OBSERVATIONS ON THE FISH FAUNA ASSOCIATED WITH OFFSHORE PLATFORMS IN THE NORTHEASTERN GULF OF MEXICO

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ABSTRACT

The fish fauna associated with two U.S. Navy research platforms, Stage I and Stage II, in the northeastern Gulf of Mexico off Panama City, Fla., was studied at irregular intervals from 1970 to 1974. Such platforms function as artificial reef habitats and support diverse and abundant fish populations not normally characteristic of the open sandy bottoms in the area.

A total of 101 taxa (identified to family or species) was recorded at the two platforms; 61 species were observed at Stage I in water 32 m deep and 86 taxa at Stage II in water 18 m deep. The greater number of species recorded at the shallower location may be more a result of the greater number of observations made there than of differences in the two habitats. The number of species present at the platforms varies considerably at different times of the day and year. Species numbers are greatest during the summer and fall, but many species begin to move offshore or southward as the water temperature drops, and only about 50-60% of those recorded at the platform remain in December. The number of species diminishes to about 16% in February at Stage II, then increases gradually with the rising water temperature in the spring.

Major species occupying the platform habitats include fishes usually characteristic of pelagic, inshore (coastal or estuarine), and rocky reef environments. At the platforms, the pelagic species and most of the larger predators occupy various levels of the water column, either directly below or surrounding the structure, while most of the other species are associated either with the pilings and cross-members of the platform or with the bottom. For some of the species, the platform provides food and shelter, while for others, it offers only shelter. Some species may be present only to feed on the numerous fishes and other organisms concentrated there. Diel rhythms of activity are obvious for many of the fishes, with some species active only during the day, and others only at night.

Offshore oil drilling platforms are known to attract various species of marine fishes and thus function as artificial reefs (Carlisle et al. 1964; Treybig 1971). Anglers often recognize such platforms as desirable fishing sites. Carlisle et al. (1964) documented the development of fish populations (as well as populations of encrusting organisms) at two platforms constructed off the coast of California. The supporting piles and cross-members of such platforms provide hard substrates for the settling of pelagic larvae of encrusting invertebrates and algae which, with their associated invertebrate populations, provide food and shelter for reef fishes attracted to the structures. In addition, many pelagic fishes congregate about these platforms, attracted either by the solid, reeflike nature of the supporting structures, or by the numerous smaller forage organisms in the area.

Many comparable platforms have been constructed in the Gulf of Mexico since the 1940's, but no studies of their associated fish faunas have been reported, even though they are known to attract numerous species of fishes. Current studies by personnel of the University of Southwestern Louisiana have documented the fish fauna of drilling platforms off the coast of Louisiana (Sonnier et al. 1976). This paper records the fish populations observed around two offshore platforms in the northeastern Gulf of Mexico off Panama City, Fla.

LOCATION AND TIME OF STUDY

Two research platforms operated by the U.S. Navy off the coast of Panama City are referred to as Stage I and Stage II. Stage I is 17.7 km offshore in water 32 m deep (lat. 30°00.5′N, long. 85°54.2′W). Stage II (Figure 1) is 3.2 km offshore in water 18 m deep (lat. 30°07.2′N, long. 85°46.4′W). The pilings of Stage I form a square on the sea bottom with each side measuring 32.6 m, whereas those of Stage II measure 19.1 m. The two platforms were the sites of biofouling studies

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FIGURE 1.—Stage II, the Navy research platform 3.2 km offshore of Panama City, Fla. (U.S. Navy photo.)

by Pequegnat et al. (1967), Pequegnat and Pequegnat (1968), and Culpepper and Pequegnat (1969). Vick (1964) mentioned 13 species of fishes either collected or reported from the stages and vicinity.

These platforms were examined occasionally from 1970 to 1974 by the first and second authors in connection with studies of reef fishes in the northern Gulf of Mexico. During the fall of 1970 (Ogren) and summer of 1972 (Hastings and Mabry), the authors participated in the Scientist-in-the-Sea (SITS I and II) diving program at the Naval Coastal Systems Laboratory in Panama City and were able to make repeated observations at the platforms.

Between September 1970 and January 1974, 10 dives were made at Stage I (including 1 night dive) and 21 dives were made at Stage II to determine the composition of the fish populations under the structures (see Tables 1, 2). During the SITS II program in 1972, a series of dives made at various times during four consecutive 24-h periods (1-4 August) enabled us to determine diel patterns of concentration of fish schools around and under the platforms.

METHODS

During each dive an attempt was made to identify each species of fish present in the area and to estimate its abundance. At the end of a dive a debriefing session was held and notes were compared as to species and numbers observed. Divers often carried hand nets or spears for collecting unusual or difficult to identify species.

