a single species. Exploitation of the "other rockfish" group has been on the rise in recent years, making it imperative that some information on biomass, stock condition, and potential yield be forthcoming.

The need for a detailed survey of Pacific Coast rockfish resources has been recognized by a wide variety of managers, negotiators, and administrators, and

as a consequence the Northwest Fisheries Center (NMFS) convened a workshop to discuss the problems that must be faced in implementing such a survey.

A broad spectrum of fisheries biologists, statisticians, managers, and administrators attended the sessions, including representatives from Canadian Department of the Environment, NMFS (Washington, D.C., Southwest Fisheries Center, Northwest Fisheries Center), Pacific Marine Fisheries Commission (PMFC), each of the Pacific coastal states, and two universities (Appendix 1).

Results

General

The workshop was convened at 0900 on January 20, and the group welcomed by A. T. Pruter, Deputy Director of the NWFC, Pruter underscored the need to expand our current resource surveys on rockfish, and to coordinate our current efforts. John Harville of PMFC outlined the state/federal/international organizational structure of fisheries management activities and emphasized the timeliness of the workshop in view of the then-impending legislation on extended jurisdiction.

After introductions and agreement on the agenda, workshop moderator W. T. Pereyra reviewed the history and status of Pacific ocean perch fisheries in the Bering Sea and northeast Pacific, and the "other rockfish" complex in the northeast Pacific. H. A. Larkins outlined the quotas and fisheries agreements that currently apply to Pacific rockfish, and pointed out that, in addition to facilitating establishment of quotas or other fisheries regulations, rockfish surveys may allow managers to delineate regions of high rockfish concentration and avoid conflicts with foreign hake fisheries.

With this background in mind, each individual agency then outlined its current research plans and capabilities regarding rockfish surveys during 1976-78.

National Marine Fisheries Service.---The Northwest Fisheries Center has recently allocated \$250,000-400,000 for rockfish surveys during 1976-78. Additional increases are possible, associated with the recently enacted extended jurisdiction legislation. A large groundfish assessment group exists at the Center, and a six-man staff has recently been set up to specialize in pelagic resource assessment and hydroacoustic system development. The pelagic assessment group will be intimately involved in the surveys since a substantial portion of the rockfish community is found in midwater, where they are unavailable to bottom trawls. Several research vessels are available for rockfish surveys, including the John N. Cobb, Oregon, and possibly the Miller Freeman. The Center's recreational fishing group will be addressing itself to stock assessment in inshore coastal areas, although current work is concentrated in Puget Sound.

The NWFC, in cooperation with other agencies, plans to undertake a pilot survey during July to September of 1976, to assess the problems, precision, and accuracy to be expected from rockfish surveys. Results of the survey will be utilized to determine a long-term rockfish survey methodology. This work is projected to take place in Queen Charlotte Sound, B.C., and in the region off Monterey Bay, California.

The Southwest Fisheries Center will be conducting work on stock assessment and community relationships for inshore and mid-depth rockfish species. Sampling of California partyboats for species and age composition of the catch will be carried out jointly with the California Department of Fish and Game. SWFC also conducts work on the identification of rockfish larvae with a view toward future use of ichthyoplankton surveys for estimating recruitment and spawning biomass. The David Starr Jordan will participate in the 1977 synoptic survey for approximately one month, and is equipped for deep-water trawling. Some personnel will also be available for the surveys and ichthyologists from the

California Academy of Sciences have indicated an interest in participating in the cruises.

Canadian Department of the Environment.--The Fisheries and Marine Service has carried out extensive resource surveys for rockfish in the past, and will continue to monitor the status of Pacific ocean perch stocks. This will probably involve field work every three to four years. The G. B. Reed and Arctic Harvester will both be available for this work, and the latter vessel has been designed with midwater trawling in mind.

Alaska Department of Fish and Game.--A new groundfish program has been initiated, providing the salary for one biologist. The program will concentrate on sampling groundfish landings made by domestic trawlers landing at Alaskan ports.

