Habitat and Nursery Grounds of Pacific Rockfish, *Sebastes* spp., in Rocky Coastal Areas of Southeastern Alaska

H. RICHARD CARLSON and RICHARD R. STRATY

H. Richard Carlson and Richard R. Straty are with the Auke Bay Laboratory, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, P.O. Box 155, Auke Bay, AK 99821.

ABSTRACT—During late July 1978 we used a small submarine to explore the rugged rocky substrate along the coast of southeastern Alaska to depths of nearly 240 m (130 fathoms). The extensive boulder fields and pinnacle-studded bottom were populated mostly by rockfish, Sebastes *spp., of several species and a wide range of sizes. This untrawlable zone is a nursery area for rockfish, and dense schools of thousands of small 6-8 cm (2.5-3 inch) red rockfish were sighted at 90-100 m (49-55 fathom) depths over crevices and cover. Fish were less abundant in similar surveys of protected waters of a bay and fiord adjacent to the coastal sites.*

Introduction

The location of nursery grounds for juvenile Pacific ocean perch, *Sebastes alutus,* and most other rockfishes, *Sebastes* spp., in the North Pacific Ocean is poorly known. We have long suspected that the rocky, untrawlable areas along the rugged coastline of southeastern Alaska were important nursery grounds for Pacific ocean perch. These rough areas extend offshore on the continental shelf to a depth of 420 m (230 fathoms) or more. A few thousand juvenile rockfishes, primarily Pacific ocean perch, have been trawled nearshore in coastal bays and fiords of southeastern Alaska over steep slopes and ledges near rocky areas (Carlson et al.[1]). Incidental catches by commercial salmon trollers indicate that echosign over these areas is composed primarily of rockfish.

Offshore, beyond most of the rocky areas, Pacific ocean perch and several other rockfish species were heavily exploited by foreign trawlers (Major and Shippen, 1970) before U.S. management control (in 1977) over continental-shelf fisheries within the 200-mile limit. Neither foreign catches nor those of U.S. research vessels conducting resource surveys in these waters contained any early juvenile stages of Pacific ocean perch or other rockfish species (Lyubimova, 1965; Paraketsov, 1963; Ronholt[2]).

Pacific ocean perch and other rockfish species are ovoviviparous (livebearers) and are believed to release larvae in deeper water (Lyubimova, 1965; Gunderson, 1971). The planktonic larvae are transported to the nearshore waters by ocean currents (Lisovenko, 1964), a characteristic of the life history of many marine fishes (May, 1974), e.g., Dover sole, *Microstomus pacificus*; rex sole, *Glyptocephalus zachirus*; and petrale sole, *Eopsetta jordani* (Pearcy et al., 1977); English (lemon) sole, *Parophrys vetulus* (Ketchen, 1956); and darkblotched rockfish, *S. crameri*; canary rockfish, *S. pinniger*; and rosethorn rockfish, *S. helvomaculatus* (Richardson and Laroche, 1979).

The age that young of most rockfish species become demersal is not precisely known. Phillips (1964) captured young-of-the-year darkblotched rockfish and stripetail rockfish, *S. saxicola,* at 73-128 m (40-70 fathoms) while trawling for shrimp off northern California. Boehlert (1977) found that young splitnose rockfish, *S. diploproa,* move from surface to near-bottom waters during their first year of life in southern California. Some Pacific ocean perch become demersal by age 1, and most probably adopt a demersal existence in the nearshore coastal zone by the end of their first summer of life (Carlson and Haight, 1976). Recent evidence supports this idea. Twenty-five young-of-the-year Pacific ocean perch were captured in a bottom trawl in early October 1979 at 55-84 m (30-46 fathoms) in two fiords of southern Baranof Island and 28 more in late October 1980 at 73-128 m (40-70 fathoms) off northern Chichagof Island in southeastern Alaska (Carlson[3]). They ranged from 5 to 8 cm (2 to 3 inches) FL (fork length) and had just begun formation of the first annulus, marking the end of their first growing season.

The lack of young rockfish in offshore catches and their occurrence in catches at several nearshore locations led Carlson and Haight (1976) to hypothesize that the nearshore, rocky-bottom coastal areas and adjacent bays and straits of Alaska are nursery areas for Pacific ocean perch. Adult Pacific ocean perch reside in and

[1]Carlson, H. R., R. E. Haight, and K. J. Krieger. 1977. Species composition and relative abundance of demersal marine life in waters of southeastern Alaska, 1969-77. Processed rep., Auke Bay Laboratory, Northwest and Alaska Fisheries Center, NMFS, NOAA, P.O. Box 155, Auke Bay, AK 99821.

