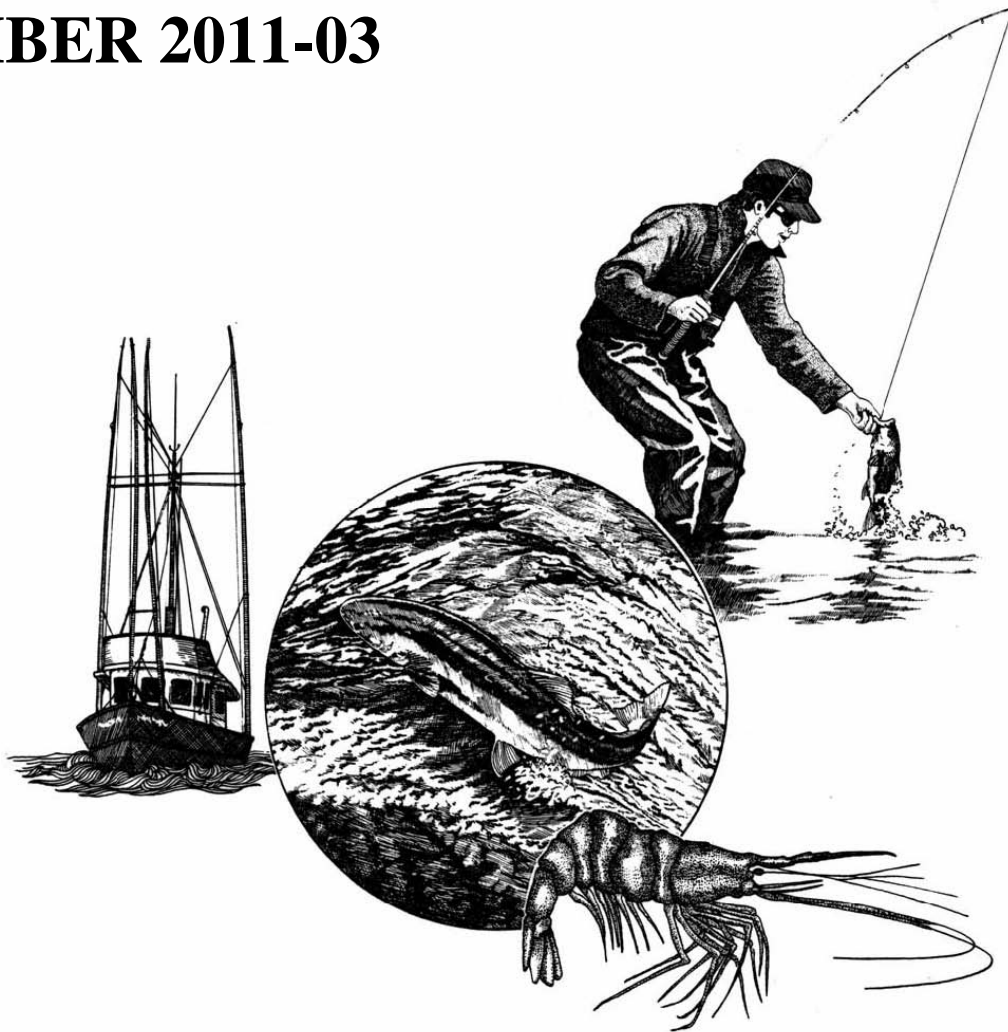


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The Oregon Shore-Based Cobb Seamount Fishery, 1991-2003:
Catch Summaries and Biological Observations

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The Oregon Shore-Based Cobb Seamount Fishery, 1991-2003:
Catch Summaries and Biological Observations

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ABSTRACT

In 1991, Oregon saw the first commercial landings from a new fishery targeting widow rockfish (*Sebastes entomelas*) with midwater trawl gear on Cobb Seamount, approximately 280 nautical miles (500 km) slightly northwest of the northern Oregon coast. From 1991 through 2003, approximately 5400 metric tons of widow rockfish (from all catch areas) were landed into Oregon by shore-based midwater trawlers. The Oregon Department of Fish and Wildlife sampled widow rockfish, sablefish (*Anoplopoma fimbria*) and other groundfish caught at Cobb Seamount during this time period, in addition to conducting routine sampling of commercial landings from areas closer to shore. Data were collected on length, age, sex, and reproductive maturity of the Cobb Seamount fish.

The objectives of this study were to describe the developing fishery for widow rockfish at Cobb Seamount, and to attempt to identify biological differences between widow rockfish from Cobb Seamount and those found closer to shore. It was hoped that such differences could be used to facilitate shoreside enforcement of different fishing regulations for each area. Data collected from landings during the 1991-2003 time period suggest that compared to widow rockfish caught within 200 miles of shore (inside the U.S. Exclusive Economic Zone), the Cobb Seamount population had a smaller average overall size, and a smaller average female size-at-maturity.

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INTRODUCTION

Description of Cobb Seamount and Early Exploration

Cobb Seamount is a 27 million-year-old submerged basalt volcano. It is located outside the U.S. Exclusive Economic Zone (EEZ), approximately 280 nautical miles slightly northwest of the mouth of the Columbia River, which forms the border between the states of Oregon and Washington (Figure 1).

