Biological observations from the Cobb Seamount rockfish fishery

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The Cobb Seamount was discovered in 1950 by the crew of the fishery research vessel *John N. Cobb* (Anonymous, 1950). This submerged volcanic mountain (Budinger, 1967) is located approximately 280 nautical miles (nmi) off the southern Washington coast and comes to within 50 meters of the sea surface. At the 200-m isobath, its area is approximately 32 nmi^2 (Budinger, 1967). Various efforts have been made to study the biological, oceanographic, and geologic characteristics of the seamount since its discovery (Budinger, 1967; Birkland, 1971; Dower et al., 1992), but these efforts have been somewhat limited in scope and duration. The studies have shown that the seamount has concentrations of commercially valuable species including rockfishes (genus *Sebastes*). Most of the information about commercial fishing operations on the seamount is anecdotal and speculative, primarily because the seamount is located outside the Exclusive Economic Zone (EEZ) and therefore fishing vessels operating there are not subject to fishing regulations or routine sampling. What is known, however, is that bottom trawl, midwater trawl, gill net, and longline fishing has occurred at various times.

Foreign and domestic fleets have fished on the Cobb Seamount from at least the mid 1960's (Sasaki, 1986). Most of the fishing operations appear to have been aimed at several species of rockfish. Sasaki (1986) suggests that prior to 1985, there was intense fishing pressure on the seamount by the Japanese fishing fleet. In 1985, a few fishermen from Oregon attempted to trawl on the Cobb Seamount but were unsuccessful. It is not known why these efforts failed. Little fishing activity is believed to have occurred on Cobb Seamount between 1985 and September 1991.

In 1991, fishermen from Oregon and Washington returned to Cobb Seamount; this time they were successful. This success drew the attention of fishery managers because fish caught outside the EEZ are not regulated by the west coast Fisheries Management Plan governing nearshore stocks. Because of the regulatory problems presented by this new fishery, port samplers were instructed to give a high priority to sampling of landings from Cobb Seamount in part as an effort to identify any unusual characteristics which might make landings identifiable. In this paper we present some of the unique characteristics of the fish populations found on Cobb Seamount, particularly widow rockfish (*S. entomelas*). This seamount is isolated enough from coastal fish populations so that recruitment dynamics, density dependent growth, and bioenergetic studies could provide valuable new insights into fisheries biology.

Methods

Landings of commercially important groundfish are routinely sampled by biological technicians in Oregon according to standard protocols. Landings of fish from Cobb Seamount were sampled by port samplers in Oregon at two or three times the normal level and the majority of landings were sampled. All samples of widow rockfish were taken from vessels by using midwater trawl gear with the same mesh size as used in the nearshore widow rockfish fishery. During a four-month period, 11 landings were sampled by taking multiple 50-pound subsamples from each landing. Fork lengths were obtained from 891 widow rockfish, otoliths were removed from 724 of these fish for age determination by the broken and burnt method (Chilton and Beamish, 1982).

Mean length-at-age, age composition, and physical characteristics of the otoliths were compared to samples collected from landings of widow rockfish caught in the nearshore areas of the northern Oregon-southern Washington coast. To eliminate yearly and seasonal bias, comparisons of nearshore widow rockfish to Cobb Seamount widow rockfish were limited to the same months and years for both groups. To compare mean length-at-age of Cobb widow rockfish to the nearshore widow rockfish, only six-year-old fish could be used because of the small number of fish in other

Manuscript accepted 27 April 1993.
Fishery Bulletin: 91:573–576 (1993).

age groups for both areas. Otoliths were visually inspected without a microscope to look for gross morphological differences.

Results and discussion

Several unique features were observed in the landings of widow rockfish from Cobb Seamount. Mean length-at-age was similar for six-year-old widow rockfish in both areas; however, size composition, age composition, and physical structure of the otoliths were very different between the two areas.

