

Comparison of Fishes Taken By a Sportfishing Party Vessel Around Oil Platforms and Adjacent Natural Reefs Near Santa Barbara, California

Milton S. Love

Marine Science Institute, University of California
Santa Barbara, California 93106

William Westphal

VANTUNA Research Group, Occidental College
1600 Campus Road, Los Angeles, California 90041

Since 1958, 29 oil platforms have been sited in the southern California Bight of which 28 still remain in place. However, with the exception of a few papers (Carlisle et al. 1964, Bascom et al. 1976, Allen and Moore 1976), little is known of the fish populations surrounding these structures, particularly those sited in water deeper than 30 m. Moreover, except for a brief reference in Carlisle et al., no scientific papers have been published on the use of southern California platforms by sport fishermen.

In the course of research on the Santa Barbara, California, party vessel sport fishery, it was noted that the platforms off Santa Barbara supported considerable sportfishing activity. Those platforms, located to the southeast of Santa Barbara in depths of 48–62 m (Fig. 1), were particularly important and were fished intensively for various rockfishes (genus *Sebastes*). When fishing a platform, the vessel pulled up to within 5–10 m of a platform and drifts along one side, with the vessel operator using intermittent power to keep it near the structure. Most of the desirable species, particularly rockfishes, remained close to the platforms, rarely venturing more than perhaps 20 m from the structure. The party vessels also spent considerable time fishing over

nearby natural reefs. In this survey, it was noted that there appeared to be differences in species catch composition and fish size between oil platforms and these natural reefs.

Increased offshore oil drilling off California has raised interest in the role platforms play in marine systems. Questions have been raised regarding what fish live around platforms, how these structures influence populations over surrounding reefs, and whether the platforms act as fish enhancers (promoting recruitment) or only as aggregators. These questions are particularly relevant when the platforms are to be decommissioned and the possibility of allowing them to remain as artificial reefs is raised. This paper describes the results of our study on the fish populations around oil platforms and nearby natural reefs off Santa Barbara.

Methods

The study was conducted aboard the 16-m sportfishing vessel *Hornet*, berthed in Santa Barbara. During the course of this study the *Hornet* operated 6 days per week; 3 three-quarter day trips (7 am–3 pm) and 3 half-day trips (7 am–noon, 12:30 pm–5:30 pm). The *Hornet* carried a maximum of 40 passengers. Fish taken aboard the *Hornet* were sam-

pled weekly from April 1975 to April 1978. All fish landed were measured, even those returned alive to the water as undesirable or in compliance with bag or size-limit regulations. Each was placed on a plastic measuring sheet and the length marked. Total length was recorded to the nearest mm for all fish except members of the jack (*Carangidae*) and mackerel (*Scombridae*) families, for which fork length was taken to the nearest mm. Also recorded were the number of anglers aboard the vessel, hours fished, and the location and depth of fishing effort. Of particular importance was the total time the *Hornet* fished around or over all the fishing sites. This information was obtained through biweekly interviews with *Hornet* operators throughout the 3-year survey.