[2]Ronholt, L. L. 1979. Northwest and Alaska Fisheries Center, NMFS, NOAA, 2725 Montlake Blvd. East, Seattle, WA 98112. Personal commun.

[3]Carlson, H. R. Evidence for an early demersal existence of young-of-the-year Pacific ocean perch in southeastern Alaska waters. Unpubl. manuscr. avail. Auke Bay Laboratory, Northwest and Alaska Fisheries Center, NMFS, NOAA, P.O. Box 155, Auke Bay, AK 99821.

along gullies and canyons farther seaward on the outer continental shelf (Major and Shippen, 1970).

In July 1978, we used a small submersible to search for young Pacific ocean perch and visually survey fish in two rocky-bottom coastal areas exposed to open-sea conditions and in an adjacent bay and strait protected from open-sea conditions in the northern part of southeastern Alaska. This paper presents our observations of the behavior and habitat of young rockfish believed to be Pacific ocean perch, and describes the behavior and habitat of several other species of rockfish at various life stages.

Methods

The two exposed, rocky-bottom coastal areas were off Cape Cross on Yakobi Island and off Portlock Harbor on Chichagof Island in the northern part of southeastern Alaska (Fig. 1). The two protected areas were approximately 3 km (2 miles) inside Lisianski Strait in the Cape Cross vicinity and 1.6 km (1 mile) inside Portlock Harbor near its southern entrance. These four areas were selected as being representative of the coastal bottom topography of the northern part of southeastern Alaska after we conducted echo-sounding surveys in May 1978 in this region.

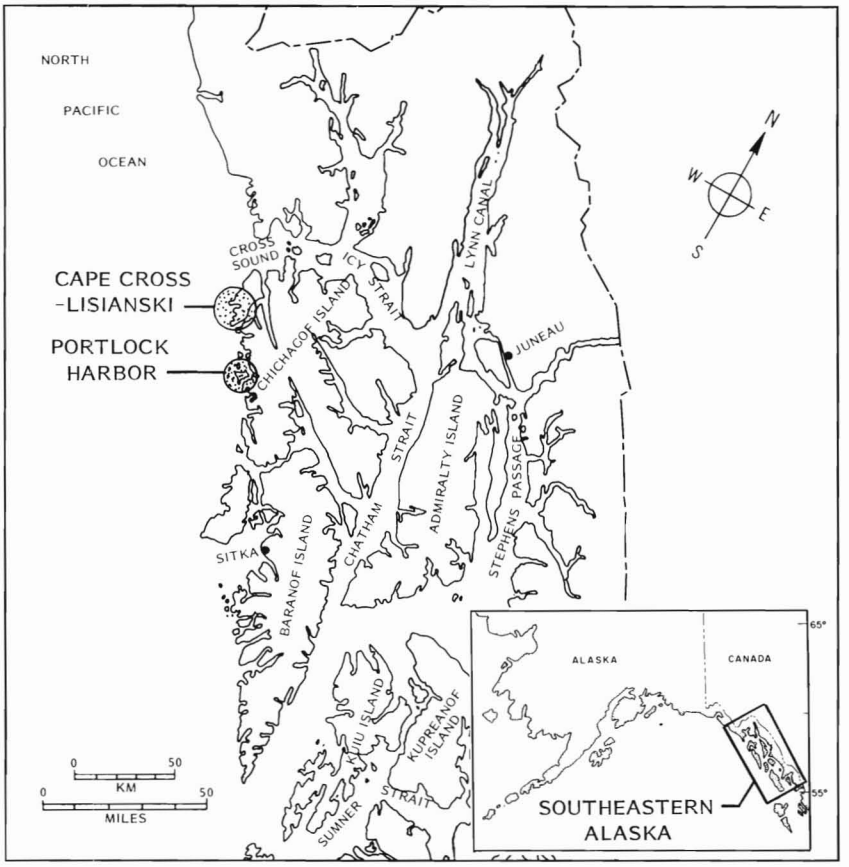

Figure 1.—Sites of surveys of demersal fish communities off southeastern Alaska, July 1978.