Dives were usually conducted on an irregular basis, and the length of the observation period and the area examined varied considerably from one dive to the next. Consequently, no numerical values were assigned to these estimates of abundance. Instead, relative terms such as few, several, common, and abundant were used, simply to indicate the impression received by the divers as to the numbers of each species present. It should be kept in mind, however, when considering these estimates, that such relative terms may have different meanings when applied to different species of fishes. For example, an absolute number such as 100 individuals might be interpreted as few if applied to a schooling species such as *Harengula pensacolae*, but as abundant if applied to a solitary reef species such as *Chaetodon ocellatus*. These estimates (recorded for all dives in Tables 1 and 2) are admittedly subjective but may be useful in describing the seasonal changes in the fish populations around the platforms.

Our dives at Stage II during the SITS II program were scheduled to occur at approximately 5-h intervals from 1 to 4 August 1972. Although this schedule was not always followed because of other diving commitments of the program, we made 10 dives which included at least 2 dives during each quarter of the 24-h day. Times of the dives are presented as Central Standard Time (CST) in this report. During early August 1972, the times of sunrise and sunset at Stage II were approximately 0500 and 1840 CST, respectively.

During the SITS II program, two censusing stations were set up under Stage II: Station 1 on the bottom at 18.3 m; and Station 2 directly above, about 4.6 m below the water surface. Both stations were the same size and were conveniently delimited by the cross-members at one corner of the platform. The stations measured 4.9 × 4.9 × 7.0 m. Counts were restricted to that portion of the water column estimated to extend 1 m upward from the base of the cross-members (corresponding to the bottom at Station 1). Thus, the water volume included within each station was about 12 m^3.

During each dive at the censusing stations the authors attempted to identify and count all species of fishes present within each station. Counts were recorded on plastic slates during the censusing, then transferred to data sheets after surfacing. Times required to make each census varied because of the great variation in the numbers of fishes present, but were usually about 10-15 min for each station. In most cases both stations were censused on each dive, and counts for Station 2 were made about 15-20 min after the counts for Station 1. On dives 1, 9, and 10, only one of the two stations was censused. Some species were so numerous at times that only estimates of their abundance could be made. Such estimates of fish abundance by two divers making counts at the same time were generally in the same order of magnitude.

During nocturnal diving operations, an underwater light was suspended near the surface below a ladder (to facilitate diver return) at the corner of the platform farthest from the censusing stations. It was not visible underwater at the censusing stations and did not appear to affect our counts. Although some fishes were attracted to this light, they were mostly juveniles and larvae of pelagic species.

Nomenclature and arrangement of the families in Tables 1, 2, and 3 follow Bailey et al. (1970).

RESULTS AND DISCUSSION

All species recorded at the two stages during this study are listed in Tables 1 and 2. Table 3 is a list of the species recorded in the two stations at Stage II during the SITS II dives. These tables should be examined in connection with the following synopsis of the results of this study. At least 101 taxa (identified to family or species) were recorded during this study at the two platforms; 61 species were recorded at Stage I during 10 dives, and 86 taxa were recorded at Stage II during 21 dives. The greater number recorded at Stage II is probably primarily a result of the greater number of observations there. In general, the fish faunas of the two stages are quite similar, and most of the species recorded at only one could be expected to occur at both occasionally. Of the 101 taxa recorded, about 75 were frequently observed during the study and could be regarded as characteristic members of the fauna, 41 were recorded as common or abundant. Of the latter group, 27 species were recorded at Stage I and 36 at Stage II.

Faunal Composition

The two stages represent an artificial reef habitat in an area previously characterized by flat sand bottoms. Thus, the fishes inhabiting the stage environment are a mixture of faunal types, including some species usually expected in such flat, sandy areas, but also including many species more characteristic of other habitats of the northern Gulf of Mexico, especially fishes which are attracted to reef environments.

A number of demersal species characteristic of open sand habitats of the northern Gulf of Mexico were frequently recorded at the stages, but these were usually seen over the open sandy areas surrounding the stages. Examples are *Dasyatis* sp., *Raja eglanteria, Arius felis, Ogcocephalus radiatus, Stenotomus caprinus, Hemipteronotus novacula, Prionotus* sp., *Paralichthys albigutta, Lactophrys quadricornis*, and *Chilomycterus schoepfi*. In addition, many species recorded at the stages are pelagic fishes characteristic of open

TABLE 1.—Fishes recorded at Stage I off Panama City, Fla., with estimates of usual abundance and habitat occupied.