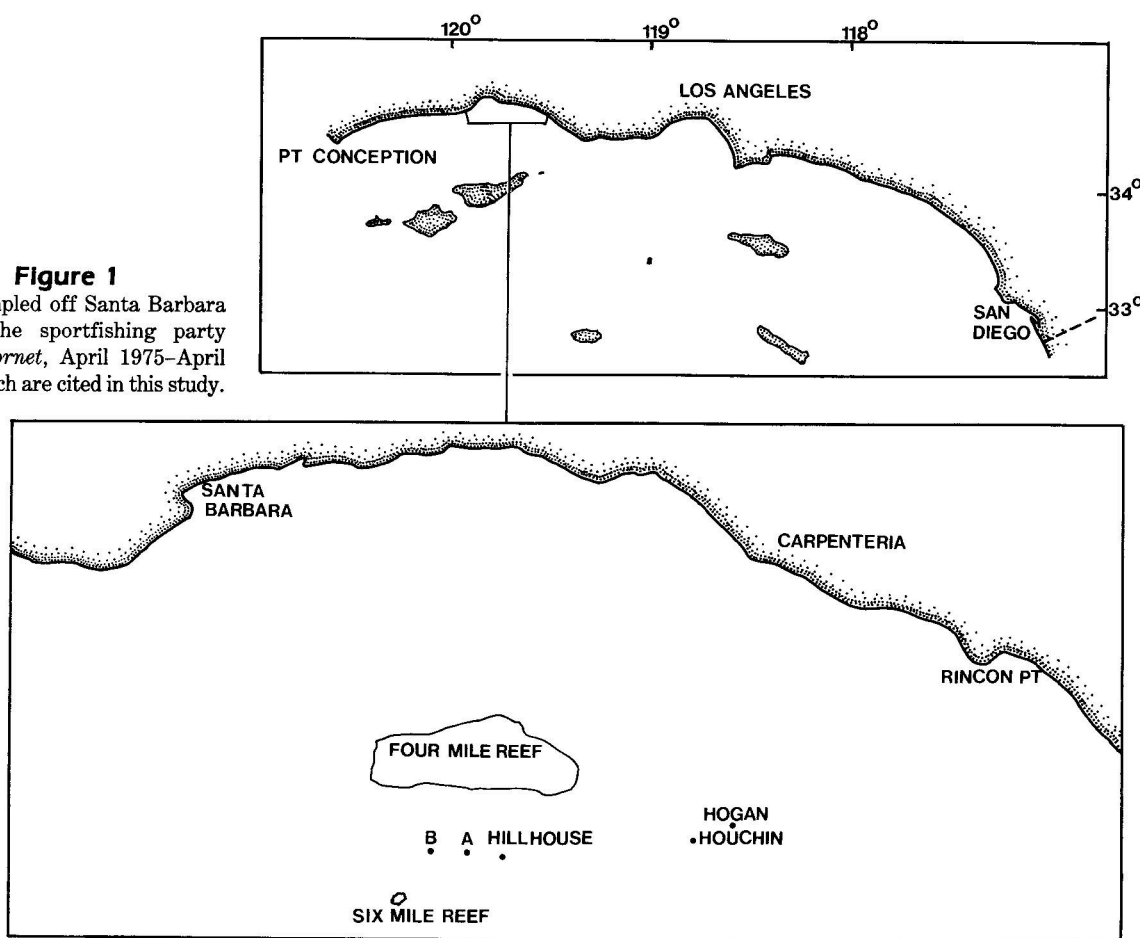
Data from this study could not give an unbiased estimate of species composition. Most angling involved fishing with live bait (primarily northern anchovies *Engraulis mordax*) or with lures simulating fishes or small crustaceans at the three sites used in this study. Thus, because the sample was biased toward relatively large-mouthed, piscivorous species, we determined distributional patterns of whatever species were taken by these methods, rather than describing entire fish communities.

For this report we have divided the study sites into three locations (Fig. 1): 4 Mile Reef, 6 Mile Reef, and five platforms. Twenty-one other reefs and kelp beds located well away from this area are not included. The 4 Mile Reef is an aggregation of 1–7 m high pinnacles in 40–50 m of water. The oil platforms fished included Platforms A, B, Hillhouse, Houchin, and Hogan. These are steel structures 25–45 m on the side, situated in water depths between 54 and 62 m. The 6 Mile Reef

Manuscript accepted 22 March 1990.
Fishery Bulletin, U.S. 88:599–605.

Figure 1

Sites sampled off Santa Barbara aboard the sportfishing party vessel *Hornet*, April 1975–April 1978, which are cited in this study.



is located in a depth of 74 m and rises to about 6 m above the substrata.

Results

The *Hornet* spent 18.2% of its total fishing time around the platforms, compared with 18.4% over the 4 Mile Reef and 2.4% over the 6 Mile Reef (Table 1). About 17% of all fish recorded at all 24 sites were taken around the platforms, compared with 27.6% over 4 Mile Reef and 3.2% over 6 Mile Reef (Table 2).

Twenty-eight species were taken around the platforms, compared with 34 and 17 species over the 4 Mile and 6 Mile Reefs, respectively (Table 3). Rockfishes (*Sebastes* sp.) predominated the catches at all sites in both species numbers and abundance. Of all species captured at the platforms, 53.6% were rockfishes, compared with 50% at the 4 Mile Reef and 82.4% at the 6 Mile Reef. Of all fish taken around the platform, 83% were rockfishes, compare with 96.0% and 90.8% at the 6 Mile and 4 Mile Reefs, respectively. Catch-per-unit-

Table 1

Percent of total fishing time spent off Santa Barbara at oil platforms, 4 Mile Reef, and 6 Mile Reef, April 1975–April 1978, by the sportfishing party vessel *Hornet*. Based on biweekly interviews with *Hornet* operators.

Site	Hours	% Total
4 Mile Reef	613.2	18.4
Platforms	607.6	18.2
6 Mile Reef	78.5	2.4
Other (21) sites	2039.6	61.0

Table 2

Percentage, by average, of all fish sampled off Santa Barbara aboard the sportfishing party vessel *Hornet*, April 1975–April 1978.