The areas off Cape Cross and Portlock Harbor were exposed to open-ocean sea and swell conditions, and the water was much clearer than inside Lisianski Strait and Portlock Harbor where waters were not as subject to oceanic influence and heavy seas and swells. The greater turbidity of the protected areas may be due to material suspended in the water from surface runoff and streams, and restricted circulation with the adjacent, clearer offshore waters.

We were fortunate to have unusually good weather during the survey period. Seas off the coast generally ranged from a gentle ocean swell to 1 m (3 foot) swells, which permitted launching and retrieval of the submersible without incident. Moderate to heavy seas, which frequently occur in this region, could render the submersible operation hazardous. Water visibility was outstanding on open-coast surveys and ranged from 10 to 23 m (33 to 75 feet). On the surveys inside fiords and bays, visibility was much less, being only 2-7 m (6-23 feet).

The submersible *Nekton Gamma* (Fig. 2), chartered from General Oceanographics[4] of San Diego, Calif., by NOAA's Manned Undersea Science and Technology Program Office, was made available to the authors from 21 to 28 July 1978 to conduct surveys beyond scuba depths (>40 m or >130 feet). The submersible is 5 m (16 feet) long, battery-powered, carries two persons, and can operate down to 305 m (167 fathoms) and operates at 1.8-5.5 km/h (1-3 knots) for 2-4 hours.

The transects at exposed coastal locations were plotted across uneven bottom located on earlier echo-sounding surveys. These transects were <6 km (3.7 miles) long and generally ran from shallow to deep water. We surveyed single transects <2 km (1.2 miles) long across the sites in Lisianski Strait and Portlock Harbor.

It was almost impossible to adhere to the coastal transects because of the extreme uneveness of the bottom (Fig. 3, 4). Navigating steep pinnacles and sheer ledges would have required frequent, rapid changes in depth largely beyond the capabilities of the submersible at its normal cruise speed of

[4]Reference to trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

3.7 km/hour (2 knots). After some experience, we decided to cruise along the bottom for short distances and stop frequently to make observations when the submersible path was obstructed by abrupt changes in bottom topography. We followed transects across the center of the two inside protected sites without difficulty.

We identified in situ the types of substrate and fish species, estimated their sizes and relative abundance, and noted schooling behavior and reaction of fish to the submersible. Descriptions of the fish, their habitats, and behavior were recorded on a small portable tape recorder. Fish and their habitats were photographed in color with an externally mounted 35 mm Benthos Model 372 camera with flash. The camera was operated by the submersible pilot as subjects of interest came into view. We also used a portable video cassette camera to obtain black-and-white

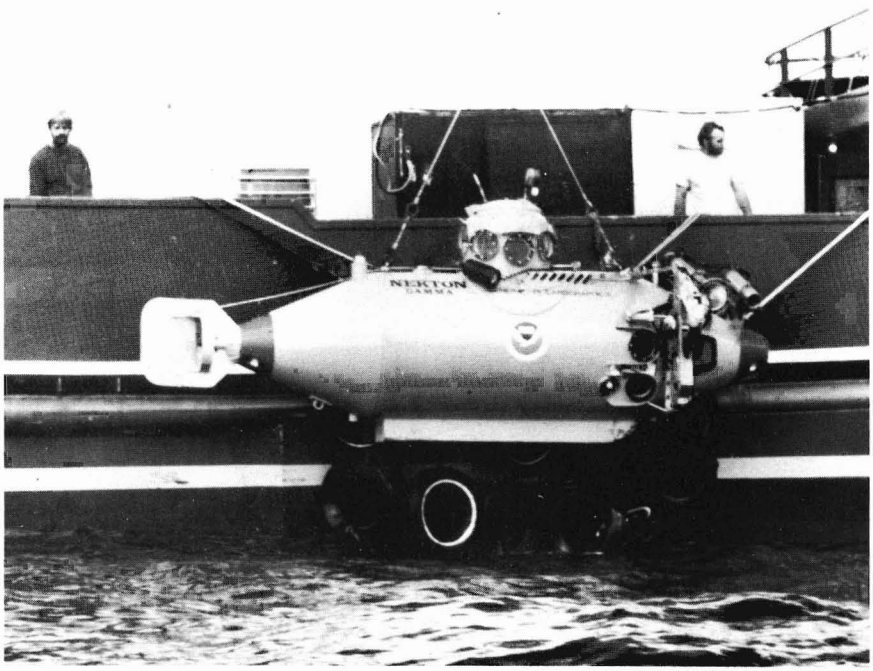

Figure 2.—The research submarine *Nekton Gamma* used to survey demersal fish in southeastern Alaska.

