Shortbelly Rockfish, *Sebastes jordani*: A Large Unfished Resource in Waters Off California

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Introduction

The shortbelly rockfish, *Sebastes jordani*, is one of the more distinctive members of the 57 species of rockfish (genus *Sebastes*) which are reported from California waters. The species obtains its common name from the fact that its vent is about midway between the origin of the anal fin and insertion of the pelvic fin, while the vent of other species of rockfish is located farther back, much closer to the origin of the anal fin. The shortbelly rockfish also has a more strongly incised tail and a more fusiform shape than most rockfish.

Moser et al. (1977) noted that larvae of shortbelly rockfish are the longest at birth of eastern Pacific rockfish studied to date. Also, the larval period is long prior to transformation to the juvenile stage when compared with other eastern Pacific rockfish. These features, in addition to the pigmentation pattern and morphometrics of young larvae, are remarkably similar to those of the redfish or ocean perch, *S. marinus*, group of the Atlantic Ocean.

Another distinction of adult shortbelly rockfish is that it occurs in midwater and away from underwater objects such as reefs or kelp more often than most, if not all, California representatives of the genus. Occasional catches have been made by purse seiners fishing in southern California waters, and the species predominated in midwater and demersal trawl catches of rockfish off central California in the 1977 rockfish survey (Gunderson and Sample, 1980).

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Shortbelly rockfish have been reported from San Benito Island, Baja California, Mexico (Moser et al., 1977) to La Perouse Bank, British Columbia (Miller and Lea, 1972). Miller and Lea also report maximum depth as 283 m (155 fathoms) and maximum total length as 305 mm (12 inches).

While there is no fishery for shortbelly rockfish, the species appears to be very abundant in California waters. Moser et al. (1977) estimated that larvae of shortbelly rockfish composed 20 percent of all rockfish larvae taken in a sampling program off southern California and 12 percent off central California in 1966. While the catch of shortbelly larvae compared with all rockfish larvae was higher off southern California than central California, the catch per standard haul was higher off central California (4.22 larvae) than southern California (2.65 larvae). The biomass in a limited area of its range, between Pt. Ano Nuevo and Pt. San Pedro, was estimated to be 295,000 metric tons (t) from the results of the hydroacoustic and midwater trawl segment of the rockfish survey) Mason[1]).

Preparation of this paper was prompted by the interest shown by both fishermen and processors in developing a fishery for shortbelly rockfish. The objectives of the paper are to summarize information on the species and: 1) Describe the biology of the species, 2) make first approximations of the reaction of the stock(s) to various levels of fishing, 3) review the rockfish survey results with regard to fishing, 4) review potential of a fishery, and 5) discuss management options for the fishery.

Biology

Larval and Juvenile Stages

Moser et al. (1977) summarized available information on larval and juvenile stages of shortbelly rockfish. The larvae are released at an average size of 5.4 mm by the ovoviviparous females between January and April. Larvae were collected between northern Baja California, Mexico, and as far north as San Francisco, Calif. Their samples were not taken north of San Francisco. While larvae were collected as far as 278 km (150 miles) offshore, all above-average catches were taken much closer to shore. They also reported that larvae metamorphose to juveniles at 27 mm and appear to begin forming schools at the surface at that time. Juveniles up to 62.8 mm have been taken by dip nets under night lights. On the other hand, specimens as small as 70 mm were taken by bottom trawling during the rockfish survey.

Growth

Shortbelly rockfish, while being one of the smaller species of rockfish, has the highest rate of growth completion (k) of 10 California species studied by Phillips (1964). The von Bertalanffy

ABSTRACT—Shortbelly rockfish, Sebastes jordani, *appear to be abundant in California waters and present the potential for development of a new large fishery in the area. This paper contains: 1) A description of the biology of the species, 2) first approximations of the effect of fishing on the stock, 3) a review of the rockfish survey results with regard to fishing, 4) a review of the potential for development of a fishery, and 5) a discussion of management options for the fishery.*

[1]Mason, J. E. 1978. Preliminary report on the hydroacoustic/midwater trawl survey for rockfish conducted off parts of the American and Canadian west coasts during July 12-September 30, 1977. Unpubl. manuscr., 6 p. Northwest and Alaska Fisheries Center, NMFS, NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

growth curve was used to describe growth:

$$L_t = L_\infty(1 - e^{-k(t - t_0)})$$

where L_t = total length (mm) at t,
t = age in years,
k = growth completion rate,
t_0 = theoretical age when fish is length 0,
and
L_∞ = estimate of average length attained at maximum age.