Site	N	% Total
4 Mile Reef	4 390	27.6
Platforms	2 746	17.3
6 Mile Reef	510	3.2
All Other Areas	8 272	52.0

Table 3

All fish surveyed off Santa Barbara aboard the sportfishing party vessel *Hornet*, April 1975–April 1978, around the oil platforms (A, B, Hillhouse, Houchin, and Hogan), 4 Mile Reef, and 6 Mile Reef.

Species	Total length (mm)	SD	N	% Total	Species	Total length (mm)	SD	N	% Total
Oil platforms¹					4 Mile Reef²				
<i>Sebastes serranoides</i>	270.0	28.1	831	30.3	<i>Sebastes mystinus</i>	259.6	35.6	1044	23.8
<i>Sebastes entomelas</i>	265.4	25.8	420	15.3	<i>Sebastes hopkinsi</i>	215.5	17.1	947	21.6
<i>Scomber japonicus</i>	358.3	44.8	283	10.3	<i>Sebastes serranoides</i>	294.3	40.1	750	17.1
<i>Sebastes pinniger</i>	238.8	24.3	191	7.0	<i>Sebastes paucispinis</i>	298.2	58.4	716	16.3
<i>Sebastes auriculatus</i>	269.1	49.9	183	6.7	<i>Scomber japonicus</i>	306.6	25.8	228	5.2
<i>Sebastes paucispinis</i>	260.8	32.8	147	5.4	<i>Sebastes entomelas</i>	189.3	24.4	97	2.2
<i>Sebastes miniatus</i>	262.1	37.8	143	5.2	<i>Sebastes rosaceus</i>	197.2	23.7	97	2.2
<i>Sebastes mystinus</i>	243.0	27.2	128	4.7	<i>Sebastes constellatus</i>	287.6	44.6	60	1.4
<i>Paralabrax clathratus</i>	318.5	61.2	92	3.4	<i>Sebastes rubrivinctus</i>	266.7	46.7	57	1.3
<i>Sebastes hopkinsi</i>	213.2	16.8	60	2.2	<i>Paralabrax clathratus</i>	334.4	85.9	54	1.2
<i>Sebastes caurinus</i>	260.2	34.4	60	2.2	<i>Sebastes auriculatus</i>	333.4	67.6	51	1.2
<i>Sebastes flavidus</i>	255.9	23.0	59	2.2	<i>Sebastes miniatus</i>	375.5	90.6	42	1.0
<i>Ophiodon elongatus</i>	490.2	136.2	17	0.6	<i>Ophiodon elongatus</i>	537.3	117.9	36	0.8
<i>Genyonemus lineatus</i>	294.6	33.9	16	0.6	<i>Sebastes umbrosus</i>	197.7	28.1	30	0.7
<i>Trachurus symmetricus</i>	226.5	33.1	15	0.6	<i>Sebastes caurinus</i>	346.7	57.6	25	0.6
<i>Sebastes dalli</i>	157.1	27.0	14	0.5	<i>Sebastes dalli</i>	136.9	27.9	16	0.4
<i>Medialuna californiensis</i>	259.2	12.5	13	0.5	<i>Anoplopoma fimbria</i>	216.9	2.0	14	0.3
<i>Paralabrax nebulifer</i>	455.2	65.3	12	0.4	<i>Atractoscion nobilis</i>	878.6	166.0	12	0.3
<i>Sebastes rubrivinctus</i>	238.7	24.7	12	0.4	<i>Chromis punctipinnis</i>	310.6	48.4	10	0.2
<i>Sebastes rosaceus</i>	213.4	17.7	10	0.4	<i>Genyonemus lineatus</i>	303.2	52.1	10	0.2
<i>Sebastes constellatus</i>	280.0	39.3	5	0.2	<i>Sebastes pinniger</i>	241.8	98.3	10	0.2
<i>Sarda chiliensis</i>	512.5	15.8	4	0.2	<i>Trachurus symmetricus</i>	272.8	20.7	9	0.2
<i>Citharichthys sordidus</i>	208.7	11.0	3	0.1	<i>Scorpaena guttata</i>	253.6	43.5	7	0.2
<i>Chromis punctipinnis</i>	290.0	1.4	2	0.1	<i>Sebastes flavidus</i>	255.3	33.1	7	0.2
<i>Scorpaena guttata</i>	219.0	96.2	2	0.1	<i>Semicossyphus pulcher</i>	545.8	69.0	5	0.1
<i>Scorpaenichthys marmoratus</i>	362.5	14.8	2	0.1	<i>Paralabrax nebulifer</i>	531.8	61.7	5	0.1
<i>Squalus acanthias</i>	989.5	4.9	2	0.1	<i>Sebastes carnatus</i>	218.3	13.3	4	0.1
<i>Sebastes umbrosus</i>	147.0	94.8	2	0.1	<i>Hydrolagus collicii</i>	500.3	81.3	3	0.1
Total			2728		<i>Medialuna californiensis</i>	250.0	12.7	2	<0.1
					<i>Sarda chiliensis</i>	440.5	7.8	2	<0.1
					<i>Squatina californica</i>	1040.5	57.3	2	<0.1
					<i>Eptatretus stouti</i>	287.0	0.0	1	<0.1
					<i>Synodus lucioceps</i>	328.0	0.0	1	<0.1
					Total			4354	