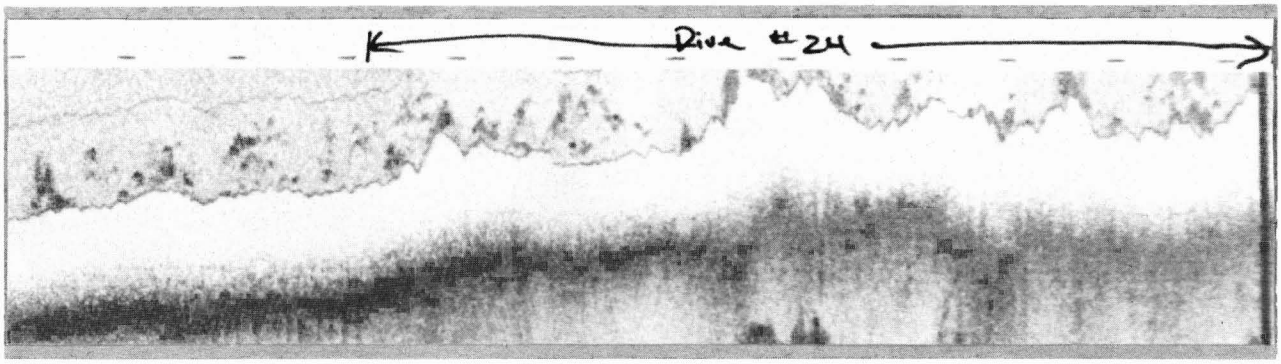

Figure 3.—Bottom topography of the survey area as charted seaward from Portlock Harbor.

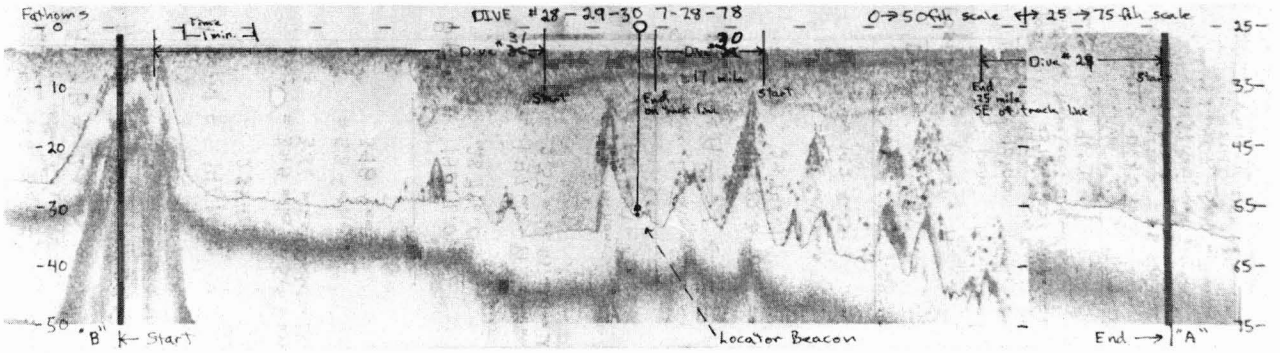

Figure 4.—Bottom topography of the survey area as charted seaward from Cape Cross.

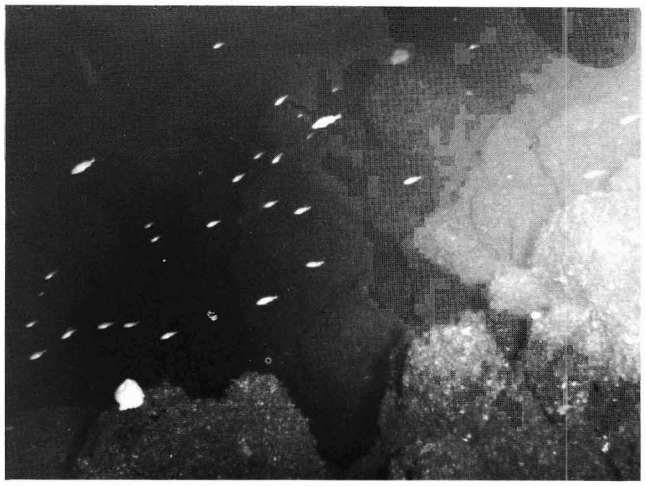

Figure 5.—Young rockfish over part of a steep, rocky pinnacle.

