Predator-Prey Studies of the Shortbelly Rockfish
Offshore Sampling Problems

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Investigations of predator-prey relationships that have considered aspects of prey distribution and availability have, with few exceptions, been confined to well defined sites or areas where precise sampling and/or direct observations can be made. Most such studies have been conducted nearshore, where logistical problems are reduced and where direct observations are often feasible (e.g. Hobson 1968, 1974: Hobson and Chess 1976; Van Blaricom 1977; and Cailliet et al. 1979). Comparable investigations have dealt most often with organisms like flatfishes that live on the sea floor where methods for collecting benthic predators and prey species are relatively precise (e.g. Pearcy and Hancock 1978; Gabriel and Pearcy 1981). When offshore midwater sampling is required, problems arise which are not encountered in most nearshore or offshore benthic studies.

The variations in temporal and spatial distribution patterns of both predators and prey in this large three dimensional environment contribute to inconsistent sampling, especially of the predators. Furthermore, because of the dynamics of the water column and the patchy distribution of the plankton and planktivores, the interpretation of plankton samples that are intended to represent prey availability is often difficult, i.e. do the samples adequately reflect the actual prey items available to the predators.

Shortbelly Rockfish

The shortbelly rockfish, *Sebastes jordani*, is a large unfished resource in waters off California. During the past several years however, there has been a growing interest in the development of a fishery by fishermen and processors (Lenarz 1981).

A major portion of the shortbelly population occurs between latitude 36°56' and 37°21' (Gunderson and Sample 1980). In this area they appear to aggregate on the continental shelf and slope near submarine canyons or steep dropoffs at depths between 128 and 275 meters.

The shortbelly reaches maturity at about 16.5 cm and attains a maximum size of about 33 cm (Lenarz 1981), an appropriate-sized forage species for larger predators. This species is known to be an important item in the diet of king salmon off San Francisco (Merkel 1957).

Determining the value of shortbellies as a forage species for other large predators and understanding the dynamics of its own predatory activities is important before a large shortbelly fishery is established. It is unusual that the opportunity to study a commercially valuable species has arisen prior to its exploitation.

Objectives of the Study

Originally, the objectives in studying the trophic relationships of the shortbelly were to determine: a. its importance as a forage species, b. diel feeding patterns and prey selectivity, c. seasonal distribution and prey, d. depth/size relationships, and e. the variations in prey selectivity within various size classes.

All but the first, continue to be goals of the study. The collection of guts from the larger predatory fish from trawl samples proved unsatisfactory because of regurgitation of gut contents during trawl retrieval. So the role of shortbellies as a forage species is being considered in another segment of the overall program that samples these predators from sportfishing boats.

Study Areas

Beginning in the spring of 1979, when shiptime was offered by the Northwest Alaska Fisheries Center, attempts were made to locate specific sites where shortbellies aggregated. Our study of diel feeding patterns and prey availability is centered in an area of about 17 square kilometers on the shelf just west of Ascencion submarine canyon (37°00' N, 122°27' W). The bottom depths vary between about 120 and 200 meters. Our collections to determine size/depth distribution patterns and variations in prey selectivity with shortbelly size and depth are taken in an area less well defined near Pioneer Canyon (37°20' N, 23°00' W) where depths vary from about 120 to 275 meters.

Vessels

Twice during the first year of the study we used the NOAA ship Oregon. This vessel, however, was a trawler and not equipped to tow plankton nets. So no "prey samples" were obtained. It was well rigged and manned for trawling operations, though, and valuable data were gathered on distribution patterns of shortbellies. Also, during the first year we were able to use the NOAA ship Miller Freeman for 3 days. This ship had both trawling capabilities and elaborate acoustical fish monitoring equipment, in addition to standard oceanographic equipment. It enabled us to collect our first sample series of shortbellies and their prey. Since the fall of 1980 we have had the use of the NOAA ship David Starr Jordan on an approximate quarterly schedule. This ship, a well-equipped oceanographic vessel, had only limited trawling capabilities during the first three cruises. A recent refitting however, has dramatically increased its trawling capabilities, with improved net reel, door stanchions, hydroacoustic and navigational equipment.

Collecting Samples

We have determined from hydroacoustic tracings, that nearbottom daytime aggregations of shortbellies disperse up into the water column at night. To determine diel feeding patterns, gut samples are needed from both distribution modes, from periods immediately preceding daybreak and dark. Depth stratified plankton samples are also needed from midday and midnight periods to determine the diel distribution patterns of potential prey species.