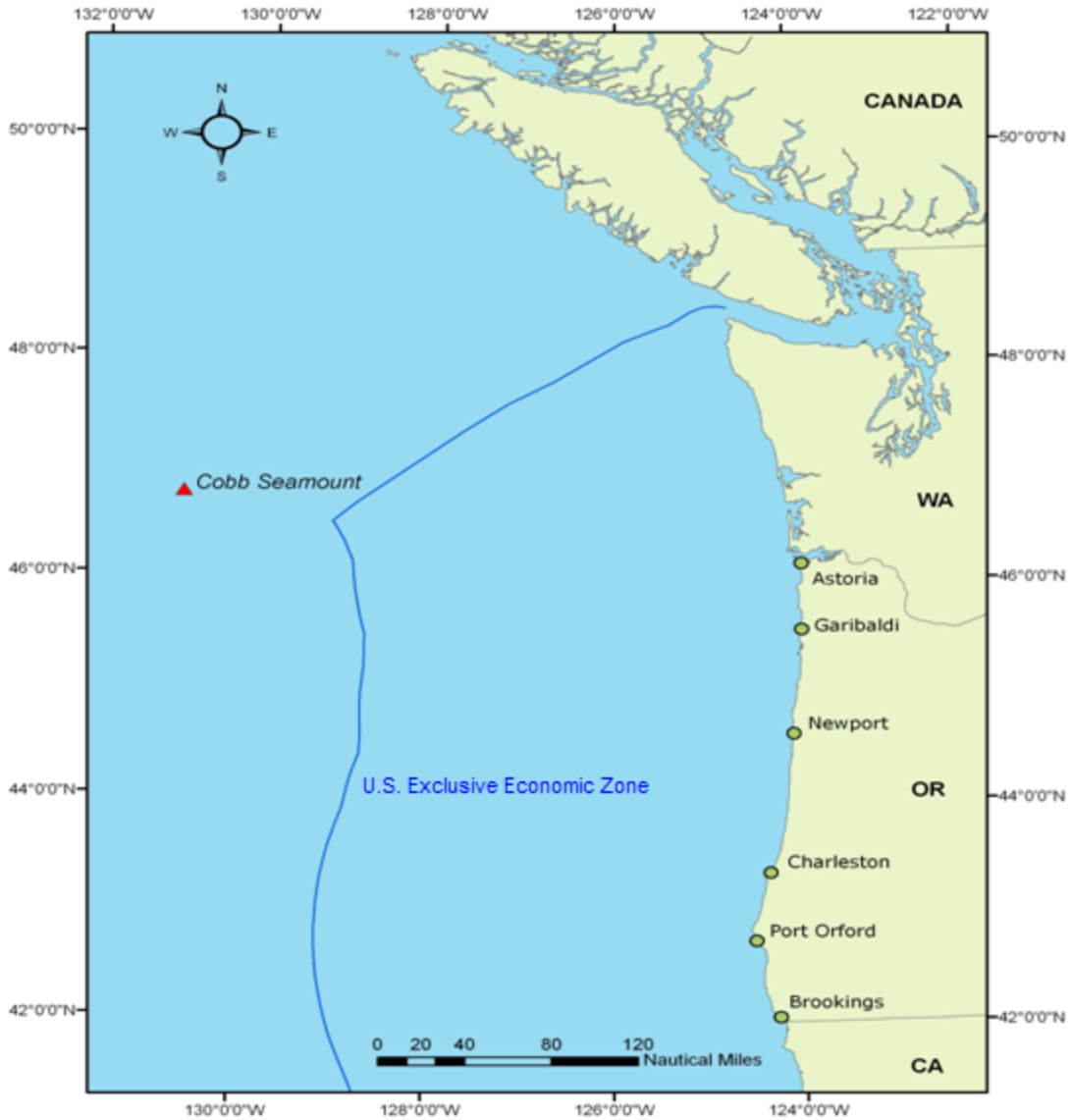


Figure 1. Location of Cobb Seamount and major Oregon fishing ports.

The base of Cobb Seamount is approximately 820 meters (1500 fathoms or 9000 feet) deep, rising to within 33 meters of the surface. The top is flat, and measures approximately 200 by 400 meters. There are four terraces, at 915, 183, 146, and 82 meters (Budinger 1967).

The research vessel *John N. Cobb* began investigations of Cobb Seamount fish communities in 1950 using longline gear. Several species of rockfish (*Sebastes spp.*) and Pacific halibut (*Hippoglossus stenolepis*) were caught. Oceanographic observations began in 1952. In 1956, bottom samples and sounding observations were collected. Extensive underwater observations began in 1965 by the University of Washington at Seattle, Washington and Oregon State University at Corvallis, Oregon (Budinger 1967).

One of the central northeast Pacific seamounts, Cobb Seamount is part of the Juan De Fuca Ridge and is affected by underwater volcanic activity. The Juan De Fuca Ridge extends from about 300 miles west of Newport, Oregon northward to Vancouver Island, Canada. In 1993, underwater volcanic activity was recorded at the Coaxial Segment, approximately 61 miles southeast of Cobb Seamount (Hill 1993). In 1998, underwater volcanic activity was also recorded from Axial Seamount, approximately 69 miles south-southeast of Cobb Seamount (Hill 1998). This volcanic activity was known because the U.S. Navy allowed research scientists to access their underwater listening system in 1991 at the Whidbey Island Naval Air Station north of Seattle, Washington.

Dynamic oceanographic conditions, particularly currents and eddies, characterize open ocean seamounts. Research indicates that strong eddies become trapped over seamounts. These eddies could lead to retention of fish larvae that otherwise would be swept to inhospitable deep-water regions. Heights and longevity of these eddies are not well known. Huppert & Bryan (1976) reported that for certain flow conditions, the water column becomes stationary. Cheney (1980) reported a satellite-tracked drifter that became entrapped over a small seamount and circled the seamount for a month before moving on. This suggests a strong likelihood of some mechanism(s) for retention of larvae and juvenile fish in the area of open ocean seamounts.

History of Foreign Fishing Activity at Cobb Seamount

Takashi Sasaki described the development of trawl fisheries in the vicinity of the central North Pacific seamounts (Uchida et al., 1986). The Soviet Union pioneered seamount fisheries in 1967, targeting pelagic armorhead (*Pentaceros richardsoni*) and alfonsin (*Beryx splendens*). The Japanese fleets joined the seamount fisheries in 1969. By 1978, the armorhead populations were overfished, and alfonsin became the primary target species through 1981.

It is unclear when commercial vessels began fishing the central *northeastern* Pacific seamounts. Chikum (1971) reported Japanese trawlers catching considerable amounts of “black rockfish” at Cobb Seamount in September, 1970. Japanese catch statistics document the first commercial activity at Cobb Seamount in 1978 (T. Sasaki, National Research Institute of Far Seas Fisheries, Japan; personal communication). Japanese stern trawlers fished Cobb Seamount from July 1978 to July 1979, and reported catching approximately 396 metric tons (mt) of “red rockfish”

(*Sebastes spp.*). Roughey rockfish (*S. aleutianus*) dominated the rockfish catch composition¹. Japanese fishers returned in 1985-1989, using bottom longline and gillnet gear, as well as heavy-duty tire trawl gear² (Sasaki, personal communication). Total removals reported by the Japanese fishers during the 1970's and 1980's included almost 1,000 mt of groundfish (88% red rockfish, 3% sablefish and 9% other³). Other countries likely fished Cobb Seamount during this period, but no data are available.

Oregon Shore-Based Fishing at Cobb Seamount

Several exploratory trips to Cobb Seamount were made by Oregon shore-based trawlers during the mid-to-late 1980's, as landing limits inside the U.S. EEZ became more restrictive. It was not until 1991 that large, fishable schools of groundfish, primarily widow rockfish (Figure 2), were discovered at Cobb Seamount by Oregon fishers. They became the target of a new shore-based commercial trawl fishery, which continued through 2003.



Figure 2. Widow rockfish (*Sebastes entomelas*) (Photo: ODFW)

From 1994-1996, the fishery slowed considerably, with only three trips made to Cobb Seamount in three years. Fish were still present, but vessels had a difficult time locating schools large enough to set their gear on, and low-volume catches plus significant fuel expenses for the long trips deterred most fishers. During this time period, increased underwater volcanic activity was noted at the nearby Axial Seamount and Coaxial Segment (Hill 1993, 1998).

Trawl vessels used mid-water gear exclusively, as the seamount terrain proved too rough to deploy bottom trawl nets. Bottom longline and fish pot gear were used at Cobb Seamount by vessels targeting sablefish (Figure 3).