Species	Total length (mm)	SD	N	% Total	Species	Total length (mm)	SD	N	% Total
6 Mile Reef³									
<i>Sebastes mystinus</i>	262.5	42.3	146	28.6	<i>Sebastes chlorostictus</i>	205.3	22.1	4	0.8
<i>Sebastes entomelas</i>	309.7	28.0	112	22	<i>Sebastes caurinus</i>	357.0	58.2	3	0.6
<i>Sebastes hopkinsi</i>	234.0	27.0	85	16.7	<i>Ophiodon elongatus</i>	639.0	172.5	2	0.4
<i>Sebastes paucispinis</i>	307.6	60.7	75	14.7	<i>Sebastes flavidus</i>	297.5	0.7	2	0.4
<i>Sebastes rubrivinctus</i>	270.8	43.8	26	5.1	<i>Paralabrax nebulifer</i>	537.0	0.0	1	0.2
<i>Sebastes serranoides</i>	286.6	47.5	20	3.9	<i>Sebastes dalli</i>	157.0	0.0	1	0.2
<i>Genyonemus lineatus</i>	301.6	21.7	17	3.3	<i>Sebastes rosaceus</i>	171.0	0.0	1	0.2
<i>Sebastes constellatus</i>	267.4	70.9	5	1.0	<i>Sebastes umbrosus</i>	186.0	0.0	1	0.2
<i>Sebastes miniatus</i>	387.6	57.3	5	1.0	Total			506	

¹No. trips = 15; No. anglers = 352; No. hours fished = 47.0; Effort = 8251 angler hours; CPUE = 0.33 fish per angler hour; H' = 1.03.
²No. trips = 24; No. anglers = 454; No. hours fished = 79.8; Effort = 36 206 angler hours; CPUE = 0.12 fish per angler hour; H' = 0.95.
³No. trips = 6; No. anglers = 58; No. hours fished = 12.5; Effort = 725 angler hours; CPUE = 0.70 fish per angler hour; H' = 0.95.