Species	Abundance[1] Spring (Apr.)	Summer-fall (July-Nov.)	Winter Dec.	Winter Jan.	Habitat[1]
Carcharhinidae:					
Carcharhinus milberti	—	few	—	—	O
Dasyatidae:					
Dasyatis sp.	—	few	—	—	B
Muraenidae:					
Gymnothorax nigromarginatus	—	few	few	—	B
Clupeidae:					
Sardinella anchovia	—	com-abun	abun	—	U
Ariidae:					
Arius felis	—	sev	—	—	B
Batrachoididae:					
Opsanus pardus	sev	sev	sev	com	B
Antennariidae:					
Antennarius ocellatus	few	few	few	few	B
Ogcocephalidae:					
Ogcocephalus radiatus	—	few	few	few	B
Serranidae:					
Centropristis ocyurus	com	com	com	com	B
Diplectrum formosum	sev	sev-com	sev-com	—	B
Epinephelus nigritus	—	—	—	few	L
Mycteroperca microlepis	—	few-com	few	sev	L
Serranus subligarius	sev	sev-com	sev-com	com	B-P
Grammistidae:					
Rypticus maculatus	—	sev-com	sev	com	B-P
Apogonidae:					
Apogon pseudomaculatus	few	sev-com	—	sev	B
Rachycentridae:					
Rachycentron canadum	—	few	few	—	O-U
Echeneidae:					
Echeneis neucratoides	—	few-sev	—	sev	([2])
Carangidae:					
Caranx crysos	—	com	—	—	U
Caranx hippos	—	sev-com	—	—	O-U
Caranx ruber	—	few-com	few	—	U
Decapterus punctatus	—	com-abun	abun	few	U
Elagatis bipinnulata	—	sev	sev	few	O-U
Seriola dumerili	sev	few-com	com	com-abun	L-O-U
Seriola rivoliana	—	—	few	—	U
Trachurus lathami	—	com	—	—	L
Lutjanidae:					
Lutjanus campechanus	—	few	few	—	L
Lutjanus griseus	few	sev-abun	few	sev	L-U
Rhomboplites aurorubens	sev	com-abun	—	com	L
Pomadasyidae:					
Haemulon aurolineatum	com	com-abun	com-abun	sev	L
Haemulon plumieri	—	—	few-sev	—	L
Sparidae:					
Archosargus probatocephalus	—	few	—	—	U
Lagodon rhomboides	—	sev	—	—	L-U
Sciaenidae:					
Equetus lanceolatus	—	sev-com	—	com	B
Equetus umbrosus	com	sev-com	com	com	B
Equetus sp.[3]	—	few	—	—	B
Kyphosidae:					
Kyphosus sectatrix	—	sev	—	—	U
Ephippidae:					
Chaetodipterus faber	com	sev-com	sev	com	L-U
Chaetodontidae:					
Chaetodon ocellatus	few	few	few	few	B-P
Chaetodon sedentarius	—	few	few	—	B
Holacanthus bermudensis	sev	sev-com	sev	sev	L-U
Pomacentridae:					
Abudefduf saxatilis	—	few-sev	—	sev	P
Chromis enchrysurus	—	few	—	few	B
Chromis scotti	—	sev-com	—	sev	B-P
Pomacentrus partitus	—	few-sev	—	—	P
Pomacentrus variabilis	com	sev-com	sev	com	B-P
Labridae:					
Halichoeres caudalis	com	sev-com	—	few	B
Thalassoma bifasciatum	—	few-sev	—	sev	P
Sphyraenidae:					
Sphyraena barracuda	—	sev-abun	sev	few	O-U
Blenniidae:					
Blennius marmoreus	—	sev	—	—	B-P
Hypleurochilus geminatus	few	few-com	—	—	P

TABLE 1. — Continued.

Species	Abundance[1] Spring (Apr.)	Summer-fall (July-Nov.)	Winter Dec.	Winter Jan.	Habitat[1]
Gobiidae:					
Coryphopterus punctipectophorus	few	few	—	—	B
Ioglossus calliurus	—	sev	—	—	B
Acanthuridae:					
Acanthurus coeruleus	—	—	—	few	P
Scombridae:					
Euthynnus alletteratus	—	sev-com	sev	sev	O-U
Bothidae:					
Paralichthys albigutta	—	few	—	—	B
Balistidae:					
Balistes capriscus	few	few-sev	few	few	L-U
Monacanthus hispidus	—	few-sev	—	—	P
Ostraciidae:					
Lactophrys quadricornis	few	few	few	—	B
Tetraodontidae:					
Canthigaster rostrata	—	few	—	—	B
Sphoeroides spengleri	—	few	—	—	B
Diodontidae:					
Chilomycterus schoepfi	few	few	few	few	B
61 species 100%	21 species 34%	57 species 93%	31 species 51%	32 species 52%	
Number of observations	1	6	2	1	
Temperature range	17°-20°C	23°-29°C	18°-19°C	18°C	

[1]Abbreviations are as follows: sev-several, com-common, abun-abundant, B-on bottom, L-lower water column, P-on pilings, O-open water around platform, U-middle to upper water column under platform.
[2]*Echeneis neucratoides* on *Epinephelus, Sphyaena, Seriola, Balistes,* and *Caretta.*
[3]*Equetus* sp. - an undescribed species listed by Bullis and Thompson (1965) as "*Equetus* sp. nov." and by Struhsaker (1969) as "Blackbar drum *Pareques* sp. (undescribed)."

waters, which are attracted to solid, reeflike structures. Smaller baitfishes, such as *Harengula pensacolae, Sardinella anchovia, Etrumeus teres, Opisthonema oglinum, Decapterus punctatus, Trachurus lathami,* and *Scomber japonicus,* were abundant at times and formed dense schools under the stages. Klima and Wickham (1971) demonstrated the potential for harvesting commercial quantities of these and other species by attracting schools to artificial structures. In research conducted near Stage II during 1969, they found *Decapterus* and *Sardinella* more numerous than *Harengula,* but did not record the other species. *Harengula pensacolae* was usually the most common species at Stage II during our observations made in 1972, while *Decapterus* and *Sardinella* were more common in other years.