¹Remaining miscellaneous rockfish species cited: shortraker (*Sebastes borealis*), redstripe (*Sebastes proriger*), harlequin (*Sebastes variegatus*), rosethorn (*Sebastes alascanus*), black (*Sebastes melanops*), Pacific ocean perch (*Sebastes alutus*) and yelloweye (*Sebastes ruberrimus*) (Sasaki, personal communication)

² Trawl footrope made of automobile tires

³ Primarily jack mackerel, with other unspecified non-commercial species (Sasaki, personal communication)



Figure 3. Sablefish (*Anoplopoma fimbria*) (Photo: ODFW)

Most trawl landings from Cobb Seamount were delivered into Astoria; a smaller number of trawl and fish pot landings occurred in Coos Bay, and a very small number of deliveries were made into other Oregon ports (Table 1).

Table 1. Number of commercial deliveries of fish caught at Cobb Seamount between 1991-2003, by port and gear type.

<i>Port</i>	<i>Gear Type</i>			<i>Total number of landings</i>
	<i>Trawl</i>	<i>Pot</i>	<i>Longline</i>	
Astoria	147	3	3	153
Garibaldi	1	0	0	1
Newport	5	6	0	11
Coos Bay	17	19	0	36
Total number of landings	170	28	3	201

A total of 5,739 mt of fish caught at Cobb Seamount were landed between 1991 and 2003. The vast majority of the landings were trawl-caught widow rockfish (Table 2).

Table 2: Commercial landings (round, in metric tons) into Oregon ports of fish caught at Cobb Seamount, 1991-2003.

year	# vessels fishing	# trips	gear type	widow rockfish	other rockfish	sablefish	misc. species
1991	4	14	trawl	568	0	0	0
1992	8	28	trawl	1042	0	0	0
	2	3	longline	0	3.6	6.9	0
1993	2	3	pot	0	0.7*	10.1	0
	8	32	trawl	1398	0.3	0	0
1994	1	3	pot	0	0.3*	10.9	0
	2	3	trawl	31	0	0	0
1995	1	2	pot	0	0.1*	28.5	0
	0	0	trawl	0	0	0	0
1996	1	2	pot	0	0.2*	22.7	0
	0	0	trawl	0	0	0	0
1997	1	3	pot	0	0.7*	29.8	0
	6	25	trawl	937	0	0	0.4
1998	4	6	pot	0	2.0*	42.6	trace
	7	18	trawl	470	0.5	0	0
1999	1	2	pot	0	2.4*	13.5	0
	3	10	trawl	239	0.1	0	3.8
2000	1	1	pot	0	1.4*	11.0	0
	2	3	trawl	189	trace	0	4.9
2001	1	2	pot	0	0	30.4	0
	5	21	trawl	549	0.3	0	0
2002	1	2	pot	0	0.7	53.3	0
	2	10	trawl	93	1.0*	0	0
2003	1	1	pot	0	0.4*	32.5	0
	2	5	trawl	49	trace	0	0
2003	1	1	pot	0	0.5*	26.5	0
	total (mt)	--	--	--	5,396	15.2	319

* Caught with hook and line gear
** 4.3 mt jack mackerel (*Trachurus symmetricus*) and 4.8 mt Pacific mackerel (*Scomber japonicus*)

Fishery Management Concerns

Fishing activity within the U.S. EEZ is regulated by the National Marine Fisheries Service, with an overall goal of maintaining harvest at sustainable levels for all species affected by fishing activity. Management measures such as gear restrictions, area restrictions, and trip limits (maximum amount of fish that a vessel may land during a specified period of time) are commonly used to achieve management goals. Widow rockfish catches within the U.S. EEZ have been subject to trip limits since 1982.

Because Cobb Seamount lies outside the U.S. EEZ, it is not subject to U.S. fishing regulations. The U.S. trawl fleet wished to pursue the additional opportunity available to them to fish at Cobb Seamount, for landing amounts above the trip limits that applied to their catch inside the EEZ. However, this was impossible due to the fact that there was no way to distinguish Cobb Seamount widow rockfish from coastal widow rockfish when landed at the dock, and there was no comprehensive at-sea observation of fishing activity or enforcement of area-specific regulations. With the primary point of fisheries enforcement dockside, there was no way to enforce the trip limits for U.S. waters while allowing vessels that met those trip limits to land additional widow rockfish from Cobb Seamount.

One of the objectives of this study was to determine whether differences between the two geographically distinct populations existed and could be used to distinguish between catches from the Cobb Seamount fishery and the coastal fishery at the point of landing. If this proved possible, fisheries managers would be able to allow both fisheries to occur simultaneously, protecting conservatively managed coastal populations through practical enforcement of trip limits, while adding an important viable economic alternative for fishers whose opportunity inside the U.S. EEZ had been restricted by the trip limits.

Goals and Objectives

The goals of this project were to expand the existing understanding of the Cobb Seamount groundfish fishery, and to identify biological indicators for use in dockside differentiation between widow rockfish caught at Cobb Seamount and those caught in more nearshore areas inside the U.S. EEZ. Specific objectives included:

- Obtaining biological baseline data on a new and developing fishery;
- Describing the population structure and biological characteristics of widow rockfish at Cobb Seamount;
- Determining whether significant, detectable differences existed in average population age, size, or age at reproductive maturity between the Cobb Seamount and coastal populations of widow rockfish.

METHODS

From 1991 to 2003, widow rockfish landed by commercial trawlers at Cobb Seamount were sampled by Oregon Department of Fish and Wildlife staff. Biological data about other groundfish species caught incidentally with widow rockfish at Cobb Seamount were also gathered. Sampling of Cobb Seamount catches occurred as time permitted outside of routine dockside sampling duties (*e.g.*, collecting biological samples and species composition data from trawl landings of fish caught within the U.S. EEZ).

Most of the catch from Cobb Seamount was delivered into the port of Astoria, with some deliveries into Coos Bay, Newport, and Garibaldi. Samples were collected at fish processing plants at all ports for widow rockfish, sablefish and miscellaneous bycatch species caught on trips targeting widow rockfish and sablefish.

Sample size mirrored routine nearshore dockside widow rockfish sampling. Approximately 50 fish per landing were sampled for age, sex, length and weight. If time permitted, an additional 150 fish were sampled for length, sex, maturity and weight. If time permitted, all miscellaneous bycatch species were also sampled. No samples were collected from sablefish, as they were landed frozen and dressed (head and viscera removed).

For each sample, landing date, vessel, gear, catch location and catch depth were recorded. The following biological data were collected for each individual widow rockfish in the sample: fork length (cm), sex, maturity status, and weight (pounds). Maturity was determined visually according to criteria found in "Maturity of Widow Rockfish" (Barss and Echeverria 1987). Samples were taken throughout the year as opportunities arose. Seventy-six out of 170 trawl trips landing fish caught at Cobb Seamount were sampled from 1991 to 2003.

RESULTS

Widow Rockfish Fishery

From 1991-2003, the Oregon shore-based midwater trawl fishery landed 5,396 mt of widow rockfish caught at Cobb Seamount. Table 3 presents summarized data from the seventy-six sampled landings.