A three-bridle midwater trawl with 100 ft headrope is used for collecting shortbellies for gut analysis and an opening/closing Tucker net with 1 m^2 effective opening is used for plankton collecting.

Sampling Problems

During this investigation the problems encountered center primarily around our inability to consistently collect adequate samples of shortbellies.

Locating shortbelly aggregations. To locate aggregations of shortbellies, hydroacoustic transects are made, usually in a zigzag or bathymetric pattern within the study area. Daytime shortbelly aggregations usually show a characteristic silhouette on sounder paper, being dense, round-topped and extending several to about 30 m from the bottom. Discrete nighttime aggregations are more difficult to identify. The shortbellies disperse into the water column, sometimes moving up as far as the lower portions of the near surface deepscattering layer, where they mix with other fish species that rise into the water column at night.

The acoustic resolution is variable with the different quality sounders on the various vessels, so the interpretation of target strength and shape and identifying them as shortbellies has often been a problem. A Simrad scientific sounder EK400 with high resolution has recently been installed aboard the Jordan and in the future should help us locate and identify fish aggregations. Scanning sonar helps considerably in locating fish aggregations but has been available to us only twice, once aboard the Miller Freeman and again aboard a chartered fishing vessel (Colintino Rose II).

Setting the trawl. If no acoustic targets are found prior to the sampling period, "blind" trawl sets are usually made at locations near where fish were previously found. As it has turned out, we have been just as successful in obtaining samples during these blind sets as when setting on acoustic targets. Reasons for missing targets have been one or a combination of the following: delays in setting due to deck gear problems, navigational limitations in returning to the target position, or fish movements and drift due to currents or wind.

With the recently installed plotter aboard the Jordan, our ability to return to specific targets has been greatly improved. The plotter is coupled with the Loran C navigational system and plots the track of the ship on paper, allowing return to any previously marked position.

The deck gear problems associated with trawl set delays have largely been solved by the recent installation of a split net reel, moving the net reel aft and constructing door stanchions.

Monitoring the trawl. Estimates of the trawl fishing depths were initially made by noting the presence or absence of benthic organisms. Adjustments to the trawl warp length were made in attempting to place the net just off the bottom. The warp length/depth ratios that developed were later modified by use of a time/depth recorder. But not until we were able to use a shipboard net monitoring system, with an acoustic link with the ship, were we able to observe the actual position of the trawl in relation to the bottom, surface and fish targets. This Furuno 200 net sonde has allowed us to more effectively fish the trawl and with a single exception (when about 25,000 lbs of shortbellies were collected during a 12 minute period), to monitor fish entering the trawl and thus limit trawling time in order to avoid unreasonably large samples. It also provides the opportunity to position the trawl, by varying warp length or ship speed to the depth of targets which are detected by the shipboard sounder.

Experience level of personnel. Another important factor contributing to our sample collecting limitations involves the lack of trawling experience of our biologists and technicians. Aboard the Oregon (a NOAA trawler) and the Colintino Rose II (a chartered fishing vessel) we usually had no problem catching shortbellies. Both of these ships were rigged and manned for fishing with experienced captains directing fishing operations. Aboard the Jordan, an oceanographic vessel, the cruise leader has that responsibility, and in our case, the cruise leaders have been relatively inexperienced, and have had difficulty in catching fish. Experience comes slowly when one fishes only 5 or 6 weeks per year. The problems considered in this report might seem naive to an experienced fisherman; however they have frustrated our field efforts significantly.

Conclusions

Most oceanographic vessels are poorly rigged for trawling operations. The specialized gear requirements for these operations are often incompatible with the ship design and refitting may be impractical as well as costly. The electronic equipment used in finding fish and monitoring trawls is costly and affording state-of-the-art instrumentation is out of the question for many scientific programs. However, to consistently collect fishes near bottom or in midwater with a trawl, a vessel that is properly designed and equipped for that purpose is required.

Perhaps equally important as the vessel and rigging is the presence of experienced personnel. In the shortbelly investigation, the presence of a qualified fisherman, hired to direct operations and to train the scientific participants early in the program, would surely have improved our successes and saved a great deal of valuable ship time.

The experiences gathered by all concerned with this shortbelly study as well as the recent modifications and equipment additions to the Jordan however, have improved our fishing successes.

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