Larger pelagic species often recorded at the stages were *Rachycentron canadum, Caranx bartholomaei, C. crysos, C. hippos, C. ruber, Elagatis bipinnulata, Seriola dumerili, Euthynnus alletteratus,* and *Sphyraena barracuda.* These species were recorded at the stages often enough to indicate some attraction to the structures, even though they are characteristic open-water species. Part of the attraction for these larger predators may be the large number of smaller baitfishes which provide much of their food (Wickham et al. 1973). Publications on the attraction of fishes to artificial reefs have noted that pelagic species such as those listed here are attracted to artificial structures in greatest numbers when the structures extend a considerable distance above the bottom or even reach the surface, as do these offshore platforms (Unger 1966; Gooding and Magnuson 1967; Hunter and Mitchell 1967, 1968; Klima and Wickham 1971). Springer and Woodburn (1960) noted that *S. barracuda* occurred near shipwrecks off the Tampa Bay area but not on natural rocky reefs. The occurrence of barracuda may be associated with the higher relief of structures such as shipwrecks or the stages. In this respect the offshore platforms are ideal for attracting large numbers of typically open-water fishes.

Sharksuckers (remoras) were often seen associated with other fish species around the stages (especially the larger pelagic species such as *Caranx hippos* and *S. barracuda*) but were never numerous. The species was probably *Echeneis neucratoides,* although *E. naucrates* could also be expected in the area. Four *Echeneis* were also seen attached to one of two loggerhead turtles, *Caretta caretta caretta,* which were observed asleep on the bottom below Stage I. The remoras were attached to the turtle's plastron and ventral margin of the carapace and were inactive except for movements of their opercula.

TABLE 2.—Fishes recorded at Stage II off Panama City, Fla., with estimates of usual abundance and habitat occupied.

Species	Abundance[1] Spring (Apr.-May)	Summer-fall (June-Nov.)	Winter Dec.	Winter Feb.	Habitat[1]
Carcharhinidae	—	few	—	—	O
Sphyrnidae:					
Sphyrna sp.	—	few	—	—	O
Dasyatidae:					
Dasyatis sp.	—	few	—	—	B
Rajidae:					
Raja eglanteria	—	few	few	—	B
Muraenidae:					
Gymnothorax nigromarginatus	few	few	few	—	B
Congridae	—	—	few	—	B
Ophichthidae:					
Mystriophis intertinctus	few	few	few	—	B
Clupeidae:					
Etrumeus teres	—	sev-com	—	—	U
Harengula pensacolae	—	sev-abun	sev-com	—	L-U
Opisthonema oglinum	sev	com	—	—	U
Sardinella anchovia	com-abun	com-abun	sev-abun	—	U
Engraulidae	—	com-abun	—	—	L-U
Ariidae:					
Arius felis	—	few-abun	—	—	B
Batrachoididae:					
Opsanus pardus	few-sev	few	few-com	—	B
Antennariidae:					
Antennarius ocellatus	few	few	few-com	—	B
Ogcocephalidae:					
Ogcocephalus radiatus	few	few	few	—	B
Syngnathidae:					
Syngnathus sp.	—	few	—	—	O
Serranidae:					
Centropristis melana	few	sev	few-sev	sev	B
Centropristis ocyurus	com	com-abun	com	com	B
Centropristis philadelphica	—	—	few	—	B
Diplectrum formosum	sev-com	few-com	sev	sev	B
Epinephelus morio	few	few	few	—	B-L
Epinephelus sp.[2]	—	few	—	—	B
Mycteroperca microlepis	few	few-sev	few-sev	—	L
Serranus subligarius	sev	sev-com	sev-com	few	B-P
Grammistidae:					
Rypticus maculatus	—	few-com	few-com	—	B-P
Priacanthidae:					
Priacanthus arenatus	—	few	—	—	B
Apogonidae:					
Apogon pseudomaculatus	few	few-com	few-sev	—	B
Pomatomidae:					
Pomatomus saltatrix	few-sev	—	few	—	O-U
Rachycentridae:					
Rachycentron canadum	—	few-sev	—	—	O-U
Echeneidae:					
Echeneis neucratoides	—	few	—	—	([3])
Carangidae:					
Caranx bartholomaei	—	few-sev	few	—	L-U
Caranx crysos	—	sev-abun	few	—	U
Caranx hippos	—	com	sev	—	O-U
Caranx ruber	—	few-com	—	—	U
Decapterus punctatus	com-abun	abun	com-abun	com	L-U
Selar crumenophthalmus	—	sev-com	—	—	L-U
Seriola dumerili	few	few-sev	sev	—	L-O-U
Seriola zonata	few	—	—	—	U
Trachurus lathami	com	com	few-abun	—	L
Lutjanidae:					
Lutjanus campechanus	—	few-sev	sev	—	L
Lutjanus griseus	—	sev	few-sev	—	L-U
Lutjanus synagris	—	few	—	—	L
Rhomboplites aurorubens	sev	sev-com	few-sev	—	L-U
Lobotidae:					
Lobotes surinamensis	—	few	—	—	U
Pomadasyidae:					
Haemulon aurolineatum	com	com-abun	few-com	few	L
Haemulon plumieri	few-sev	few-sev	few	—	L
Orthopristis chrysoptera	com	abun	few-abun	—	L
Sparidae:					
Archosargus probatocephalus	few	sev	few	—	L-U
Calamus-Pagrus	—	few	few	—	L
Diplodus holbrooki	—	few-sev	few	—	U
Lagodon rhomboides	com	sev-com	sev-com	sev	L-U
Stenotomus caprinus	—	com	—	—	B-O