Table 3. Cobb Seamount widow rockfish sampling summary, 1991-2003.

year	vessel trips	vessels	trips sampled	fish sampled	males avg. fork length (cm)	females avg. fork length (cm)	% mature
1991	18	5	14	1,848	32.8	34.4	48.5
1992	27	8	19	1,623	32.2	33.7	57.4
1993	32	8	12	1,172	31.4	32.4	48.0
1994	2	1	1	151	34.1	37.0	58.9
1995	0	0	0	0	n/a	n/a	n/a
1996	0	0	0	0	n/a	n/a	n/a
1997	26	6	10	2,066	32.1	33.6	50.0
1998	18	7	1	201	33.3	35.1	45.8
1999	10	3	8	1,605	33.4	35.7	40.0
2000	3	2	1	149	30.3	33.9	55.7
2001	21	4	3	801	31.7	34.5	59.2
2002	8	2	5	1,000	32.1	33.8	51.8
2003	5	2	2	351	36.6	39.1	46.7
Total	170	48	76	10,967	n/a	n/a	n/a

Between 1991 and 1993, the length-frequency distribution of widow rockfish caught at Cobb Seamount shifted from a bi-modal to a single-modal pattern (Figure 4). A decrease in average female size-at-maturity over this time period was also observed (Figure 5). Kolmogorov-Smirnov test results indicate the average size-at-maturity changes between years were significant (1991-1992: $D_{\max}=0.234$, $p=0.040$; 1992-1993: $D_{\max}=0.217$, $p=0.44$).

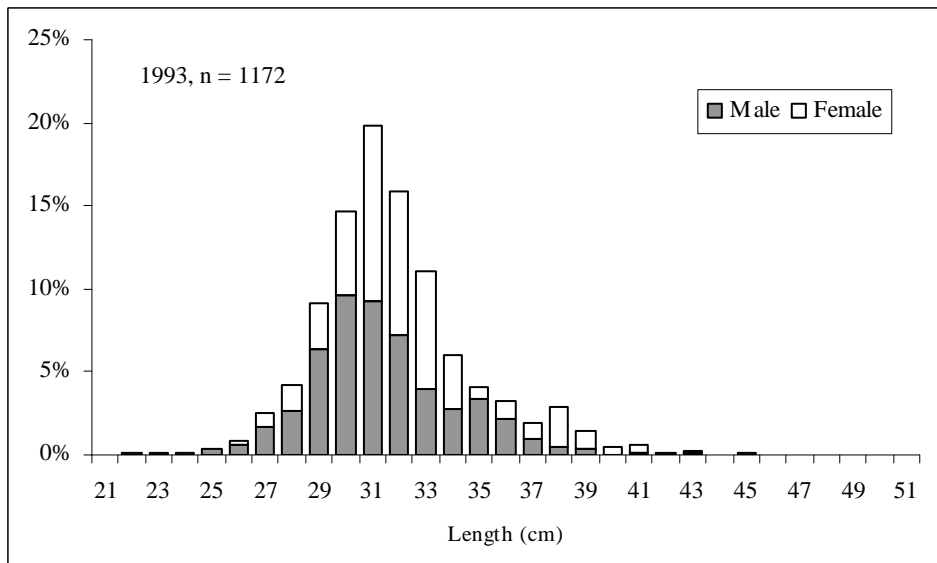
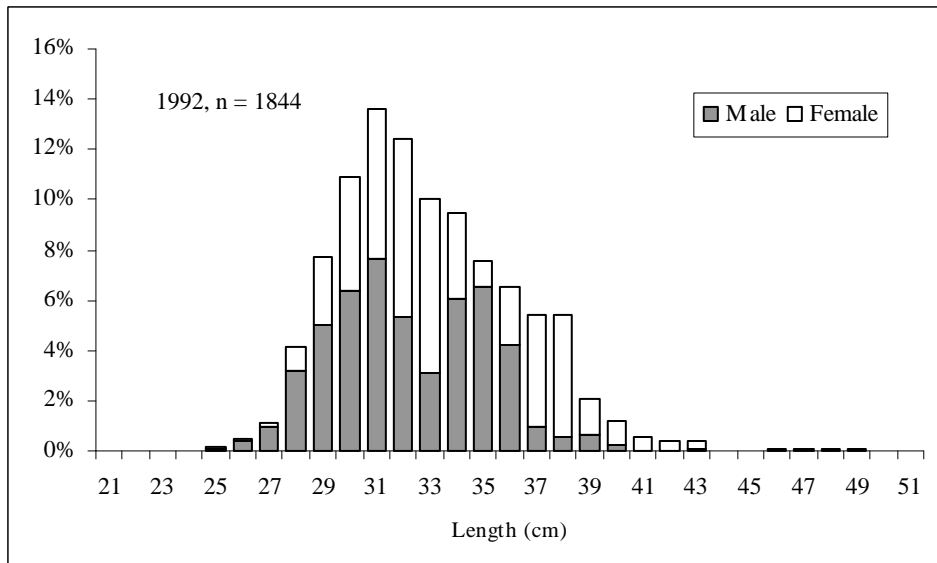
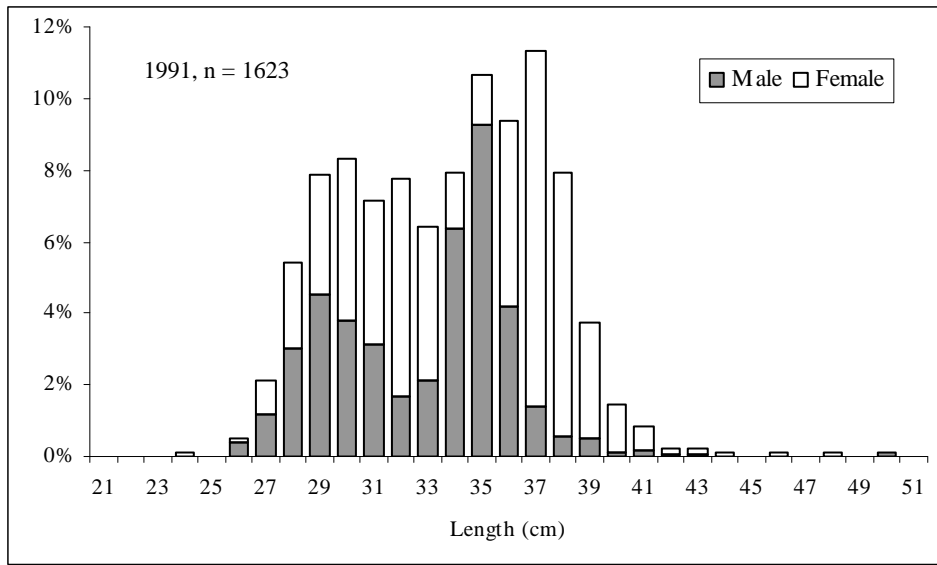


Figure 4. Length frequency of sampled widow rockfish caught at Cobb Seamount, 1991-1993.