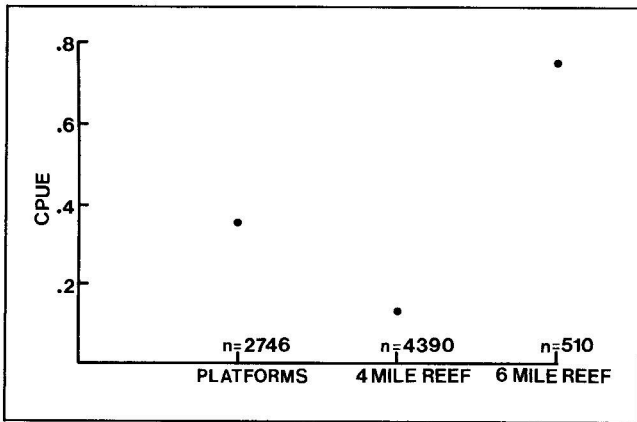
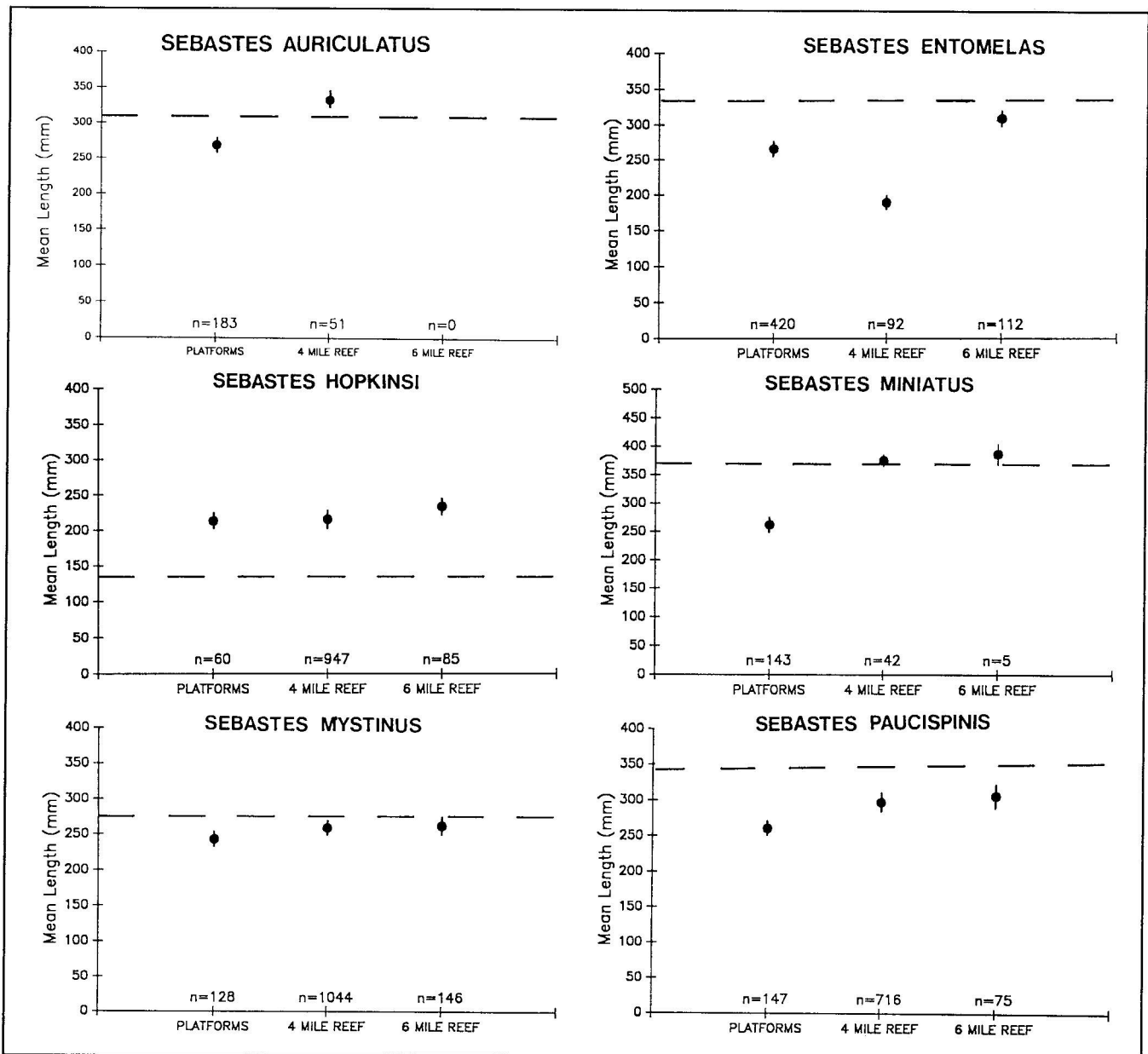


Figure 2
Catch-per-unit-effort (number of fish taken per angler hour) of all species caught aboard the sportfishing vessel *Hornet*, based on sampling during April 1975–April 1978 at three sites off Santa Barbara.

Table 4
Kendall tau rank correlation analysis of the top ten species taken by the sportfishing party vessel *Hornet*, April 1975–April 1978, at three sites off Santa Barbara, California.

6 Mile Reef	$\tau = 0.13$	
	$p = 0.26$	
	$N = 14$	
4 Mile Reef	$\tau = 0.00$	$\tau = 0.72$
	$p = 0.50$	$p = 0.01$
	$N = 14$	$N = 14$
Platform		6 Mile Reef



effort (CPUE), defined as number of fish taken per angler hour, was highest at the 6 Mile Reef, followed by the platforms and the 4 Mile Reef (Fig. 2).

At the platforms (Table 3) rockfish made up 8 of the 10 most-frequently-taken species. While olive rockfish *Sebastes serranoides*, widow rockfish *S. entmelas*, chub mackerel *Scomber japonicus* comprised 55.9% of the total catch, a number of other species (including canary rockfish, *Sebastes pinniger*, brown rockfish *S. auriculatus*, and bocaccio *S. paucispinis* were also taken in some numbers. AT the 4 Mile Reef, 8 of the top 10 species were rockfish, with blue rockfish *Sebastes mystinus*, squarespot rockfish *S. hopkinsi*, *S. serranoides*, and *S. paucispinis* dominating the catch, making up 78.8%. Nine of the top 10 species at the 6 Mile Reef were rockfish and *S. mystinus*, *S. entomelas*, *S. hopkinsi*, and *S. paucispinis* were taken in the largest numbers, forming 82.0% of the total.