Mean length of six-year-old widow rockfish on the Cobb Seamount was 35.3 cm FL (n=72, SE=0.11) and 37.3 cm FL (n=140, SE=0.09) for males and females, respectively. In the nearshore samples, the mean length of six-year-old fish was 35.3 cm FL (n=53, SE=0.22) and 37.8 cm FL (n=52, SE=0.26) for males and females, respectively. This suggests that mean length-at-age, at least for young fish, is similar between fish caught on the Cobb Seamount and fish caught in the nearshore area. Assuming that the fish on the seamount spent the majority of their lives there, then it is reasonable to assume that conditions affecting growth (temperature, food availability, competition, etc.) are probably comparable to the conditions found in the nearshore environment.

In the northern Oregon-southern Washington area of the Pacific coast, the mean length of widow rockfish in the commercial landings is 38.4 cm (Pearson and Hightower, 1991). In contrast, the mean length of widow rockfish from Cobb Seamount was 33.1 cm. Age composition of the widow rockfish in the landings from the Cobb Seamount is also very different from those in the landings from the nearshore area (Fig. 1). Only 7.5% of all fish collected from the Cobb Seamount were more than six years old, while 85.7% of fish collected from the nearshore samples were more than six years old (Fig. 1). This difference in age composition cannot be explained by differences in gear type because the same gear and mesh size was used in both areas. There are several potential explanations for these differences including differences in fishing pressure, differences in fishing behavior, differences in discard practices, and actual differences in the population age composition.

The argument for differences in fishing pressure relies on the belief that widow rockfish on the Cobb Seamount were heavily exploited prior to 1985 and therefore their population was reduced to very low levels. This argument is supported by Sasaki (1986) who reported that the seamount had, in fact, been heavily fished. Widow rockfish were never specifically mentioned as having been caught by any fishery prior to 1991. While intense fishing pressure on the Cobb Seamount may be responsible for the absence of older widow rockfish, there are arguments against this explanation. First, a sample of 50 harlequin rockfish (*S. variegatus*) had a mean age of 15 years, much older than would be expected if they had experienced similar fishing mortality to the widow rockfish. In addition, even if the Cobb Seamount had experienced extremely heavy fishing pressure, it seems unlikely that virtually all the older fish would have been caught.

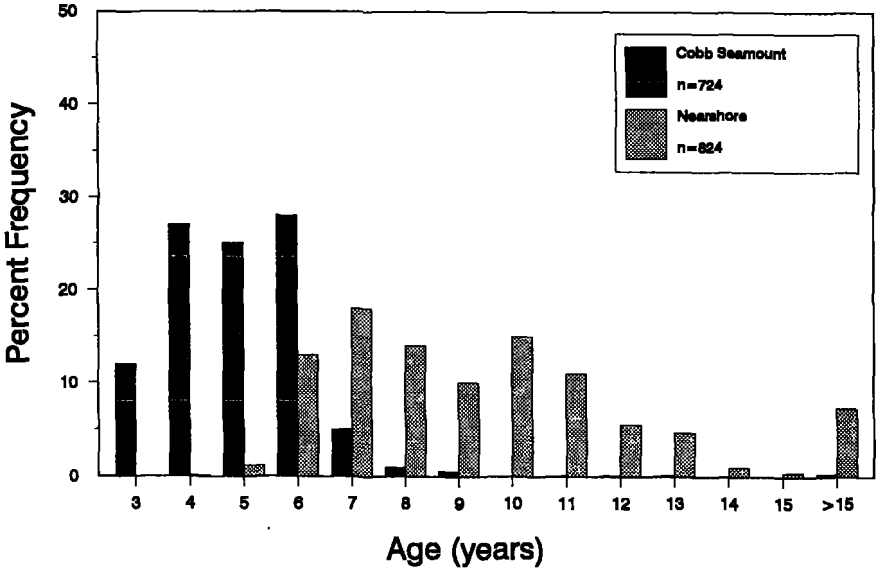

Figure 1
Comparison of age composition from widow rockfish caught on Cobb Seamount and the coastal area of northern Oregon.