TABLE 2.—Continued.

Species	Abundance[1] Spring (Apr.)	Summer-fall (July-Nov.)	Winter Dec.	Jan.	Habitat[1]
Sciaenidae:					
Equetus lanceolatus	few-sev	few-com	few-com	com	B
Equetus umbrosus	sev	sev-com	few-sev	—	B
Leiostomus xanthurus	—	com	sev	—	B
Sciaenops ocellata		few	few		B
Mullidae	—	few	—	—	O
Kyphosidae:					
Kyphosus sectatrix	—	few-sev	—	—	U
Ephippidae:					
Chaetodipterus faber	sev	few-com	sev	—	L-U
Chaetodontidae:					
Chaetodon ocellatus	—	few	few	—	B
Holacanthus bermudensis	sev-com	few-com	sev-com	sev	L-U
Pomacentridae:					
Pomacentrus variabilis	sev-com	sev-com	few-sev	—	B-P
Labridae:					
Halichoeres bivittatus	few	few-com	few	—	B
Halichoeres caudalis	sev	sev-com	few-sev	sev	B
Hemipteronotus novacula	—	few	few	—	B
Lachnolaimus maximus	—	few	—	—	L
Sphyraenidae:					
Sphyraena barracuda	—	few-sev	—	—	L-O-U
Sphyraena borealis	—	sev	—	—	U
Polynemidae:					
Polydactylus octonemus	—	—	sev	—	O
Blenniidae:					
Blennius marmoreus	few	few-sev	few	—	P
Hypleurochilus geminatus	sev-com	sev-com	—	—	P
Acanthuridae:					
Acanthurus chirurgus	—	few	—	—	B-P
Scombridae:					
Euthynnus alletteratus	sev-com	sev-com	few-com	—	O
Scomber japonicus	com	com	few	—	U
Scomberomorus cavalla	—	sev	—	—	O
Stromateidae:					
Peprilus burti	few-sev	sev	—	—	U
Scorpaenidae:					
Scorpaena brasiliensis	—	few	few	—	B
Triglidae:					
Prionotus sp.	—	few	—	—	B
Bothidae:					
Paralichthys albigutta	sev	few-sev	sev	few	B
Syacium papillosum	—	few	—	—	B
Balistidae:					
Balistes capriscus	few-sev	few-com	few-sev	few	L-U
Cantherhines pullus	—	few	few	—	P
Monacanthus hispidus	—	few	sev	—	L-P
Ostraciidae:					
Lactophrys quadricornis	few	few-sev	few	—	B
Diodontidae:					
Chilomycterus schoepfi	few	few-sev	few	few	B
86 taxa 100%	41 species 48%	81 taxa 94%	57 taxa 66%	13 species 15%	
Number of observations	3	13	4	1	
Temperature range	17°-20°C	20°-30°C	15°-19°C	13°C	

[1]Abbreviations are as follows: sev - several, com - common, abun - abundant, B - on bottom, L - lower water column, P - on pilings, O - open water around platform, U - middle to upper water column under platform.
[2]*Epinephelus* sp. - A juvenile apparently either *E. flavolimbatus* or *E. niveatus* based upon color pattern (brownish with small white spots on lateral surface and a dark saddle on caudal peduncle, Smith 1971).
[3]*Echeneis neucratoides* on *Caranx* and *Sphyraena*.

A few species recorded at the stages are typical inshore fishes which are characteristic of coastal or estuarine areas. Examples are *Orthopristis chrysoptera, Lagodon rhomboides,* and *Leiostomus xanthurus.* These first two species were important members of the fauna at Stage II, while *L. xanthurus* was common at times but usually remained over the surrounding open sand bottom.