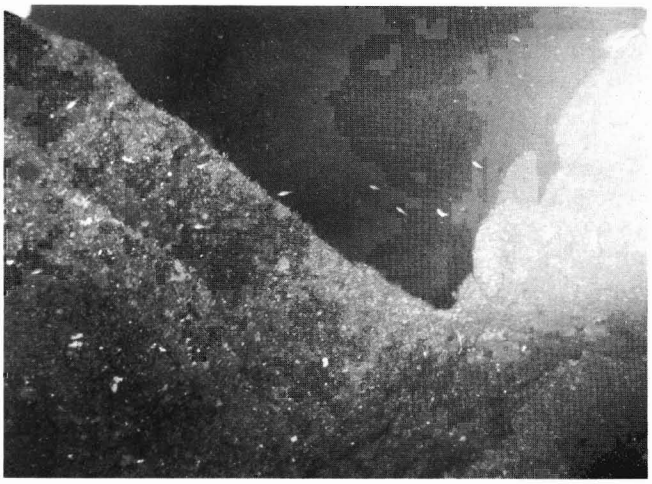

Figure 6.—Young rockfish and rugged, rocky substrate.

Figure 7.—Several rockfishes over part of an extensive boulder field. A young yelloweye rockfish is in the extreme lower right, a tiger rockfish to the right, and small unidentified rockfish to the upper center and upper left.

Figure 8.—A large (≥2 m) wolf-eel moves slowly over a boulder field.

documentation of fish and their behavior.

Rockfish Nursery Area

Our most significant findings came from the surveys offshore from Portlock Harbor and Cape Cross (Fig. 1). Here we found what appeared to be nursery grounds for young rockfish. These schools were at 90-100 m (49-55 fathoms), over a bottom that varied from ragged, steep, rocky pinnacles (Fig. 5, 6) to extensive boulder fields (Fig. 7, 8) interspersed with areas of gravel-shell that were deeply furrowed, apparently by wave action.

Marine life in the rocky areas was abundant and diverse. Rockfish of several species and wide size-range predominated. Clouds of thousands of 6-8 cm (2.5-3 inch) reddish rockfish (Fig. 9), which we believe are Pacific ocean perch, extended as far as the limits of visibility (as much as 18 m or 60 feet) in all directions. These small rockfish were reddish with some darker blotching above the lateral line and generally had a slender body profile. They had no heavy spines evident in the head region; no black margin on fins; no distinct stripes, spots, or bars; and no disproportionate feature such as large eye, high dorsal fin, etc. Larger Pacific ocean perch have a pronounced symphyseal knob or projecting lower jaw, but this is not well developed in the young.

We saw other fishes in the rocky offshore areas (Table 1). Large

Figure 9.—Part of a dense school of young, 6-8 cm, red rockfish (believed to be *Sebastes alutus*) that extended to the limits of visibility over a rugged, rocky boulder field.