Washington State Department of Fisheries.--A rockfish stock assessment program has been supported for several years, with most of the current work focused on obtaining detailed catch statistics and sampling rockfish catches for species composition and biological characteristics. The Department recently hired a biologist-acoustician, and, although most of his work is focused on Puget Sound, he will be devoting some time to offshore rockfish surveys, along with other Department biologists.^{1/}

Oregon Department of Fish and Wildlife.--Past assessment work has been directed toward flatfish, the most important group in Oregon trawl landings. These surveys will be continued through the summer of 1976, and some effort will be committed toward evaluating incidental rockfish catches during the surveys. Upon completion of the 1976 surveys, flatfish surveys will be de-emphasized, and more emphasis placed on resource surveys of rockfish.

^{1/} The Washington Department of Fisheries currently plans to conduct gear calibration studies during the pilot study in Queen Charlotte Sound, and to participate in other phases of the survey.

California Department of Fish and Game.--The primary emphasis has been on obtaining catch data and biological information from commercial and recreational fisheries. Analyses of data from inshore gill-net surveys of rockfish stocks is in progress. No trawl surveys are planned. The N. B. Scofield is being retired this year; the Alaska may be available for surveys, although it is not as suitable for trawling as is the Scofield. The Department might not be able to participate with personnel in rockfish surveys in 1976 due to heavy work commitments. However, background information respecting California stocks and fishing areas can be provided.

Pacific Marine Fisheries Commission.--The primary contribution of this agency would be in facilitating coordination of rockfish surveys (e.g., providing funds for interstate travel where necessary).

University of Washington/Oregon State University.--Considerable work is being carried out on inshore rockfish communities, the role of rockfish in marine food webs, community analysis and hydroacoustics. It is possible that the academic community could become involved in rockfish surveys and could provide some additional support in development of survey techniques or data analysis. They are also interested in carrying out independent studies which would support or supplement the rockfish survey itself.

Other.--It was pointed out that the Bureau of Land Management will be supporting research to assess the possible risk from oil and gas development in Pacific Northwest waters and that this work might include rockfish surveys. It is also possible that under extended jurisdiction the governments of USSR, Japan, or Poland^{2/} may be persuaded to provide some support for rockfish survey activities.

Several participants were interested primarily in surveys of inshore (less than 30 fm.) rockfish communities, and since the techniques employed in such

^{2/} Recently a meeting was held with Polish scientists at which time they offered the services of the 89-meter Professor Siedleki for several months during the summer of 1977.

surveys differ substantially from those used in offshore areas, it was agreed that the workshop be divided into inshore and offshore working groups. Prior to separating, however, the group agreed that the broad objectives of both inshore and offshore surveys should be:

- A. To estimate rockfish abundance and biomass, by species; and
- B. To describe the ecology of the key rockfish species--
 - (1) stock identification,
 - (2) seasonal distribution and abundance, and
 - (3) age composition and growth of individual species.

The second objective was considered necessary for mapping out the stock distribution and interrelationships for which no "map" currently exists, and in determining the causes behind variations in biomass. Without this information, there is no way of differentiating whether changes in biomass are being brought on by variations in seasonal abundance, fishing mortality, or recruitment.

These objectives in mind, the workshop then broke up into inshore and offshore working groups.

Inshore Working Group

This group addressed itself to the problem of surveying rockfish stocks inside 30 fms., and began by dividing the coast into the following geographic categories: Dixon Entrance North, Dixon Entrance to Cape Blanco, Cape Blanco to Pt. Conception, and Pt. Conception South. Each area has unique characteristics, differing widely in the extent and nature of protected waters (inside passages in southeastern Alaska, Puget Sound, and San Francisco Bay).

Active sport fisheries already exist in the region south of Dixon Entrance, and in certain areas it is possible to use catch data from these fisheries to assess the population. Sampling these catches would provide information on

species composition and age distribution, and tagging studies might be instituted to study migrations and movements.