Most of the species recorded at the stages are species characteristic of rocky bottom areas offshore in the Gulf of Mexico. The platforms with their supporting pilings, as well as litter and shell hash which has accumulated in the area immediately surrounding the stages, serve as artificial reef habitat for such species. Some of the important reef species are *Gymnothorax nigromarginatus, Mystriophis intertinctus, Opsanus*

TABLE 3.—Counts of fishes at two stations below Stage II off Panama City, Fla., 1-4 August 1972. (Bold numerals are estimates.)

Family and species	Time of census (CST)									
	0129-0216	0525-0604	0715-0755	1042-1133	1152-1228	1325-1405	1519-1553	1721-1800	1833-1913	2308-2342
Station 1 (bottom)										
Ophichthidae:										
Mystriophis intertinctus	0	0	0	1	0	1	([1])	0	1	0
Clupeidae:										
Harengula pensacolae	0	0	**20**	**100**	**100**	**100**	([1])	**200**	0	0
Batrachoididae:										
Opsanus pardus	1	0	0	0	0	0	([1])	0	0	1
Antennariidae:										
Antennarius ocellatus	2	0	1	1	1	2	([1])	1	2	1
Ogcocephalidae:										
Ogcocephalus radiatus	0	1	0	0	0	0	([1])	0	0	0
Serranidae:										
Centropristis ocyurus	3	8	10	20	18	14	([1])	14	10	4
Epinephelus sp.[2]	0	0	0	0	0	0	([1])	1	0	0
Mycteroperca microlepis	0	0	1	0	0	1	([1])	0	1	0
Serranus subligarius	2	4	8	8	7	12	([1])	9	4	3
Grammistidae:										
Rypticus maculatus	4	5	4	8	1	3	([1])	5	10	6
Apogonidae:										
Apogon pseudomaculatus	2	0	2	3	0	0	([1])	1	7	3
Carangidae:										
Decapterus punctatus	0	0	0	0	0	5	([1])	0	0	0
Seriola dumerili	0	5	0	0	0	0	([1])	0	0	0
Lutjanidae:										
Rhomboplites aurorubens	0	0	2	0	0	0	([1])	4	0	0
Pomadasyidae:										
Haemulon aurolineatum	0	**30**	**200**	**200**	**300**	**300**	([1])	**200**	**100**	1
Haemulon plumieri	1	1	2	3	1	1	([1])	1	1	3
Orthopristis chrysoptera	2	**100**	**100**	**200**	**30**	**200**	([1])	**40**	11	0
Sparidae:										
Lagodon rhomboides	0	0	0	0	0	0	([1])	0	2	0
Sciaenidae:										
Equetus umbrosus	6	2	2	2	3	2	([1])	0	2	3
Kyphosidae:										
Kyphosus sectatrix	0	0	0	0	0	0	([1])	2	0	0
Ephippidae:										
Chaetodipterus faber	0	1	1	0	1	0	([1])	0	1	0
Chaetodontidae:										
Holacanthus bermudensis	0	1	4	5	2	3	([1])	1	1	0
Pomacentridae:										
Pomacentrus variabilis	0	1	10	11	13	14	([1])	12	2	0
Labridae:										
Halichoeres caudalis	0	0	6	12	22	6	([1])	9	1	0
Acanthuridae:										
Acanthurus chirurgus	0	0	1	0	0	0	([1])	0	0	0
Scorpaenidae:										
Scorpaena brasiliensis	0	0	0	1	0	1	([1])	0	1	0
Balistidae:										
Balistes capriscus	1	3	5	0	7	3	([1])	4	2	3
Monacanthus hispidus	0	0	1	1	0	0	([1])	0	0	0
Diodontidae:										
Chilomycterus schoepfi	2	1	2	0	0	1	([1])	0	0	1
Station 2 (subsurface)										
Clupeidae:										
Harengula pensacolae	0	**500**	**50**	([1])	**300**	**500**	**1,000**	**200**	0	([1])
Serranidae:										
Serranus subligarius	1	2	4	([1])	3	7	3	1	1	([1])
Grammistidae:										
Rypticus maculatus	3	0	0	([1])	0	0	0	2	2	([1])
Carangidae:										
Caranx crysos	0	**50**	**30**	([1])	**30**	7	**20**	**10**	0	([1])
Caranx ruber	0	0	1	([1])	0	0	0	0	0	([1])
Decapterus punctatus	0	5	10	([1])	**20**	2	0	0	0	([1])
Sparidae:										
Diplodus holbrooki	0	0	0	([1])	0	0	1	0	0	([1])
Lagodon rhomboides	0	6	11	([1])	12	18	12	14	0	([1])
Kyphosidae:										
Kyphosus sectatrix	5	6	1	([1])	5	2	10	0	2	([1])
Blenniidae:										
Hypleurochilus geminatus	4	2	3	([1])	2	3	2	3	2	([1])
Acanthuridae:										
Acanthurus chirurgus	0	0	0	([1])	0	0	1	0	0	([1])

[1]No census made.