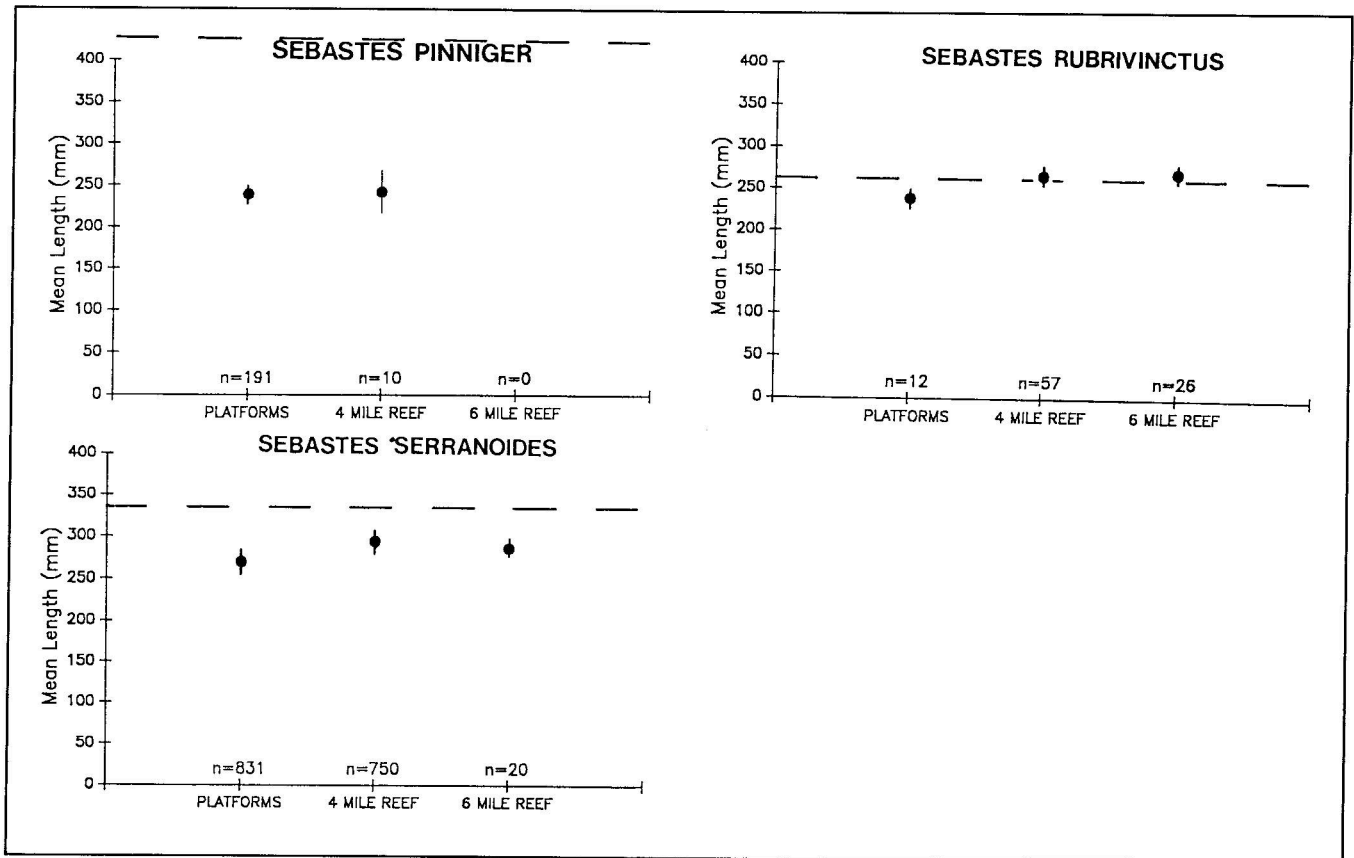
We compared the rank abundances of the top 10 species at the three sites with the Kendal tau coefficient test (Sokal and Rohlf 1969). Based on this mea-

sure, species composition was significantly correlated between natural reefs only, and species arrays from natural reefs were not correlated with that of the platform (Table 4). The primary differences between the reefs and platforms were the relative abundances of *S. hopkinsi*, *S. mystinus*, starry rockfish *S. constellatus*, and flag rockfish *S. rubrivinctus* at the natural reefs and the scarcity of *S. auriculatus* and *S. pinniger* over these reefs.