The argument for differences in fishing behavior has some merit. Fishermen report that the terrain on the Cobb Seamount is very rugged and it is possible that the fishermen tend to keep their nets higher off the bottom to avoid snags than they would in the nearshore areas. This could result in a different age composition if young fish tended to disperse higher into the water column than older fish.

The argument for the difference in age composition being due to a difference in discard practices also has some merit. Fishermen operating under trip limits in the nearshore areas, and having to deal with market demands for larger fish, would tend to discard smaller fish. The problem with this argument is that it would tend to explain a higher proportion of small fish in the Cobb Seamount widow rockfish landings, but it would not explain the virtual absence of older, larger fish which certainly would be retained by the fishermen.

The possibility that the age composition of the two areas is actually different also has merit. It is not known whether the population of widow rockfish on the Cobb Seamount is self sustaining or if the fish recruit to the seamount from the nearshore population. Juvenile rockfish have an extended pelagic phase. During this stage they can be advected offshore. Recent studies of juvenile rockfish off the central California coast have found juvenile rockfish more than 200 miles offshore[1]. If this also occurs off Oregon, then it is possible that some fraction of the existing population on the Cobb Seamount originated as juveniles or larvae, or both, in the nearshore area. While it cannot be completely discounted that adults migrate to the seamount it seems unlikely because adult widow rockfish are not considered pelagic and the seamount is more than 200 miles from the nearest suitable habitat. It is possible that older fish either emigrate from the seamount or experience high mortality for some unknown reason. It is also possible that there was a massive kill of widow rockfish on the Cobb Seamount prior to 1985. Another possibility is that there never were widow rockfish on the Cobb Seamount prior to 1985. This latter possibility may have some merit since yellowtail rockfish appear to be totally absent from the Cobb Seamount; yet, they are quite abundant in the nearshore area, although the habitat at the Cobb Seamount would seem to be ideal for them. If getting to the Cobb Seamount is a fortuitous event, then it is possible that yellowtail rockfish just have not been lucky yet and that widow rockfish have only been lucky recently. Only further studies can determine the cause for the apparent differences in age composition between the Cobb Seamount and the nearshore populations.

Otoliths from many species can undergo a process of vaterite replacement (Gauldie, 1986) in which the aragonite in the otoliths is replaced by vaterite. This process results in a quite distinctive otolith morphology (Fig. 2) and has been observed by the authors in many species of rockfish, flatfish, and other groundfish species. Vateritic otoliths are sometimes called "resorbed" or "crystallized" owing to their somewhat crystalline appearance. In nearshore widow rockfish sampled in Oregon from 1991, only 2.5% of the fish had vateritic otoliths. In contrast, 28 percent of otoliths from Cobb Seamount widow rockfish are vateritic. Gauldie (1986), working with salmon, suggested that vaterite replacement is under single locus genetic control but can be overridden by temperature extremes. It is possible that Cobb Seamount could be subject to temperature extremes during certain oceanographic events like El Niños.

Three other interesting observations have been made about rockfish from Cobb Seamount during this fishery. Rosy rockfish (*S. rosaceous*) was caught; thus a northern range extension for this species was created.[2] Harlequin rockfish have been caught; thus, their southern range has been extended from its previously reported southern limit of Queen Charlotte Sound, British Columbia (Eschmeyer et al., 1983). Five shortbelly rockfish (*S. jordani*) were caught, three of them in excess of 34-cm fork length, which exceeds the largest fish previously known to the authors (33 cm). Studies on other seamounts in the Pacific have shown that rare species, exceptionally large specimens, and range extensions occur on other seamounts (Hughes, 1981).

The Cobb Seamount undoubtedly holds many other surprises for fisheries biologists. Studies of rockfish communities on the Cobb Seamount and how colonization occurs could lead to a better understanding of the population dynamics of this large, valuable group of groundfish. One possible way colonization could occur would be if it were found that strong cohorts on the Cobb Seamount were weak cohorts in the nearshore area and vice versa. This would suggest the possibility that advection of juveniles has an important role in determination of cohort strength which would have major ramifications in management of nearshore fisheries. Continued examination of fish with vateritic otoliths could yield new information, particularly if other populations of fish are found to have a high percentage of vateritic otoliths. Remotely operated vehicle studies would be a useful approach to examine the benthic community to determine its similarity to nearshore areas.