Phillips combined age-length data from both sexes and made his estimates from back-calculated lengths (estimates of length at time of formation of each annual ring on a scale) made from scale readings and measurements. He assumed that scales form at birth. My experience with several other species of rockfish indicates that scales form when the fish reach about 20 mm. Thus the back-calculations of Phillips probably slightly under-estimate lengths of young fish.

Additional data on growth are available from the rockfish survey. Otoliths from 1,081 specimens were read. Opaque zones of fast growth were just beginning to be formed at the time of sampling (midsummer). Phillips' back-calculations appear to be at the end of the growth season (midwinter). Thus fish from the rockfish survey should be 0.5 year older than those Phillips used. Phillips used total lengths, while fork lengths were measured for the rockfish survey. Total length is about 15 mm greater than fork length for shortbelly rockfish, and the survey data were adjusted accordingly. The program BGC2 (Abramson, 1971) was used to estimate parameters of the growth curve. The estimate of k for the survey data, 0.27721, is very close to the estimate by Phillips, 0.27520. The estimates of L_∞ are also close, 315 (Phillips) and 301 (survey). Comparison of the two growth curves (Fig. 1) reveals that the main differences occur at young ages. As previously mentioned, Phillips probably underestimated length of fish at young ages. Also mesh size of the nets used by the survey may have selected for relatively large fish at young ages. Phillips obtained fish from several sources and evaluation of selectivity is not possible. Data from the surveys (Fig. 2) indicated that females grow larger than males and attain maximum size at a slower rate of completion (lower k). Growth does not appear to be related to depth of capture, but there are insufficient data from the survey to arrive at conclusive results.

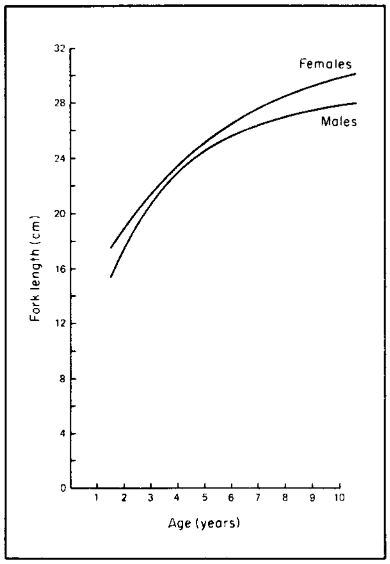

Figure 1.—Von Bertalanffy growth curves for *Sebastes jordani* estimated from this study and by Phillips (1964).

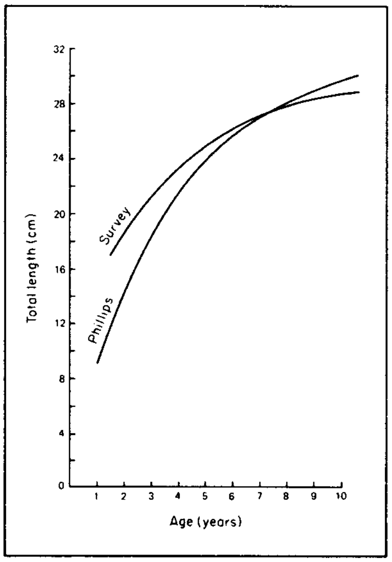

Figure 2.—Von Bertalanffy growth curves for female and male *Sebastes jordani*. L_∞ is 324 mm for females and 290 mm for males; k is 0.2112 for females and 0.2980 for males.

Length-Weight

The length-weight relationship was estimated by Phillips to be log $W = \alpha + \beta \log L$, where W = weight in pounds, L = total length (mm), $\alpha = -8.05202$, and $\beta = 3.1518$.