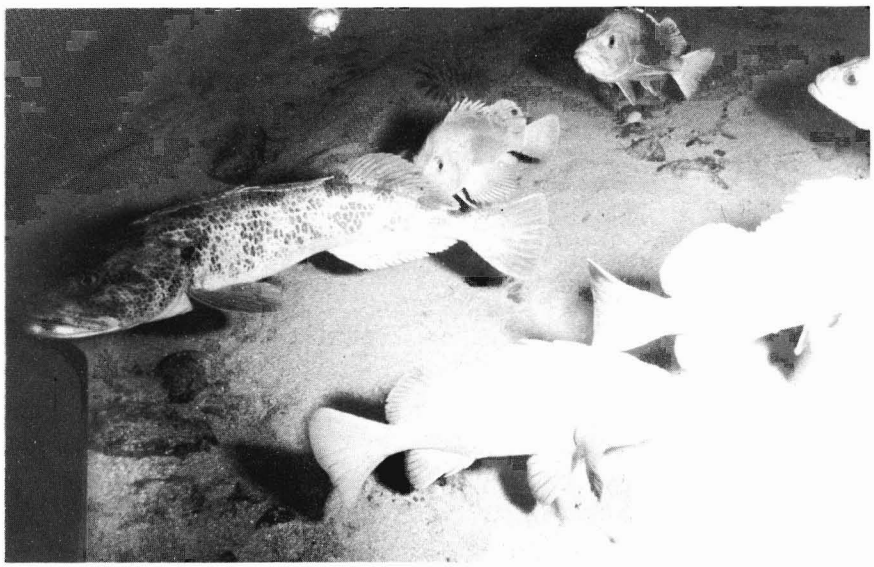

Figure 10.—A large (1 m) lingcod (left) and several yelloweye rockfish photographed over a portion of sand-shell substrate adjacent to rocky zones. Furrows in the sand (upper left) were apparently caused by surge action down to 90-100 m (49-55 fathoms). These rockfish were attracted to the submarine and examined it closely.

yelloweye rockfish, *S. ruberrimus* (Fig. 10), were abundant. Also present were yellowtail rockfish, *S. flavidus*; china rockfish, *S. nebulosus*; quillback rockfish, *S. maliger*; rosethorn rockfish; widow rockfish, *S. entomelas*; rougheye rockfish, *S. aleutianus*; tiger rockfish, *S. nigrocinctus*; and silvergray rockfish, *S. brevispinis*; as well as a few large Pacific halibut, *Hippoglossus stenolepis*; lingcod, *Ophiodon elongatus*; kelp greenling, *Hexagrammos decagrammus*; and wolf-eels, *Anarrhichthys ocellatus*. Small yellowtail rockfish, china rockfish, quillback rockfish, and either dusky rockfish, *S. ciliatus*, or black rockfish, *S. melanops*, were observed by scuba divers at 9-18 m (30-60 feet) inshore at Cape Cross (Barr[5]) at the same time as our observations; therefore, the nursery area probably extends into subtidal shallows.

Invertebrates in rocky offshore areas were not sparse but generally lacked variety. Frequently encountered were anemones, *Metridium senile* (Fig. 11); hydrocorals, *Allopora* sp.; sea stars (i.e., *Crossaster papposus, Henricia* sp., *Solaster* sp.); basket stars, *Gorgonocephalus* sp.; brittle stars; sponges; and bryozoans.

The two submersible surveys inside bays and fiords with entrance sills near the open coast, in Lisianski Strait and Portlock Harbor, covered depths of 18-240 m (10-130 fathoms). We found steep, rocky ledges that extended from nearshore and were overlaid with sand-shell at shallower depths and sand-silt at deeper depths. At deeper depths, we found a few isolated boulders and smooth rocky outcrops. At the inside sites, rockfish were not as abundant and fewer species were sighted. Most of the fish were types that lay in contact with the substrate, such as flatfish, skates, sculpins, and poachers. The only rockfishes sighted were a school of mixed large and small dusky rockfish in 18 m (10 fathom) shallows and isolated large individual rougheye rockfish, quillback rockfish, and Pacific ocean perch at deeper levels, ≥183 m (100 fathoms). We also saw a few large Pacific cod, *Gadus macrocephalus,* and large and small walleye pollock, *Theragra chalcogramma.*

Invertebrates were abundant and diverse at inside sites. Below 91 m (50 fathoms), pink shrimp, *Pandalus*

[5]Barr, L. P.O. Box 361, Auke Bay, AK 99821. Personal commun.

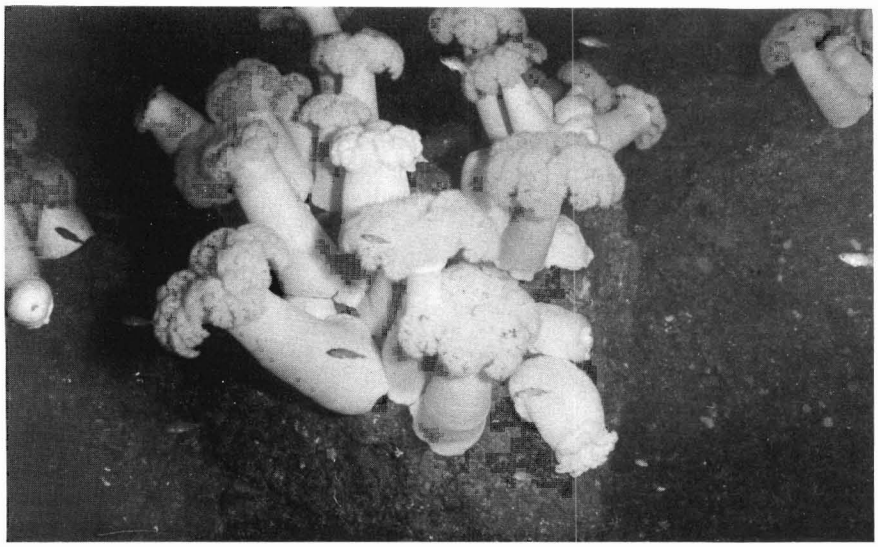

Figure 11.—Large white anemones, *Metridium senile,* growing on boulders, provide shelter for small rockfish, *Sebastes* sp.