With only a few exceptions, all rockfish taken around the platforms were juveniles (Fig. 3). A major exception was *S. hopkinsi*, a species in which all individuals taken were mature. In addition, a few adult *S. auriculatus* and *S. mystinus* were caught, as well as one vermillion rockfish *S. miniatus*. At the 4 Mile Reef, a higher percentage of fish were mature. Again, all *S. hopkinsi* taken were adults, as were most *S. auriculatus* and *S. miniatus*, many *S. mystinus* and *S. rubrivinctus*, and a few *S. serranoides*. In general, more adult rockfish were taken over the 6 Mile Reef than at the other two stations. All *S. hopkinsi* were mature,

Figure 3 (bottom facing page and below)

Mean size (with 95% confidence interval) of 9 species caught aboard the sportfishing party vessel *Hornet*, based on sampling during April 1975–April 1978 at three sites off Santa Barbara. Also included are 50% lengths at maturity from data in Wyllie Echeverria (1987), Love et al. (1990), and Love (unpubl. data).



as were most *S. miniatus* and *S. rubrivinctus* and many *S. entomelas*, *S. mystinus*, *S. paucispinis*, and *S. serranoides*.

Discussion

During the period sampled, the platforms were important sites for the *Hornet's* fishing effort. They were also fished by other sportfishing party vessels from Ventura Harbor, about 30 km to the east, though we are unsure of the total effort from these vessels. In both circumstances, these structures provided the vessel operators with a relatively reliable source of easily caught, though generally small, fish. The ease with which small rockfish were caught made the platforms particularly attractive to the *Hornet's* operators on half-day runs, when the vessels carried many inexperienced fishermen. The platforms were also utilized when fishing was poor at other locations for more desirable species, such as kelp bass *Paralabrax clathratus*.

We have recently (1989) discussed platform fishing with current Santa Barbara party vessel operators. They report that though the platforms are still fished for small rockfish, kelp bass are an equal or more important species during summer months. This is particularly true of the eastern platforms, particularly Houchin, Hogan, and Hope (2 km east of Hogan). Though there are five platforms in this complex, only these three are routinely fished. During the season's peak, as many as 300–400 *P. clathratus* per trip are caught from around a single platform. Based on tagging studies by P. Hart (Dep. Biol. Sci., Univ. Calif., Santa Barbara 93106, pers. commun., Sept. 1988), it is likely that kelp bass move onto the platforms before summer and leave in the fall, traveling both east and west, with reported movements of as much as 32 km in 6 months.

In the study conducted between 1975 and 1978, there were significant differences in both species compositions and mean sizes between the three sites (though the natural reefs were much more similar with each other). Much of the differences in species composition between the platforms and the natural reefs came from the relative abundance of high-relief substrate-associated rockfish (such as *S. constellatus* and *S. rubrivinctus*) over the reefs and their near absence around the platforms. The substrata around these structures are composed of a mixture of drill cuttings and mussels which have broken off the platform pilings. This does not appear to be suitable habitat for many rockfish species.

On the other hand, a few substrate-associated species, such as juvenile *S. auriculatus* and *S. pinniger*, were most abundant around the platforms. *Sebastes*

auriculatus (both juveniles and adults) are most often found associated with low relief or the sand-rock interface, habitat most similar to that around the platforms. We do not know what substrata juvenile *S. pinniger* prefer, though its abundance around the platforms and scarcity over natural reefs imply it favors habitats similar to *S. auriculatus*.

It is unclear why *S. mystinus* and particularly *S. hopkinsi* should be relatively uncommon around the platforms, yet abundant on the reefs. Both species are mid-water planktivores, always found in association with high relief. A possibility is that both species take refuge in crevices at night and that these are relatively uncommon on the platform pilings and cross members.

Differences in depths between the sites were probably responsible for only a few of the observed differences in species abundances and sizes. The absence of *P. clathratus* from the 6 Mile Reef was undoubtedly due to the reef's relatively extreme depth. The 6 Mile Reef is situated in 74 m, well below the 46 m maximum depth of *P. clathratus* (Eschmeyer et al. 1983). Love et al (in review) summarizing ontogenetic *Sebastes* movements, noted that almost all species recruit to waters shallower than adult depth, subsequently moving to deeper water as they mature. If depth were a major factor in our study, we would expect to see the smallest rockfish at the shallowest (4 Mile Reef) station. However, while both large and small individuals of many rockfish species were taken at 4 Mile Reef, the mean size of most species (except for *S. entomelas*) was actually larger than at the other two sites.