Maturation, Fecundity, and Sex Composition

Phillips (1964) reported that 50 percent of shortbelly rockfish " . . . are mature when 6½ inches [16.5 cm] long, or 3 years old." The fecundity-length relationship, estimated by me from Phillips' data on 10 specimens is $\ln F = \alpha + \beta \ln L$, where F = fecundity (numbers of eggs), L = total length (mm), $\alpha = -8.43523$, and $\beta = 3.30611$.

About 45 percent of the survey catches of shortbelly rockfish between 14 cm and 27 cm were males. Few of the fish larger than 27 cm were males.

Movements

While many aspects of the life history of shortbelly rockfish appear in the literature, nothing could be found on movements. Tagging studies on blue rockfish, *S. mystinus*, Miller and Geibel (1973); yellowtail rockfish, *S. flavidus*, Carlson and Haight (1972); copper rockfish, *S. caurinus*, Dewees (1970); and black-and-yellow rockfish, *S. chrysomelas*, and gopher rockfish, *S. carnatus*, Hallacher (1977) and Larson (1977) indicated little movement. However, these five species do not have strongly incised tails or fusiform bodies. These aspects of morphology would suggest that shortbelly rockfish are stronger swimmers and are better adapted to swim away from predators and/or make more extensive movements than the other five species (Hobson and Chess, 1978). Analyses of catch rates of Pacific ocean perch, *S.*

alutus, indicate considerable movement into relatively shallow waters during spring and summer and return to deeper water in the winter (Gunderson, 1972). Pacific ocean perch have more strongly indented tails and fusiform bodies than the five species that were tagged but less than shortbelly rockfish. Sorokin (1961) documented long (at least 1,112-km (600-mile)) migrations of stocks of redfish (or ocean perch), and deep-water redfish, *S. mentella*, in the Atlantic Ocean.

Data from bottom trawl catches of the rockfish survey indicate that shortbelly rockfish do make significant movements. Length and age samples were expanded to entire catches assuming that sampled fish were taken at random. Size of fish tends to increase with depth (Fig. 3). Size for a given depth stratum tends to increase in a northerly direction between lat. 34° and 39°N. Depth of capture of shortbelly rockfish also tends to increase in a northerly direction between lat. 35° and 39°N. The combined results of these trends is a very strong tendency for size to increase in a northerly direction between lat. 34° and 39°N (Fig. 4). While age composition data are not sufficient to separate effects of depth and latitude, age of shortbelly rockfish tends to increase as depth and latitude increase (Fig. 5). The age and length composition data from the rockfish survey indicate that at least during summer, shortbelly rockfish tend to move into deeper waters and to the north as they grow.

Data on larvae revealed areas of heavy spawning from Los Angeles to at least San Francisco during January 1966 and March 1975.[2] Very heavy spawning occurred off Monterey (lat. 37°N), Avila Beach (lat. 35°N), and Santa Barbara (lat. 34°N). Heaviest spawning occurred off Monterey. The heavy spawning from Los Angeles to at least San Francisco in the same month indicated that if shortbelly rockfish do tend to move north as they grow, they do not make long return migrations to the south in the winter to spawn.

[2]Unpublished data of H. G. Moser, Southwest Fisheries Center, NMFS, NOAA, P.O. Box 271, La Jolla, CA 92038. Pers. commun. 1978.