Any abundance estimates derived in this manner would apply only to those species vulnerable to hook and line fishing, however, and it was concluded that other survey techniques should be used concurrently. There are certain common habitat types throughout the region under consideration, and survey techniques must be tailored to each habitat type:

Habitat	Midwater trawl	Bottom trawl	In situ observations scuba/subm.	Trap	Hook and line	Beach seine	Set net	Hydro-acoustics
Reef-Deepwater	X		?	X	X		X	X
Slope-Soft		X		X	X	X	X	X
Slope-Rocky		X		X	X		X	X
Shelf, Canyon Dropoff	X		?		X			X
Kelp Bed			X		X		X	?

Because the survey techniques used would have to change from habitat to habitat, coast-wide systematic surveys of inshore areas are not feasible. The inshore working group consequently recommended an initial mapping of the entire inshore region of the Pacific coast by habitat type, followed by in-depth surveys of the rockfish community in each type.

It should be kept in mind that hook and line, trap, and set net surveys generate information on catch per unit effort and relative abundance. Some auxiliary work (e.g., tagging studies) would have to be carried out to arrive at population or biomass estimates.

The inshore working group also considered the feasibility of ichthyoplankton surveys. It was concluded that extensive background studies would have to be carried out on larval identification and adult fecundity of rockfish for

ichthyoplankton surveys to be effective. Information on recruitment mechanisms would also have to be forthcoming so a number of larvae in a given area could be related to the appropriate stock of adults.

Offshore Working Group

Survey design.--This group was concerned with surveying offshore rockfish populations in waters deeper than 30 fms. Discussion began by pooling current knowledge on offshore rockfish communities, and the following groups were considered to be most important:

- A. North of Dixon Entrance
 - 1. Sebastes alutus (Pacific ocean perch), 50-250 fms.
- B. Dixon Entrance to Cape Blanco
 - 1. S. alutus--trawlable bottom, 50-250 fms.
 - 2. S. proriger/S. reedi/S. zacentrus--rough bottom
 - 3. S. flavidus/S. pinniger/S. entomelas--largely pelagic, but dominates the demersal rockfish community at 50-100 fms.
 - 4. Sebastolobus--200-550 fms.
- C. Cape Blanco South
 - 1. S. pinniger/S. paucispinis/S. goodei--40-200 fms.
 - 2. Sebastolobus--200-550 fms.

For practical reasons, the Sebastolobus resource was not considered further, reducing the depth range to be examined to the 50-250 fm. zone. This depth range could probably be reduced still further in certain areas, however. In the area north of Dixon Entrance, for example, it may not be necessary to sample shallower than about 80 fms. since this area has no counterpart to the S. flavidus/S. pinniger/S. entomelas community found to the south. The intensity of sampling should be flexible enough to allow for variability in the abundance of rockfish, particularly in the 200-230 fm. zone.

The area of interest for this survey was defined as extending from Unimak Pass, Alaska, to the southern limit of the Santa Barbara Channel, the latter boundary being dictated primarily by the trawlability of the bottom. Availability of rockfish to on-bottom trawls is maximal during the summer off California, and during September in the Cape Blanco-Dixon Entrance region. All surveys should

consequently be designed to coincide with these periods.

Significant quantities of Pacific ocean perch are known to occur in mid-water regions where they are unavailable to on-bottom trawls, and there is reason to believe that some of the major species (e.g., S. flavidus) in the rockfish community may be primarily pelagic in their distribution. For this reason, it is necessary to couple hydroacoustic/midwater trawl surveys with bottom trawl surveys. Bottom trawling will be used to estimate the biomass present in the region within 1-4 meters of the bottom--the region where hydroacoustic estimates of abundance can't be made. The hydroacoustic/midwater trawl surveys will furnish the only available biomass estimates in those areas that aren't trawlable with on-bottom gear.