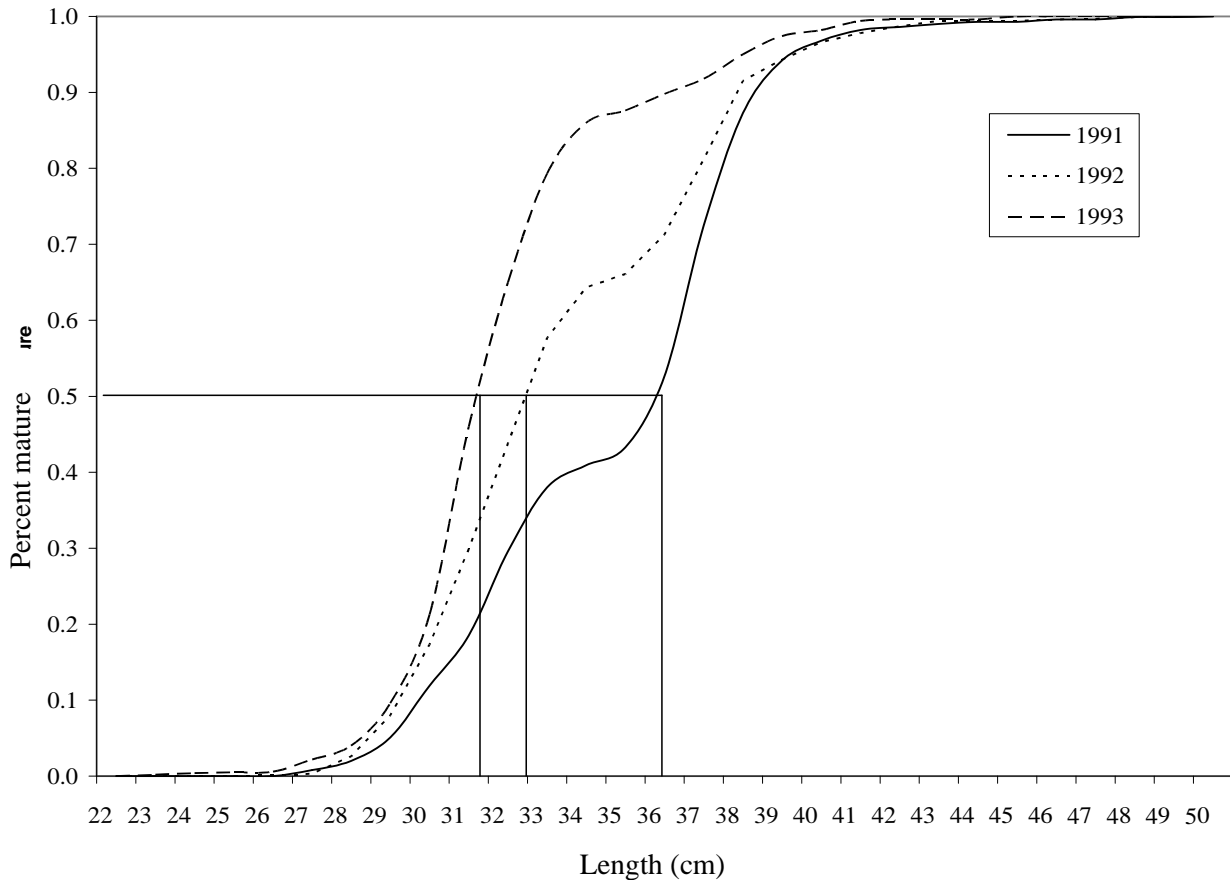


Figure 5. Cumulative percent maturity by size of sampled female widow rockfish caught at Cobb Seamount, 1991-1993.

Compared to the nearshore population of widow rockfish, cumulative length frequency and maturity data from the 1991-1993 period show a significantly smaller average size-at-maturity for female widow rockfish at Cobb Seamount (Figure 6).

From 1994-1996, the Cobb Seamount midwater trawl fishery slowed considerably, with only three trips made during the entire three-year period. Only one sample was taken.

The Cobb Seamount fishery resumed in 1997 and continued into the spring of 2004. Length-frequency data for widow rockfish showed a somewhat more diverse size-in-catch composition, with a noted increase in larger fish (Figure 7). The length-frequency distribution for 1997 appears single-modal; however, in 1998 and 1999 there were indications of a strong incoming year-class.

Between 1997 and 1999 there was an increase in size-at-maturity for female widow rockfish from Cobb Seamount (Figure 8). Kolmogorov-Smirnov test results indicate the changes between each of these years were significant (1997-1998: $D_{\max}=0.256$, $p=0.056$; 1998-1999: $D_{\max}=0.362$, $p=0.065$).