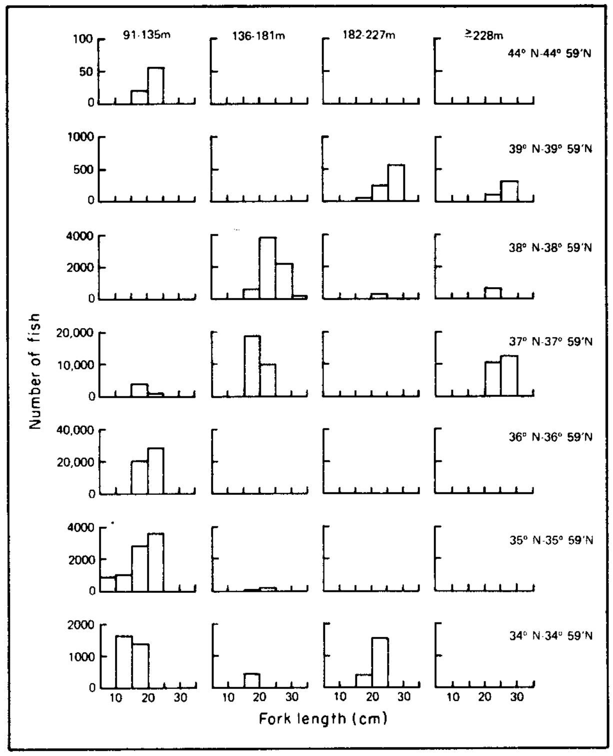

Figure 3.—Length composition of *Sebastes jordani* caught by bottom trawling during rockfish survey as a function of depth and latitude.

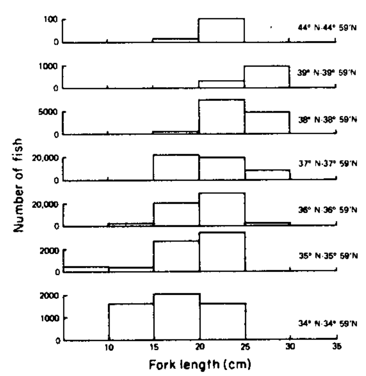

Figure 4.—Length composition of *Sebastes jordani* caught by bottom trawling during rockfish survey as a function of latitude.

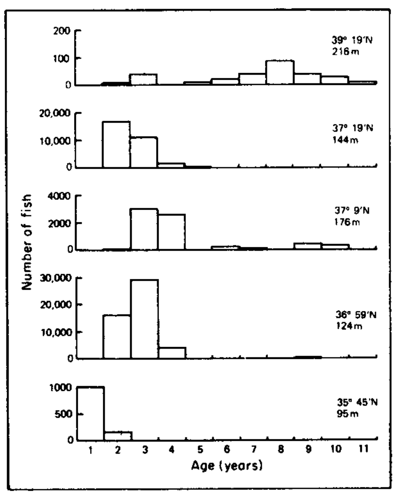

Figure 5.—Age composition of bottom trawl catches of *Sebastes jordani* during rockfish survey.

Relationships With Other Species

Shortbelly rockfish appear to be an important prey item in central and southern California. Merkel (1957) found that rockfish represented 22.5 percent of the food volume of chinook

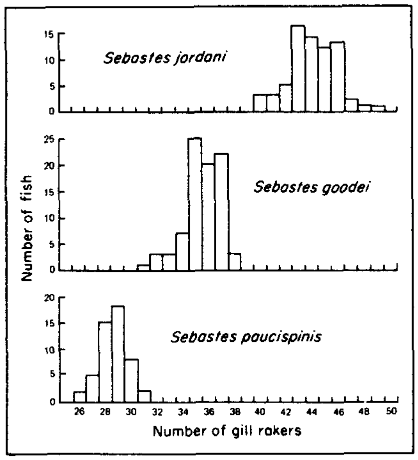

Figure 6.—Gill raker frequencies of *Sebastes jordani*, *S. goodei*, and *S. paucispinis*.

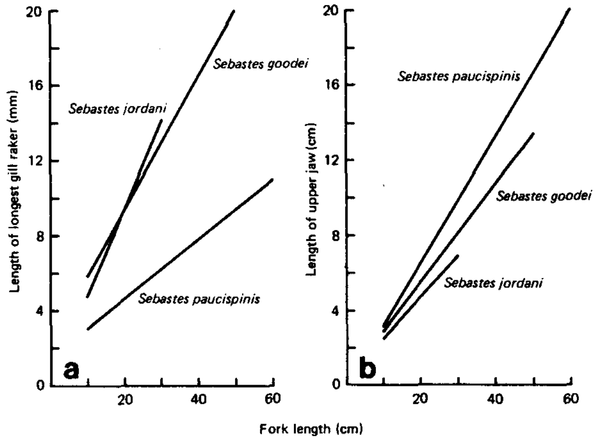

Figure 7.—Relationships between length of longest gill raker and fork length (a) and length of upper jaw and fork length (b) for *Sebastes jordani*, *S. goodei*, and *S. paucispinis*.