It was generally agreed that broad geographic coverage and the highest possible density of trawl stations and hydroacoustic tracklines were the most important factors to include in the survey design. Between-station (or trackline) variability is expected to dominate the other variance components of the survey, and the confidence interval around any final biomass estimate can best be reduced by sampling a large number of stations/tracklines.

Sampling should be stratified by depth, since rockfish species composition and abundance both vary with depth. Size composition and growth rates of Pacific ocean perch are also known to vary with depth, providing further justification for such a strategy. Considerable discussion focused around the type of survey design used within these depth strata, and the relative merits of three alternatives were considered. These were:

A. Systematic (stations every nth mile) tracklines perpendicular to the coastline, with random selection of starting point.

B. Systematic tracklines parallel to the coastline (along the depth contour), with random selection of starting point.

C. Stratified-random sampling.

Systematic designs are best for use in community analysis and studying species groupings but estimates of the variance around biomass estimates resulting from such designs are biased. Unbiased variance estimates are theoretically possible for randomized designs, but random selection of sampling stations frequently results in clumping, with poor coverage of the total survey area.

No consensus was reached as to which type of design was best, not surprising in view of the large number of participants and the diversity of their backgrounds and research objectives. In any event, it was agreed that considerable effort must be put into delineation of trawlable areas and areas of high rockfish abundance before finalizing the survey design. Information from commercial fishing operations and previous research/exploratory surveys will help in this regard, but no "maps" of abundance exist for many of the species to be dealt with. Haul length for the on-bottom survey will be determined primarily by convenience, and should be no longer than that required to obtain an adequate sample of fish (no more than one hour). Short tows seem to be best, since they allow a higher number of stations to be occupied, reduce the probability of damaging the gear, and increase the resolution of the tow for community analysis purposes.

Coordination of hydroacoustic/midwater trawl and on-bottom surveys presents something of a problem since the hydroacoustic vessel can rapidly outdistance the trawl survey vessel, and they can't be expected to operate side by side. Integration of acoustic and on-bottom surveys becomes unrealistic if an inordinate amount of time elapses between them, and it was suggested that no more than a week or two separate the two surveys. Attainment of this goal will be simplified somewhat by the fact that the hydroacoustic vessel must survey many areas that are too rough to be sampled by on-bottom trawls.

The primary goal of all midwater trawling will be to determine the species composition of the shoals censused by the hydroacoustic gear, and their

biological (size-sex-age) composition. For this reason, the location and intensity of midwater trawling will be determined at sea by the hydroacoustic/midwater trawl vessel(s).

Gear requirements.--Either conventional "Eastern" otter trawls or high opening ("Norwegian" or "Atlantic Western") trawls currently used by commercial fishermen should be employed for the on-bottom survey. In either case, 3-inch (internal measure) mesh should be used in the cod-end and intermediate portion of the trawl to minimize gilling of Pacific ocean perch. Roller gear must be attached to the footrope since the survey area contains a high proportion of rough bottom. Even with roller gear in use, many areas will still prove to be untrawlable. It was suggested that the string of roller gear be made up in five sections for quick replacement when portions of the string are damaged.

Trawl doors, dandylines (mud lines), vessel horsepower and tonnage should be carefully standardized for the on-bottom survey, and if possible the fishing characteristics of each unit of gear employed should be monitored by a trawl mensuration system. Joint comparative tows must be made if these parameters differ significantly.

The net employed for midwater trawling should have a large (approximately 2,000 sq. ft.) mouth opening with large mesh (≥ 20 in.) forward and small mesh (≤ 1.5 in.) in the codend. This net should also be furnished with netsounder equipment so that its fishing depth and effectiveness can be monitored continuously. Previous midwater trawling for Pacific ocean perch has shown that high towing speeds must be attained, and the vessel employed for midwater trawling must be powerful enough to tow the trawl at 4.0 knots (at a depth of 200 fms.).