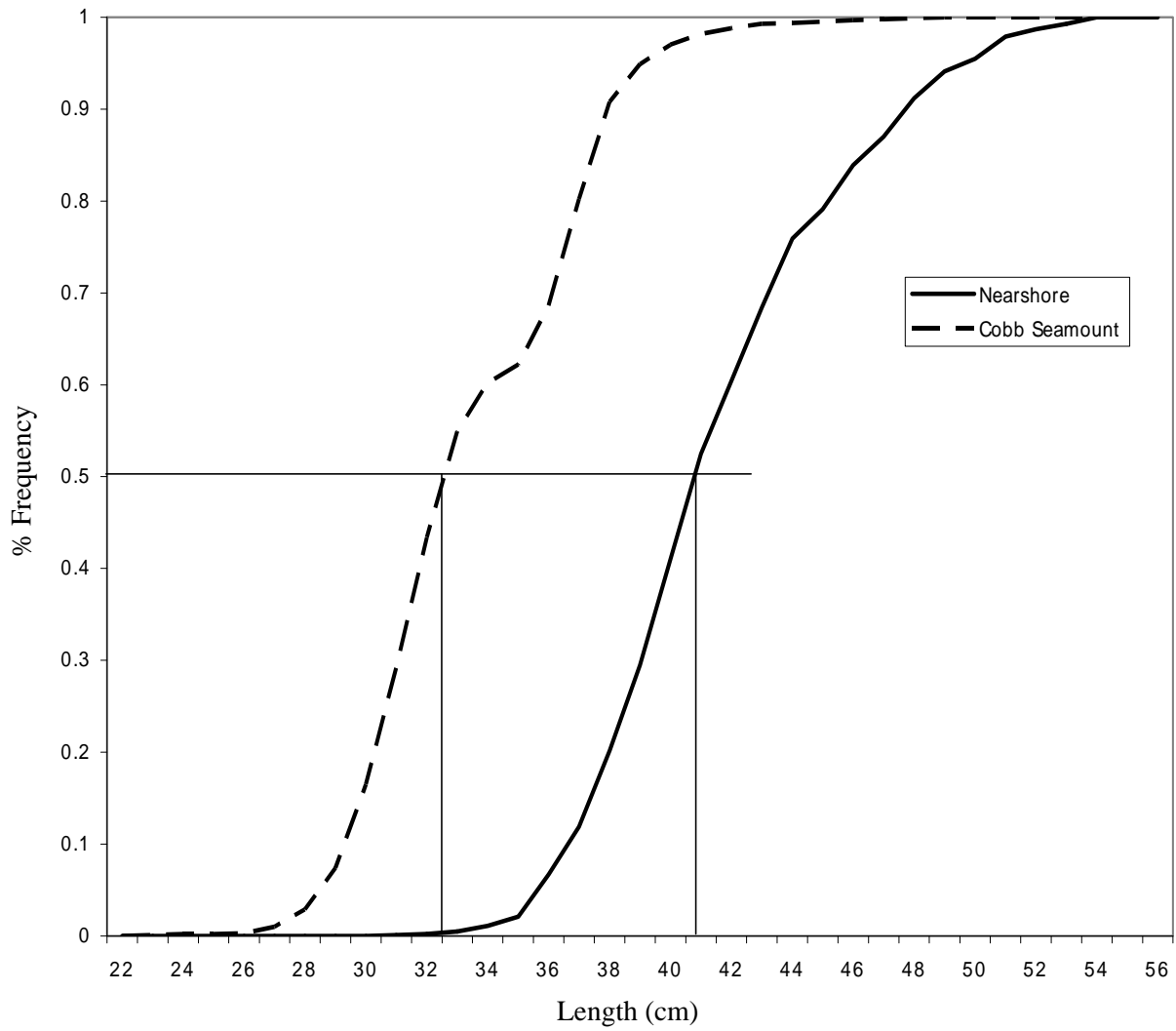


Figure 6. Cumulative length-frequency distribution of mature female widow rockfish from Cobb Seamount and nearshore populations, 1991-1993.

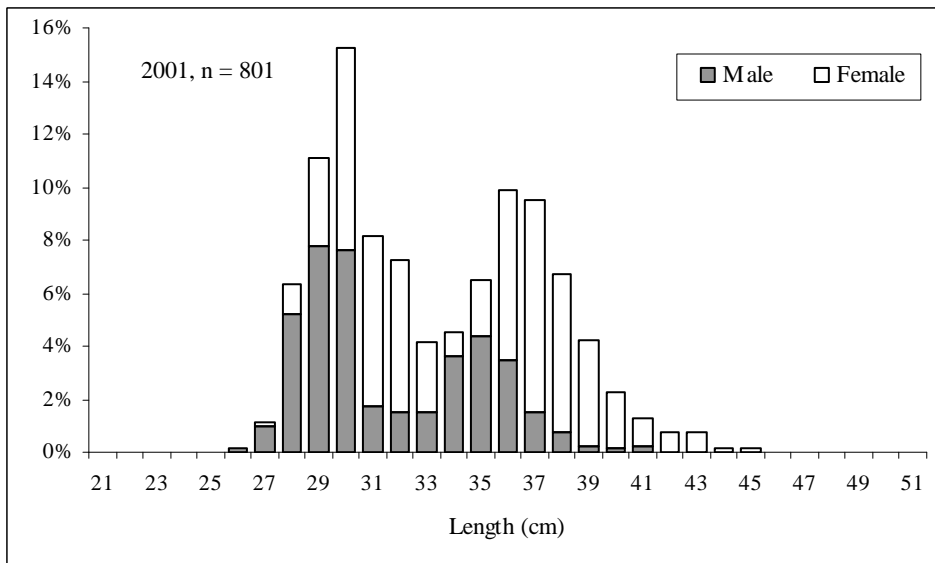
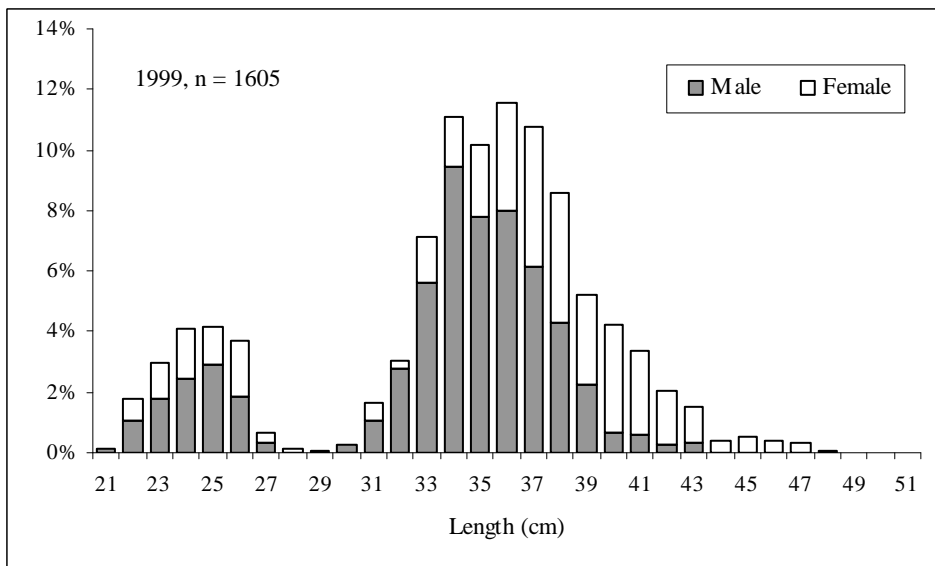
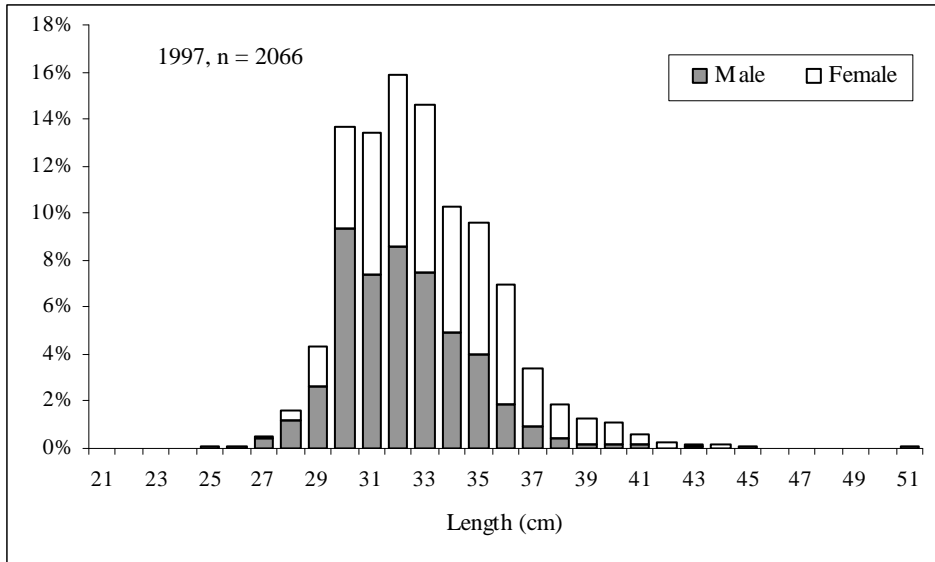


Figure 7. Length frequencies of widow rockfish caught at Cobb Seamount in 1997, 1999, and 2001.