salmon, *Oncorhynchus tshawytscha*, off San Francisco between February and November. In June and July more than 50 percent of the food was rockfish, of which 70 percent was shortbelly rockfish. Few of the rockfish exceeded 89 mm (3.5 inches). Shortbelly rockfish less than 89 mm are probably in their first year of life. Of 78 fish sampled from pigeon guillemots, *Cephus columbia*, nesting on the Farallon Islands, two were shortbelly rockfish that were 59 and 83 mm in standard length (Follet and Ainley, 1976). Hubbs et al. (1970) reported that 4 otoliths of shortbelly rockfish were found in 498 otoliths sampled from western gull, *Larus occidentalis*, castings near San Diego. The fish were thought to have been stolen from Brandt's cormorant, *Phalacrocorax penicillatus*. Trawl-caught bocaccio, *S. paucispinis*, and chilipepper, *S. goodei*, are often seen with shortbelly rockfish protruding from their mouths, but these specimens may represent unnatural feeding within the trawl. A number of studies on food of fish, marine mammals, and birds found small rockfish to be important prey items, but did not identify the items to species. In summary, at times shortbelly rockfish can be an important prey item for chinook salmon and possibly other fish. They also compose yet undetermined portions of the diets of some birds. Only two studies reported the size of consumed shortbelly rockfish. In both cases small fish, probably less than 1 year old, predominated.

Shortbelly rockfish belong to a group of important rockfish that inhabit California waters between 50 and 125 fathoms (91 and 229 m) during adult life. The other two members are bocaccio and chilipepper, both of which are very important components of California rockfish landings. All three species are relatively fusiform and have deeply incised tails for rockfish.

Since the three species are often caught together and belong to the same genus, ecological theory requires that there be mechanisms that separate the species into different niches. Morphological features, measured following procedures of Phillips (1957), related to feeding differ considerably among the species. For example, there is almost no overlap in gill raker counts for the three species (Fig. 6). However, the relationship between length of the largest gill raker of the first arch and fork length is similar for chilipepper and shortbelly rockfish, but differs between these two species and bocaccio (Fig. 7a). There are considerable differences in the relative length of upper jaw among the species (Fig. 7b). The data presented in Figures 6 and 7 suggest that shortbelly rockfish consume the smallest organisms, probably plankton, of the three species and bocaccio consume the largest, probably fish. Phillips (1964) stated that the shortbelly rockfish " . . . feed exclusively on macroplanktonic organisms, primarily euphausids," while chilipepper " . . . may feed on euphausids and small squids, or on small fishes such as anchovies, young hake, *Merluccius productus*, and lanternfish," and bocaccio " . . . feed on smaller rockfishes, sablefish, *Anoplopoma fimbria*, anchovies, lantern-fish, and squids, *Loligo opalescens*."

A compilation of upper jaw length frequencies of the three species in rockfish survey tows containing shortbelly rockfish indicates little overlap (Fig. 8). Since young specimens of the larger species have jaw lengths of the same size as older specimens of the smaller species, the lack of overlap shown in Figure 8 suggests that the three species are distributed in a fashion that minimizes the possibility of competition for food.

First Approximation of Reaction of Species to Fishing

Yield per recruit calculations often are used to make first approximations of production of a stock under different fishing strategies. Estimates of growth

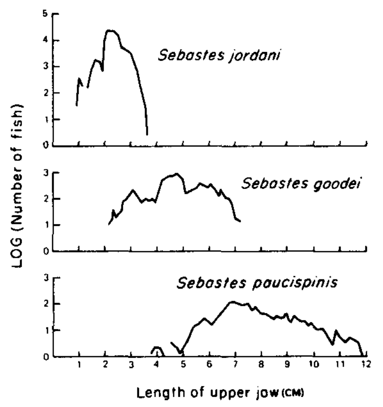

Figure 8.—Frequencies of upper jaw length of *Sebastes jordani, S. goodei,* and *S. paucispinis* caught in rockfish survey bottom trawls containing *S. jordani*.