The hydroacoustic data collection and processing system currently used by the NWFC was described by M. O. Nelson. Few participants were hydroacousticians,

and discussion of this topic was quite limited. The NWFC system consists of a 4-foot towed body that houses dual beam transducers, as well as depth, pitch, and roll sensors. Nominal towing depth and speed are 12 fm. and 9 knots. Signal processing equipment is housed in a 20x10x8.5 foot van, and is capable of either surface or bottom-locked echo integration/density estimation by depth interval, and of obtaining target strength measurements for individual fish. The system is capable of operating down to 250 fm.

Determining age composition.--Length data can be collected quite rapidly and in large quantities at sea, while collection of otoliths requires considerably more time. Once ashore, a further expenditure of manpower and time is necessary to obtain reliable age determinations from the otoliths. The traditional solution to this problem has been to use age-length keys from a limited collection of otolith samples to convert length composition to age composition. However, it is known that the age-length relation for some rockfish species varies substantially with depth and time, and the workshop participants were divided as to the utility of age-length keys for rockfish work. Randomized collection of age structures will probably be required on early rockfish surveys until the bias and error introduced by using age-length keys are better understood. It was suggested that a small working group discuss the techniques and intensity of sampling the catch for age composition in greater detail prior to finalizing survey plans.

Age determination (from otoliths) will present another problem for several species. Studies with Pacific ocean perch have shown that it is important to spend considerable time exploring the validity and accuracy of rockfish aging techniques, and at present this has only been done for a few species. Special efforts will have to be made to develop valid aging criteria for several of the more common species along the coast, including S. pinniger, S. goodei, and S. paucispinis. To help attain this goal, otoliths should be collected over the entire size spectrum of these species, and attempts should

be made to locate and collect juvenile rockfish (usually found in regions inshore of the proposed survey area).

Implementation.--The working group agreed that a two-phase approach should be taken to surveying offshore rockfish stocks, with a pilot study in 1976 and full-scale synoptic surveys in 1977. It was agreed that two study areas should be examined during the pilot surveys--Queen Charlotte Sound, B.C., and the region off Monterey Bay, California. Examination of catch statistics for the Queen Charlotte Sound-California region shows that these are the two most important areas of rockfish production, and the dominant types of rockfish community that might be expected in offshore surveys are well represented in these areas.

A backlog of commercial catch statistics and resource survey data is available from Queen Charlotte Sound and Monterey Bay, and forthcoming survey results can be compared with them. These data will also prove useful in determining suitable sites for on-bottom sampling.

Both hydroacoustic/midwater and on-bottom surveys should be carried out during the pilot study, with the following principal objectives:

A. Determine species and biological (size-age-sex) composition of on-bottom (trawlable areas only) and midwater trawl catches (both trawlable and untrawlable areas) of rockfish.

B. Obtain information on spatial distribution, schooling characteristics, and diel behavior of midwater aggregations of the principal rockfish species inhabiting the survey areas.

C. Obtain baseline information on the intensity of midwater trawling required for species identification.

D. Examine problems in integrating results of on-bottom and hydroacoustic surveys.

E. Estimate the biomass of selected rockfish species in the survey areas.

F. Evaluate the precision and accuracy of these biomass estimates.

G. Examine ecological relationships within the rockfish community.

Inter-Agency Cooperation on Surveys

Prior to adjournment, the workshop participants discussed the possibility of different agencies taking on specific geographic subdivisions of the coast during the 1977 synoptic offshore survey. Several agencies (NMFS, CDE, ADF&G, WDF, ODF&W, and CF&G) expressed some interest in this approach, provided adequate funding could be arranged. It was agreed that all parties involved in these surveys will need a common reporting system and a common data format.

The Canadian Department of the Environment welcomed the interest of the NWFC in a pilot survey of Queen Charlotte Sound, and will request the use of one of their vessels to participate in this effort. The Washington State Department of Fisheries and SWFC will definitely be able to provide some manpower during the pilot survey, and students from OSU will also participate.