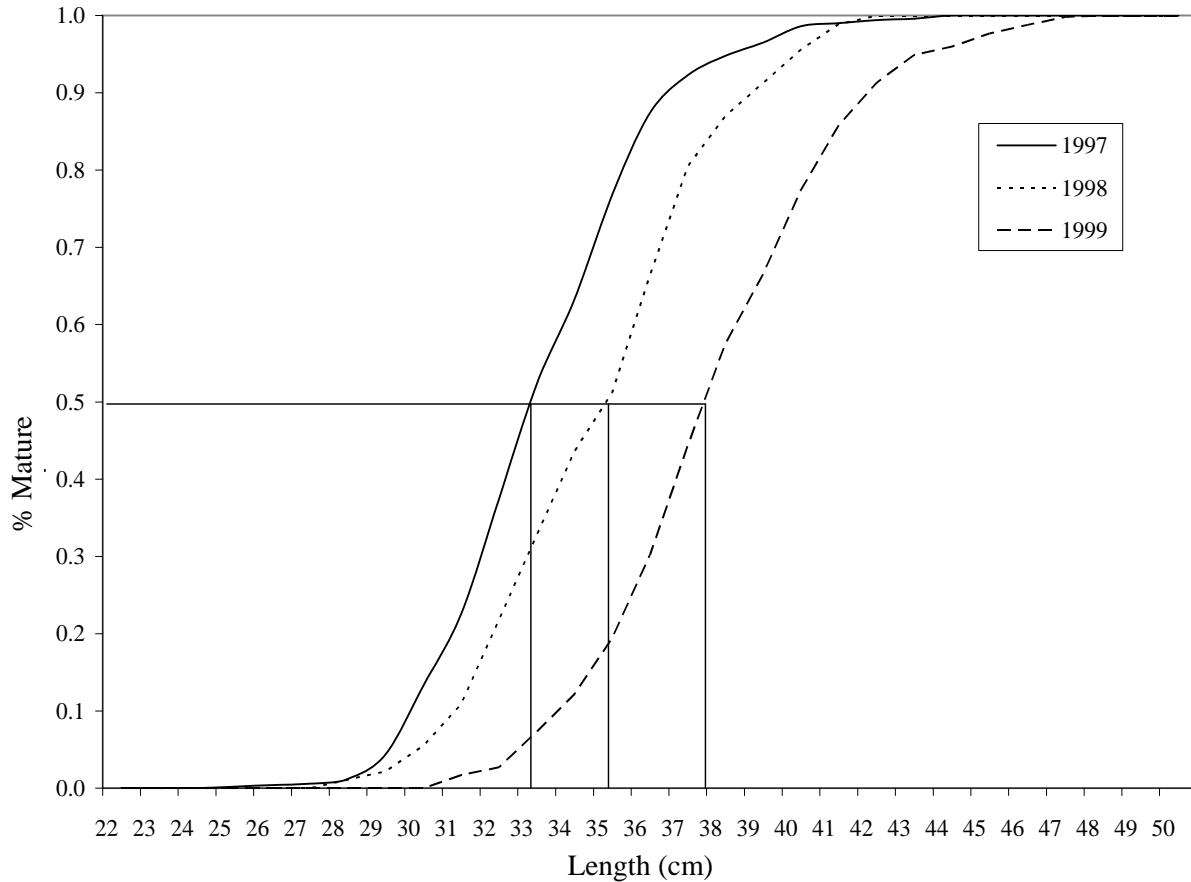


Figure 8. Cumulative percent maturity by size of female widow rockfish caught at Cobb Seamount, 1997-1999.

Sablefish Fishery

During the 1991-2003 period, Oregon shore-based vessels using bottom longline and fish pot gear on trips to Cobb Seamount landed approximately 312 mt of sablefish and 13 mt of rockfish. Very little biological data were gathered from these sablefish landings as all of the product was landed dressed and frozen. A total of 28 trips using pot gear delivered fish into Oregon ports from Cobb Seamount: 19 into Coos Bay, six into Newport, and three into Astoria. Only three longline deliveries were made, all into Astoria (Table 4). The sablefish catch was dominated by fish of 3-4 pound dressed (head and viscera removed) landing weights.

Table 4. Sablefish caught at Cobb Seamount between 1991 and 2003 with fixed gear and landed into Oregon.

Gear	Dressed Weight Landing Categories						Estimated Round Weight (mt)*	# Trips
	1-2 lbs	2-3 lbs	3-4 lbs	4-5 lbs	5-7 lbs	7+ lbs		
longline	2.6%	26.6%	34.5%	21.2%	12.0%	3.1%	6.9	3
pot	70.0%	18.3%	38.2%	23.6%	16.2%	3.0%	304.6	28

*Round weight conversion factor: 1.6 x dressed weight

Incidental Species

As summarized in Table 2, approximately 15.2 mt of “other rockfish” were caught at Cobb Seamount between 1991 and 2003. Almost all of this catch was made with bottom longline gear, with lesser amounts from vertical hook and line gear and pot gear. The hook and line catch was primarily made by vessel crewmen between trawl sets and during pot soak periods. Rougheye rockfish (*Sebastes aleutianus*) dominated the bottom longline catch, while rosy rockfish (*S. rosaceus*) and yelloweye rockfish (*S. rubberimus*) dominated the hook and line catches (Figure 9).