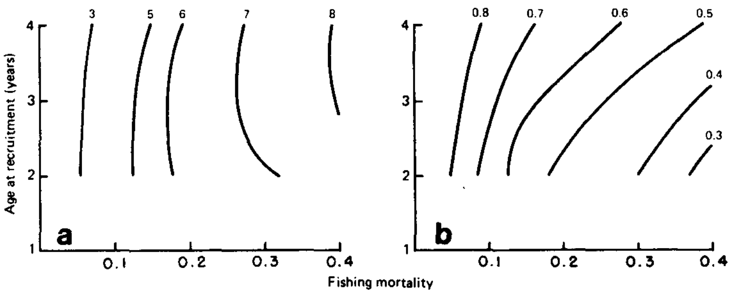

Figure 9.—Yield per recruit (a) and relative fecundity (b) (production of larvae by fished stock/production of larvae by unfished stock) of *Sebastes jordani* as functions of age at recruitment and instantaneous rate of fishing mortality (F).

and mortality are needed for the calculations. Growth estimates have already been presented. No estimates of mortality rates were found in the literature. Often the rate of natural mortality (M) is approximately equal to k (Beverton and Holt, 1959). Thus a first approximation of M is 0.275. Of 1,081 shortbelly rockfish aged from rockfish survey catches the oldest were 12 years old, which is older than the 10-year maximum age reported by Phillips (1964). It is likely that, if M is significantly lower than 0.275, older fish would occur in the samples. Indeed, a higher value of M would be reasonable.

Assuming that natural mortality is constant and that fishing mortality is constant beyond age at recruitment, I used the Ricker (1958) yield equation to estimate yield per recruit at three ages of recruitment: 2, 3, and 4 years. Results of the calculations indicate that yield per recruit is not sensitive to age of recruitment at F (fishing mortality) values less than 0.25 (Fig. 9a). When F is greater than 0.25, yield per recruit for recruitment at ages 3 or 4 is greater than when age at recruitment is 2 years. There is little difference in yield per recruit when age at recruitment is 3 or 4 for the values of F between 0.05 and 0.4.

The fecundity of shortbelly rockfish is similar to the clupeids which have a well-documented history of recruitment failures in heavily fished stocks (Murphy, 1977). With this in mind, the effect of fishing on production of larvae by a population of shortbelly rockfish was estimated. Fish were assumed to spawn once at the beginning of the year, the maturity schedule and fecundity-age relationship described in the Biology section were used, and fishing rates were assumed to be equal for males and females. The results (Fig. 9b) indicated that fishing would have a considerable effect on relative fecundity (production of larvae of fished stock/production of larvae of unfished stocks), and that relative fecundity is very sensitive to age at recruitment at higher levels of fishing mortality.

Review of Rockfish Survey Results With Regard To Fishing

Numbers of catches of shortbelly rockfish exceeding 450 kg (1,000 pounds) were made by 0.5-hour bottom and midwater trawls during the rockfish survey and a pilot survey (Gunderson and Nelson[3]) in the Monterey area during 1976 (Table 1). An area of high catches by both gears in both years was between lat. 36°56′ and 37°21′N. Large catches were made by both gears between lat. 36°18′ and 36°30′N in 1976 but not in 1977 even though nine bottom trawl hauls were made in the area in 1977. Most large midwater catches were taken by trawling close to the bottom. The midwater trawl catches averaged higher than the bottom trawl catches, 3,728 and 1,952 kg, respectively, probably because bottom trawls were set at preselected stations, while

[3]Gunderson, D., and M. Nelson. 1977. Preliminary report on an experimental rockfish survey conducted off Monterey, California, and in Queen Charlotte Sound, British Columbia, during August-September 1976. Unpubl. manuscr., 82 p. Northwest and Alaska Fisheries Center, NMFS, NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

Table 1.—Catches of shortbelly rockfish, *Sebastes jordani*, that exceeded 450 kg in one-half hour bottom and midwater trawls during 1977 rockfish survey and 1976 pilot survey.