[2]*Epinephelus* sp. - A juvenile apparently either *E. flavolimbatus* or *E. niveatus* based upon color pattern (brownish with small white spots on lateral surface and a dark saddle on caudal peduncle (Smith 1971).

pardus, Antennarius ocellatus, Centropristis ocyurus, Diplectrum formosum, Mycteroperca microlepis, Serranus subligarius, Rypticus maculatus, Apogon pseudomaculatus, Lutjanus campechanus, L. griseus, Rhomboplites aurorubens, Haemulon aurolineatum, H. plumieri, Diplodus holbrooki, Equetus lanceolatus, E. umbrosus, Chaetodipterus faber, Chaetodon ocellatus, C. sedentarius, Holacanthus bermudensis, Chromis enchrysurus, C. scotti, Pomacentrus variabilis, Halichoeres bivittatus, H. caudalis, Blennius marmoreus, Hypleurochilus geminatus, Ioglossus calliurus, Acanthurus chirurgus, and *Balistes capriscus.* A few natural rock outcrops which support reef faunas occur in the area, especially offshore from Stage I, but these are characteristically low in relief and are quite distinct in some ways from the habitats at the stages. They do support populations of the reef species listed above (and usually larger numbers than at the stages), but usually do not attract large masses of pelagic schooling and predatory species.

A few reef species observed at the stage habitats (such as *Abudefduf saxatilis, Pomacentrus partitus, Thalassoma bifasciatum,* and *Acanthurus coeruleus*) do not normally occur on the natural rocky reefs off the northwest Florida coast, but are tropical coral reef species which may be carried into the northern Gulf of Mexico by currents (see Hastings 1972). Such species are not permanent residents of the northern gulf, but are apparently usually killed by low winter temperatures, except for possibly during mild winters.

Comparison of the Two Stages

Although the fish faunas of the two stages were quite similar (Tables 1, 2), there were a few notable differences between the species lists for the two stages which may be significant. The most numerous species at Stage II during the summer and fall were the clupeids, *Harengula pensacolae* and *Sardinella anchovia*, and rather irregularly, *Etrumeus teres* and *Opisthonema oglinum.* These fishes formed dense schools (Figures 2, 3) below the platform during daylight hours, usually also with large numbers of carangids such as *Decapterus punctatus, Selar crumenophthalmus,* and *Trachurus lathami,* and the mackerel, *Scomber japonicus.* Such schools of baitfishes were considerably less abundant at Stage I except for during the fall and early winter (especially November and December) when large numbers of *Sardinella anchovia* and *D. punctatus* were present. Most of these had disappeared by January, however.

As might be expected, typical estuarine species, such as *Orthopristis chrysoptera, Lagodon rhomboides*, and *Leiostomus xanthurus*, were rare or absent at Stage I, even though they were quite numerous at Stage II. In contrast, *Elagatis bipinnulata*, a species typical of open, pelagic waters (Hiatt and Strasburg 1960), was recorded at Stage I, but not at Stage II, although Klima and Wickham (1971) found this species to be the most common jack congregating about artificial structures near Stage II in 1969. Other pelagic species such as *Seriola dumerili* and *Sphyraena barracuda* were also more numerous at Stage I. Similarly, some benthic species, which are characteristic of the deeper water, natural reefs in the northern Gulf of Mexico and may be rare in inshore waters as shallow as 18 m, were occasionally recorded at Stage I, but not at Stage II. Examples are *Chaetodon sedentarius, Chromis enchrysurus, C. scotti, Coryphopterus punctipectophorus,* and *Ioglossus calliurus.*

The tropical coral reef species, such as *Abudefduf saxatilis, Pomacentrus partitus, Thalassoma bifasciatum, Acanthurus coeruleus,* and *Canthigaster rostrata,* were recorded only at Stage I. These tend to be shallow-water species which apparently were able to survive by settling on the pilings and cross-members near the surface at Stage I. Such species are occasionally recorded in inshore artificial reef habitats in the northeastern gulf (Caldwell and Briggs 1957; Caldwell 1959, 1963; Haburay et al. 1969, 1974; Hastings 1972) and should be expected to occur occasionally at both stages.

Winter-Summer Contrast

Seasonal changes in the faunal composition at the stages were striking in some cases. Water temperatures recorded during this study ranged from 17° to 29°C at Stage I and from 13° to 30°C at Stage II. Lowest temperatures were recorded in January at Stage I and in February at Stage II. Highest temperatures were recorded during August and September. Changes in the fish fauna were apparently correlated with temperature, since the largest percentages of species recorded (93% at Stage I; 95% at Stage II) were present during the summer and fall, while the lowest numbers were recorded during either the winter

FIGURE 2.—*Sardinella anchovia, Decapterus punctatus,* and *Scomber japonicus,* in a mixed school, under Stage II off Panama City, Fla.

or spring. Estimates of abundance during the spring, summer-fall, and winter observations (Tables 1, 2) indicate that most species disappear from the area of the stages during the winter months, then gradually reappear during the spring and summer. They apparently either move offshore to deeper water, or else they migrate southward along the Florida coast (see Hastings 1972). This decrease in number of species (as well as number of individuals) occurred at both stages, but was most profound at Stage II, where temperature extremes were greater. About 50% of the number of species recorded at Stage I were present in December and January, but at Stage II, 67% were present in December and only 15% in February. These seasonal changes were most striking in the schooling clupeids and carangids (such as *H. pensacolae, Sardinella anchovia,* and *D. punctatus*) which were extremely numerous during the summer and fall, but usually rare or absent in January or February (although *Decapterus* was common at Stage II during February).