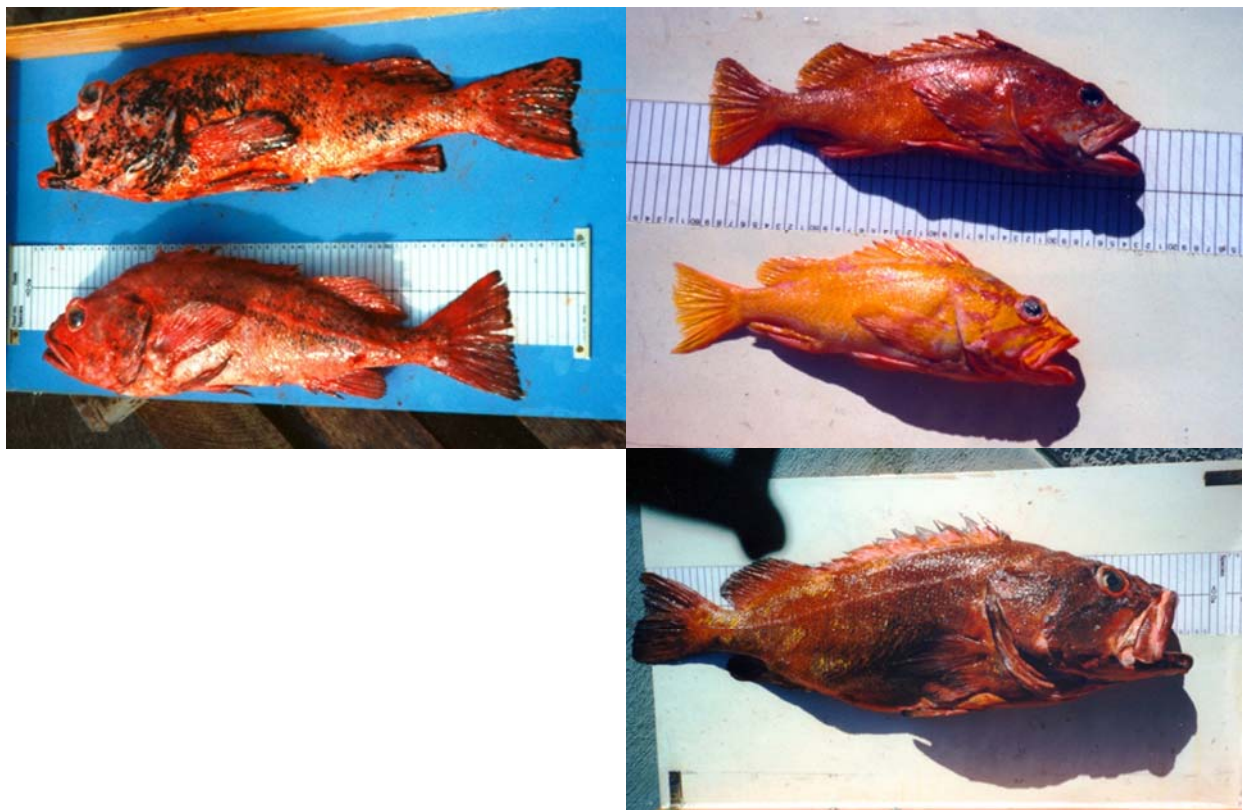


Figure 9. Dominant Cobb Seamount non-trawl rockfish species, clockwise from top left: rougheye rockfish, rosy rockfish, yelloweye rockfish. (Photos: ODFW)

Most of the incidental midwater trawl gear catch was composed of harlequin rockfish (*S. variegatus*) and shortbelly rockfish (*S. jordani*).

Table 5. Sampling summary for landed incidental groundfish species caught at Cobb Seamount, 1991-2003.

species	# fish sampled	gear	avg. fork length (cm)	sample notes
blue rockfish	4	hook & line*, longline	37.3	
rosethorn rockfish**	4	bottom trawl	28.3	
rougheyeye rockfish	76	longline	31.8	50 otoliths taken but not read
shortbelly rockfish	41	midwater trawl, hook & line*	28.4	
yellowtail rockfish	2	hook & line*	53.0	1-female=57cm & 1-male=49cm
rosy rockfish	102	hook & line*	31.9	
bocaccio rockfish	2	midwater trawl	76.5	1-female=83cm & 1-male=70cm
harlequin rockfish	94	bottom trawl, hook & line*, longline	32.2	50 otoliths taken
yelloweye rockfish	100	longline	54.5	avg. wt: 6.4 lb females; 5.1 lb males
Dover sole**	26	bottom trawl	39.0	
rex sole**	50	bottom trawl	35.7	
rock sole**	23	bottom trawl	38.5	
blue shark	1	midwater trawl	--	estimated length = 9 ft
pelagic armorhead	5	midwater trawl	29.3	
Pacific mackerel	4	midwater trawl	39.5	
skillfish	1	longline	--	147 lbs
salmon shark	1	midwater trawl	--	est. length = 6.5 ft; 117 lbs dressed
longnose skate	1	midwater trawl	--	male, 28cm
cat shark	1	longline	--	40 lbs, 148.5 cm
<p><i>*The hook & line take occurred via vessel crew members during down time at the seamount</i> <i>**These species were caught in a single experimental bottom tow made in 1991. The tow lasted 25 minutes before the net was caught on the bottom.</i></p>				

DISCUSSION

Several important differences between the Cobb Seamount and nearshore populations of widow rockfish were observed in the initial (1991) landings from the Cobb Seamount fishery: the Cobb Seamount fish had a significantly smaller average size overall, and females a smaller average size-at-maturity. Other important differences between the two populations that have been noted in previous studies include: degree of parasitic infestation and mesenteric fat content (P. Ruvelas and D. Pearson, NOAA Southwest Fisheries Science Center Tiburon Laboratory, unpublished data), and degree of vateritic⁴ otolith frequency and age composition (Pearson et al. 1993).

The differences in overall size and female size-at-maturity observed during the 1991-1993 period proved to be key characteristics allowing landings in the shore-based fishery of widow rockfish caught at Cobb Seamount to be distinguished from widow rockfish coming from the coastal population(s). Because catch from each of the two areas could be identified at landing, differential regulations could be enforced shoreside, and the high seas Cobb Seamount fishery was allowed to continue while the coastal population of widow rockfish was protected by trip limits on the fishery within the U.S. EEZ.

U.S. fishing effort and the characteristics of the widow rockfish catch varied over the time period of interest:

1991-1993

By 1993, approximately 3,000 metric tons of widow rockfish had been harvested from Cobb Seamount. It is unclear what role, if any, fishing removals had in the observed decrease in average size-at-maturity or the change from a bi-modal to a single-modal size composition over this period.

1994-1996

Midwater trawl fishing activity dropped significantly from 1994 to 1996, with only three landings made into Oregon ports. Fixed-gear sablefish fishing remained more active, with seven deliveries made into Coos Bay. During this time period, fishers reported increased temperatures and cloudy water on the Cobb Seamount fishing grounds. The volume of fish per tow dropped, eventually making the profit margin unfavorable. Reasons for the change in widow rockfish behavior are unknown. Scientists reported increased underwater volcanic activity during this time period at Axial and Coaxial Seamounts, which are near Cobb Seamount (Hill 1993, 1998), and it is possible this affected widow rockfish behavior through changes in seawater chemistry, turbidity, ambient noise levels, or other factors.

1997-2003

It was not until 1997 that fishable schools of widow rockfish were again found at Cobb Seamount. From 1997 to 1999, there was a noted increase in size-at-maturity in females. Also

⁴ Condition in which the aragonite in the otolith is replaced by vaterite (also called mu-calcium carbonate), a different structural form of calcium carbonate. Vateritic otoliths are also referred to as “resorbed” or “crystallized”.

by 1999, there were indications of a strong incoming year class, and by 2001 this year class appeared to dominate Cobb Seamount landings (Figure 7). Because size-at-maturity and overall size composition were the features that had earlier allowed differentiation between Cobb Seamount and coastal populations, the changes noted in the 1997 landings meant that it was more difficult to distinguish between catches from the two areas at landing.

More information on how environmental conditions affect recruitment, growth and natural mortality is needed to better understand the changes over time in the sampled biological characteristics of widow rockfish caught at Cobb Seamount, and recruitment to the seamount population. Environmental factors likely to play a role include variations in food availability, temperature, salinity, upwelling, and currents that influence the direction of widow rockfish larval drift. Fishing removals may also have affected the dynamics of the Cobb seamount population, but the direction and degree of the effects are unclear.

U.S. fishing activity on the Cobb Seamount ceased in early 2004 when the National Marine Fisheries Service stopped issuing high seas permits for net gear types.

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