Date	Position at beginning of tow		Depth (m)		Catch (kg)
	Lat. (N)	Long. (W)	Gear	Bottom	
		Bottom trawls			
8-15-76	36°42′	121°58′	101	101	459
8-19-76	36°20′	122°3′	212	212	627
8-19-76	36°30′	122°0′	177	177	4,120
7-18-77	35°33′	121°12′	132	132	519
7-27-77	36°59′	122°22′	124	124	4,722
7-27-77	37°10′	122°43′	176	176	881
7-30-77	37°19′	122°50′	144	144	2,790
7-30-77	37°18′	122°53′	240	240	2,499
8-4-77	38°21′	123°25′	144	144	954
		Midwater trawls			
8-12-76	36°56′	122°20′	154	229	3,314
8-13-76	37°11′	123°48′	302	302	3,156
8-13-76	37°12′	122°50′	282	285	1,415
8-19-76	36°18′	122°3′	161	165	3,313
8-20-76	36°27′	122°0′	274	274	7,264
7-27-77	37°13′	122°48′	245	247	4,055
7-27-77	37°21′	122°52′	188	192	3,578

midwater trawling was directed at concentrations detected through echo sounding.

Aimed midwater trawling could prove to be an efficient method of harvesting shortbelly rockfish which form large, off-bottom schools which are readily detected by echo sounding. The survey work indicated that with relatively little experience fishermen could learn to distinguish shortbelly rockfish from other abundant schooling species such as Pacific whiting which is the species most likely to contribute to unwanted by-catches.

Because of the small size of shortbelly rockfish, trawls would have to be constructed of mesh size smaller than allowed for bottom trawls by California regulations, 4.5 inches (11.43 cm). Cod ends used in the rockfish survey were constructed of 1.25-inch (3.18 cm) webbing. Mesh size experiments are required to determine optimum size for shortbelly rockfish.

The present California regulations are designed to prevent capture of flatfish and other rockfish that are smaller than desired. Thus by-catches of other fish should be considered. In the belief that fishermen targeting on shortbelly rockfish would limit their effort to areas producing large catches of shortbelly rockfish, catch compositions of hauls that produced more than 450 kg of shortbelly rockfish were compiled for bottom and midwater trawls made during the rockfish and pilot surveys.

The catch by weight of species other than shortbelly rockfish was considerably higher for bottom trawling (23.67 percent) than for midwater trawling (3.04 percent). Most of the by-catch was Pacific whiting for midwater trawling, while the by-catch for bottom trawling was dominated by chilipepper; bocaccio; Pacific whiting; jack mackerel, *Trachurus symmetricus*; and spiny dogfish, *Squalus acanthias*. Only 0.54 percent of the midwater trawl catches were composed of target species of domestic fishermen: Chilipepper, bocaccio, and sablefish. A relatively high 10.39 percent of the bottom trawl catches were composed of target species: Chilipepper; bocaccio; darkblotched rockfish, *S. crameri*, Dover sole, *Microstomus pacificus*; rex sole, *Glyptocephalus zachirus*; and jack mackerel.

The by-catch in a shortbelly rockfish fishery evidently can be kept at low levels by using only midwater trawls, but it would also be desirable to control age at recruitment. If mesh size restrictions prove impractical in accomplishing this, the relationships between size and age composition with depth and area of bottom trawl hauls indicated that fishermen may be able to minimize catches of relatively small or young shortbelly rockfish by choice of depth and area fished (Fig. 3, 4). Similar relationships are apparent between depth of haul and length compositions of large catches of shortbelly rockfish made by midwater trawls. Five out of nine large catches were made at depths exceeding 182 m (99.5 fathoms), and fish smaller than 200 mm fork length were not caught in significant numbers at these depths. Thus it appears that, at least during summer, fishermen may be able to minimize catches of small shortbelly rockfish through choice of depth fished. If mesh size restrictions prove practical, it appears that catches would be maximized by fishing at relatively deep depths.