Are the platforms we sampled aiding rockfish production or do they only act as aggregators? In other words, do rockfish recruit from the plankton to the platforms or do they settle out elsewhere and later migrate to these structures? Though our data is not sufficient to answer the question, there is evidence that at least some recruitment takes place around Santa Barbara platforms. In the only detailed study of a California platform, Carlisle et al. (1964) found that both *S. paucispinis* and *S. serranoides* recruited to platform Hazel, located in 30 m of water, about 6 km inshore of our study platforms. We believe it is likely that some rockfish species (i.e., *S. entomelas*, *S. mystinus*, *S. paucispinis*, *S. pinniger*, and *S. serranoides*) recruit to our platforms, particularly in light of the large numbers of small fish, most only 1–2 years old. Smaller and younger fish may be present at these platforms, but their small size precludes their being taken by hook-and-line.

There are several reasons that mature rockfish are rare around the platforms. While juveniles of deep-water species (i.e., *S. entomelas*, *S. pinniger*, *S. paucispinis*) are able to tolerate the warm shallow waters around these structures, the adults are not (Love et al.,

In review). Their subadults make ontogenetic shifts into deeper water. Secondly, fishing pressure around the platforms probably crops many larger individuals. Lastly, it is possible that artificial habitat in some unknown way discourages adult rockfish. F. Matthews (Dep. Oceans and Fish., Pacific Biol. Stn., Nanaimo, B.C., Canada V9R 5K6, pers. commun., May 1989) found that only immature rockfish occurred on an artificial reef in Puget Sound. Natural reefs supported both juveniles and adults.

As discussed before, most rockfish species (including *S. entomelas* and *S. paucispinis*) recruit to shallow water, then migrate into deeper zones as they mature. Based on catch rates, we have noted on several occasions that large aggregations of these species were present around the platforms for months, only to suddenly disappear. Hartmann (1987) tagged juvenile *S. paucispinis* around these platforms and noted recoveries from as much as 148 km away. In all cases the fish were taken in water considerably deeper than tagging depths. Thus, it is quite possible that some rockfish species settle out around these platforms, live there for a few years, and leave for deeper adult habitats, perhaps at considerable distances from the original recruitment site.

Conclusions

Platforms were important fishing locations for the sportfishing party vessel surveyed. About 18% of its total fishing time and 17% of the total catch occurred around the platforms. This compares with about 21% of fishing time and 31% of total catch at the nearby natural reefs. Rockfish dominated the catch at both the platforms and at the natural reefs. Confirming what we had first observed, there were significant differences in catches between the platforms and natural reefs. Juvenile rockfish composed most of the platform catch, while mature rockfish were more abundant over reefs. While midwater rockfish species were abundant at both platform and natural reefs, species compositions were different, with those benthic rockfish characteristics of high-relief substrata absent or rare around the platforms.

Acknowledgments

I thank Alfred W. Ebeling for reviewing this manuscript. Fred Benko of Sea Landing Sportfishing graciously allowed me space on the *Hornet*. I particularly thank partyboat operators Chet Phelps, Irv Grisbeck, Frank Hampton, George Kelly, and Dick Clift for making sampling possible.

This work was sponsored by NOAA, Office of Sea Grant, U.S. Department of Commerce, under grant no. 04-7-158-44121 (Project r/f-39).

Citations

- Allen, M.J., and M.D. Moore**
1976 Fauna of offshore structures. South. Calif. Coast. Water Res. Proj. Annu. Rep., Long Beach, CA, p. 179-186.
- Bascom, W., A.J. Mearns, and M.D. Moore**
1976 A biological survey of oil platforms in the Santa Barbara Channel. J. Petrol. Technol. 28:1280-1284.
- Carlisle, J.G. Jr., C.H. Turner, and E.E. Ebert**
1964 Artificial habitat in the marine environment. Calif. Fish Game, Fish. Bull. 124, 93 p.
- Eschmeyer, W.N., E.S. Herald, and H. Hammann**
1983 A field guide to Pacific coast fishes of North America. Houghton Mifflin, Boston, 336 p.
- Hartmann, A.R.**
1987 Movement of scorpionfishes (Scorpaenidae: *Sebastes* and *Scorpaena*) in the southern California Bight. Calif. Fish Game 73:68-79.
- Love, M.S., P. Morris, M. McCrae, and R. Collins**
1990 Life history aspects of 19 rockfish species (Scorpaenidae: *Sebastes*) from the southern California Bight. NOAA Tech. Rep. NMFS 87, 38 p.
- Love, M.S., M. Carr, and L. Haldorson**
In review Ecology of substrate-associated juvenile and pre-recruit *Sebastes*. Environ. Biol. Fish.
- Sokal, R.R., and F.J. Rohlf**
1969 Biometry: The principles and practice of statistics in biological research. W.H. Freeman, San Francisco, 776 p.
- Wyllie Echeverria, T.**
1987 Thirty-four species of California rockfishes: Maturity and seasonality of reproduction. Fish. Bull., U.S. 85:229-250.