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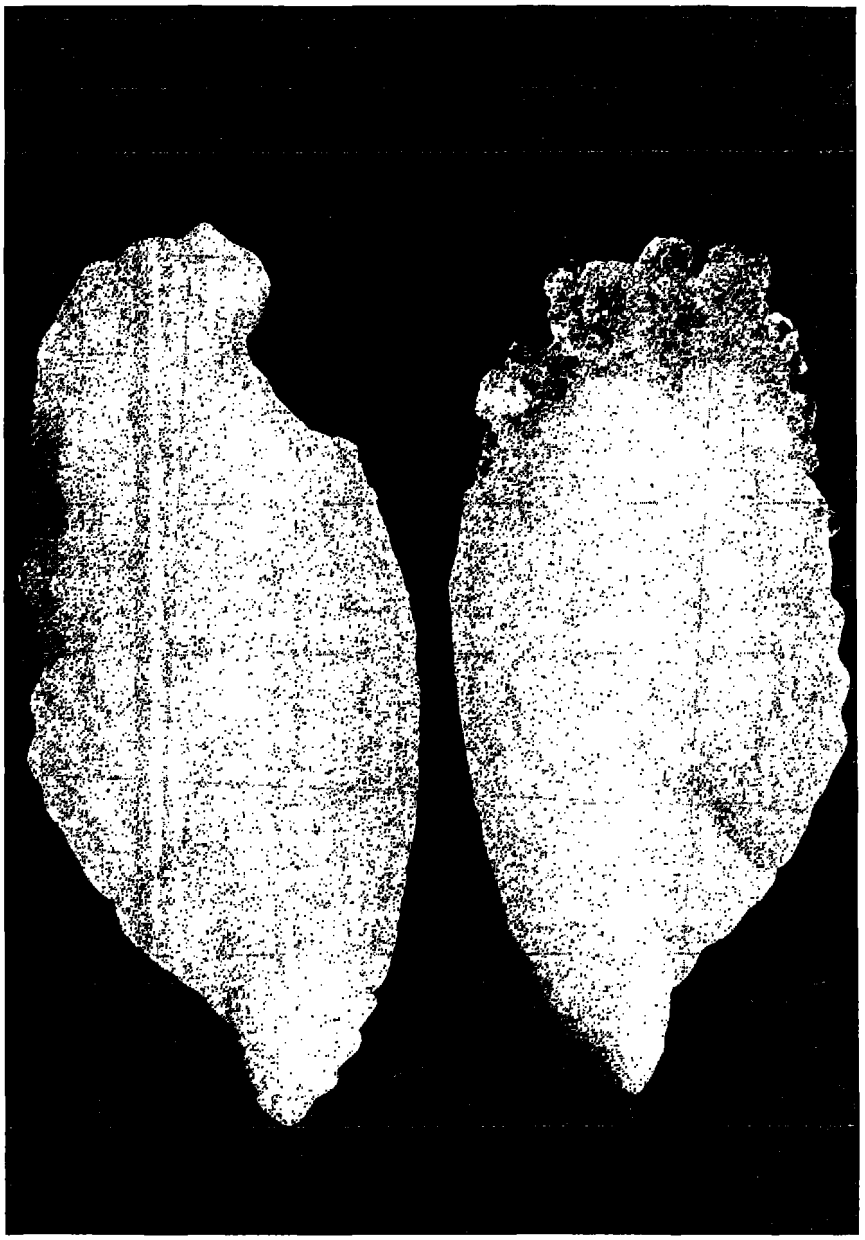

Figure 2
Two sagittal otoliths from a widow rockfish. Otolith on the left is normal, while the otolith on the right exhibits the phenomenon known as vaterite replacement.