Potential for Development of the Fishery

S. Kato, a fishery biologist specializing in fisheries development at the Tiburon Laboratory of the NMFS Southwest Fisheries Center, has identified several potential markets for shortbelly rockfish. There may be a small export market for good quality whole frozen fish. Another possible use is canning for either pet or human consumption, and a small test pack found the product acceptable as pet food. A possibly very large market exists for use as a raw product for surimi. The flesh appears to be of suitable quality for surimi, but their small size may make shortbelly rockfish more expensive to process than species currently used. Kato has tentatively estimated that the price to fishermen would be about $100 to $200 per ton. Actual prices, of course, will depend on a number of economic factors that can only be evaluated by fishermen and processors, and negotiations between the two parties.

High catch rates are necessary to support a fishery for a species that has a price range between $100 and $200 per ton. It would probably be necessary for a vessel to capture 10 to 20 tons per day to exceed operating costs. In addition to operating costs, capital outlays would be necessary to equip bottom trawlers for midwater trawling.

While the potential market, large biomass, and large catches shown in Table 1 indicated that there is considerable potential for development of a fishery for shortbelly rockfish, assistance by government agencies may be necessary for fullfillment of the potential. Kato has begun the development process by locating potential markets, purchasing appropriate fishing gear, and working with fishermen and processors in initiating a test fishery.

Management Options For Fishery Development

Management (State of California, Pacific Fishery Management Council, and U.S. Department of Commerce) has the option of either allowing or not allowing a fishery for shortbelly rockfish to develop. An argument against development of a fishery is that shortbelly rockfish have been shown to be prey items for important species such as chinook salmon (Merkel, 1957). On the other hand, Merkel's study showed that while shortbelly rockfish composed about 16 percent of the food of chinook salmon, 51 percent of the food was composed of northern anchovy, *Engraulis mordax*, Pacific herring, *Clupea harengus pallasi*, and squid (mostly *Loligo opalescens*). Significant fisheries have existed on these species without any documented evidence of causing feeding problems for chinook salmon. In addition Merkel estimated that euphausids composed 15 percent of the food of chinook salmon. Since shortbelly rockfish mainly feed on euphausids (Phillips, 1964), they may compete with chinook salmon.

Management also has the option of placing restrictions on types of gear, seasons, and locations. The results of this study suggest that it may be advisable to allow the use of midwater trawls but not bottom trawls because of relatively large by-catches of species other than shortbelly rockfish when bottom trawls are used. While yield per recruit and population fecundity analyses indicated that age at recruitment should probably be 3 or 4 years if a significant fishery develops, information is not available to make specific recommendations on obtaining that age at recruitment. The data (available only for summer months) indicated that fishermen may be able to avoid capture of small fish by choice of fishing depths and locations. No data are available on the practicality of using mesh size restrictions as a means to obtain a desired size at recruitment. Mesh size experiments and test fishing are required to determine the correct policy for obtaining a specific size at recruitment.

Estimates of a large biomass of shortbelly rockfish (295,000 t in a small portion of its range) indicated that the population could support a large fishery. However, the relatively low fecundity of the species suggests that caution in developing the fishery would be prudent. A relatively small fishery, e.g., 5,000-10,000 t of fish, may be desirable until more is known about the species. A small test fishery would allow development of procedures to obtain desired size at recruitment through mesh size experiments and monitoring of size and age composition of the catch with respect to depth and area of catch. Location and extent of areas containing high densities of fish would provide more information on size of the stock(s). Further analyses of larval survey data may provide additional estimates of stock size. Hydroacoustic midwater trawl surveys probably could be designed to produce estimates of stock size in areas of high densities of the species at relatively low cost. If the above data indicate the possibility of more than one important stock, appropriate studies should be carried out to determine the stock structure. Finally, additional work, such as predator-prey studies, on the position of shortbelly rockfish in the community is desirable. Ideally, management should take into account the effect of fishing on shortbelly rockfish on both its predators and competitors. However, as is the case for other marine fisheries, little is known on the interactions of shortbelly rockfish with other species.

Acknowledgments

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