Table 1.—Fishes observed during submersible surveys off the northwestern coast of Chichagof Island, Alaska, July 1978.

Common name	Scientific name	Common name	Scientific name
Rougheye rockfish	*Sebastes aleutianus*	Walleye pollock	*Theragra chalcogramma*
Pacific ocean perch	*Sebastes alutus*	Pacific halibut	*Hippoglossus stenolepis*
Silvergray rockfish	*Sebastes brevispinis*	Flathead sole	*Hippoglossoides elassodon*
Dusky rockfish	*Sebastes ciliatus*	English sole	*Parophrys vetulus*
Widow rockfish	*Sebastes entomelas*	Dover sole	*Microstomus pacificus*
Yellowtail rockfish	*Sebastes flavidus*	Big skate	*Raja binoculata*
Rosethorn rockfish	*Sebastes helvomaculatus*	Longnose skate	*Raja rhina*
Quillback rockfish	*Sebastes maliger*	Unidentified sculpin	*Triglops* sp.
China rockfish	*Sebastes nebulosus*	Blackfin sculpin	*Malacocottus kincaidi*
Tiger rockfish	*Sebastes nigrocinctus*	Sturgeon poacher	*Agonus acipenserinus*
Yelloweye rockfish	*Sebastes ruberrimus*	Blackfin poacher	*Bathyagonus nigripinnis*
Wolf-eel	*Anarrhichthys ocellatus*	Alaska eelpout	*Bothrocara pusillum*
Lingcod	*Ophiodon elongatus*	Coho salmon	*Oncorhynchus kisutch*
Kelp greenling	*Hexagrammos decagrammus*	Pacific sand lance	*Ammodytes hexapterus*
Searcher	*Bathymaster signatus*	Ratfish	*Hydrolagus colliei*
Pacific cod	*Gadus macrocephalus*		

borealis, were particularly abundant, and at least four other species of shrimp were seen, including sidestripe shrimp, *Pandalopsis dispar.* Octopus, nudibranchs, and gastropods were common, as were sea stars and anemones. Many small snow crabs, *Chionoecetes* sp., 1-4 cm (0.5-1.5 inches), were seen in or near the deepest part of Lisianski Strait at 227-238 m (124-130 fathoms).

Reaction of Fishes to Submersible

Most rockfish did not appear frightened by or attracted to the submersible with its lights and strobes that flashed intermittently. Notable exceptions were large yelloweye rockfish, which appeared to be attracted to the submarine and actually followed it around and cruised in close to peer in portholes. They appeared intrigued with the submersible. In one instance hundreds of these large, reddish, 7-10 kg (15-22 pound) fish trailed behind the submersible in a long column.

Large wolf-eels usually moved slowly away and appeared to beat a dignified retreat. Large lingcod briefly looked the submersible over at close range and swam off. Large halibut appeared curious but cautious and could not be approached closely. Schools of rockfish other than yelloweye rockfish appeared to behave normally and paid no particular notice to the submersible, unless we moved directly towards a school and then they moved off.

Conclusions

The rocky areas, exposed to open-sea conditions, that we surveyed are a haven or nursery ground for young rockfishes including Pacific ocean perch. This finding supports the hypothesis by Carlson and Haight (1976) that juvenile Pacific ocean perch inhabit these areas where cover and protection are afforded by cracks and crevices in and under rocks and ledges and among sessile invertebrates such as the anemone *Metridium senile.*

Near-bottom marine life differed in the two types of areas surveyed. In the exposed outer coastal areas, fishes predominated, primarily rockfishes of several species and life stages. In contrast, in the protected waters of an adjacent coastal fiord and bay, invertebrates predominated, primarily shrimp, small crabs, snails, sea stars, and anemones. Many species of invertebrates and most life stages were represented; fish were few in number and variety.

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