The workshop was formally adjourned at 1500 on January 22. A spirit of cooperation and openness characterized the entire workshop, and it is only through the continuation of this spirit that a survey of the scope proposed can be effective. A broad spectrum of expertise exists along the Pacific coast, and future cooperation will be imperative if this expertise is to be properly utilized.

Appendix 1

COOPERATIVE ROCKFISH SURVEY WORKSHOP--LIST OF PARTICIPANTS

Abramson, Norman	NMFS, Southwest Fisheries Center, Tiburon, California
Alton, Miles	NMFS, Northwest Fisheries Center, Seattle, Washington
Burgner, R. L.	Fisheries Research Institute, Univ. of Washington
Carlson, Tom	Fisheries Research Institute, Univ. of Washington
Dark, Tom	NMFS, Northwest Fisheries Center, Seattle
Demory, Bob	Oregon Dept. of Fish & Wildlife, Newport
Fraidenburg, Mike	Washington Dept. of Fisheries, Seattle
Fredd, Lou	Oregon Dept. of Fish & Wildlife
Gunderson, Don	NMFS, Northwest Fisheries Center, Seattle
Harville, John P.	Pacific Marine Fisheries Commission
Jow, Tom	California Dept. of Fish and Game
Kato, Sus	NMFS, Southwest Fisheries Center, Tiburon
Kimura, Dan	Washington Dept. of Fisheries, Seattle
Larkins, Bert	NMFS, Northwest Fisheries Center, Seattle
Low, Loh Lee	NMFS, Northwest Fisheries Center, Seattle
Mason, Jim	NMFS, Northwest Fisheries Center, Seattle
Meehan, Jim	NMFS/MARMAP, Washington, D.C.
Nelson, Marty	NMFS, Northwest Fisheries Center, Seattle
Newcome, Nikki	NMFS, Northwest Fisheries Center, Seattle
Pereyra, Wally	NMFS, Northwest Fisheries Center, Seattle
Rigby, Phil	Alaska Dept. of Fish & Game
Robinson, Jack	Oregon Dept. of Fish & Wildlife, Newport
Roe, Dick	NMFS, Washington, D.C.
Simenstad, Charles	Fisheries Research Institute, Univ. of Washington
Six, Larry	Pacific Marine Fisheries Commission
Thorne, Dick	Fisheries Research Institute, Univ. of Washington
Traynor, Jim	NMFS, Northwest Fisheries Center, Seattle
Tyler, Al	Oregon State University, Newport
VanderWerff, Fred	NMFS, Northwest Fisheries Center, Seattle
Washington, Percy	NMFS, Northwest Fisheries Center, Seattle
Wathne, Fred	NMFS, Northwest Fisheries Center, Seattle
Westrheim, S. J.	Pacific Biological Station, Nanaimo, B.C.
Worlund, Don	NMFS, Northwest Fisheries Center, Seattle



Participants in the first Rockfish Survey Workshop included (front row, from left) Tom Jow, California Department of Fish and Game; Dr. W. T. Pereyra, Tom Dark, and Nikki Newcome, NWFC; (second row, from left) S. J. Westrheim, Canadian Department of Environment; Jim Meehan, NMFS/MARMAP; Dr. Loh Lee Low, NWFC; Tom Carlson, University of Washington; Martin Nelson and Don Worlund, NWFC; Dr. Daniel Kimura, Washington State Department of Fisheries; (third row, from left) Miles Alton, NWFC; Richard Roe, NMFS; Dr. Donald Gunderson and Jim Traynor, NWFC; Mike Fraidenburg, Washington State Department of Fisheries; Jim Mason, NWFC; Dr. Norman Abramson, SWFC; Dr. A. V. Tyler, Oregon State University; Fred Wathne, NWFC; Larry Six, Pacific Marine Fisheries Commission; Bob Demory, Oregon Department of Fish & Wildlife; Phil Rigby, Alaska Department of Fish & Game; and Lou Fredd, Oregon Department of Fish & Wildlife.