Habitat Occupation and Activity Patterns

The usual habitat occupied by each species in the vicinity of the platforms is indicated in Tables 1 and 2. Station counts for some species at Stage II, indicating diel changes in activity and occurrence at the stage, are shown in Table 3.

The pelagic species which congregate about the stages normally occupied the upper water column, either surrounding or below the platform. The clupeids, *H. pensacolae* and *S. anchovia*, formed dense schools below the platform, usually near the surface but with *Sardinella* usually somewhat deeper. The carangids, *D. punctatus* and *Trachurus lathami*, were also quite numerous, *Decapturus* normally in mid-water or near the surface and *Trachurus* very near the bottom. At times, these and other schooling species of comparable size, such as *Opisthonema oglinum* and *Scomber japonicus*, formed mixed schools under the platform (Figure 2). These species

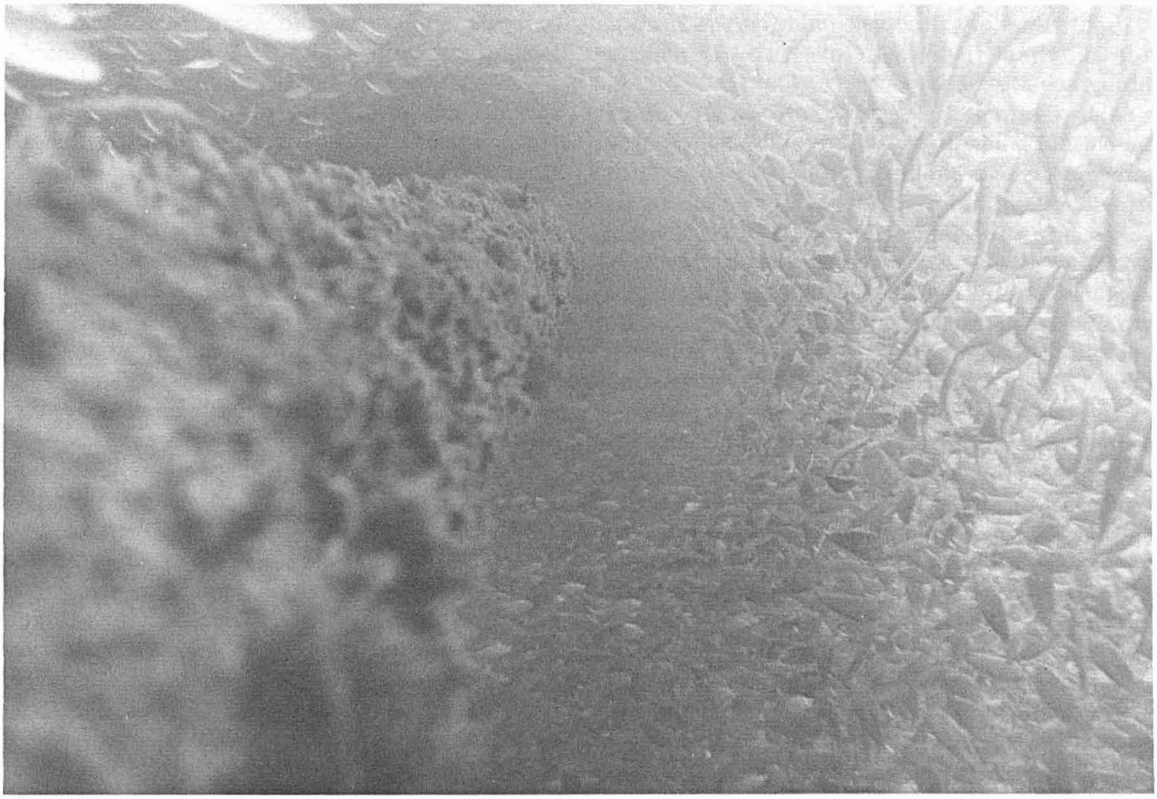

FIGURE 3.—Large school of *Harengula pensacolae* surrounding a piling of Stage II off Panama City, Fla.

gathered in compact schools below the stage during the day apparently as a defense against predation (Hobson 1965). Station counts at Stage II for *H. pensacolae* and *D. punctatus* indicate that they left the protection of the platform and moved into the open areas surrounding the stage at night. Several species of clupeids and schooling carangids, including *H. pensacolae, Sardinella anchovia, D. punctatus,* and *Selar crumenophthalmus,* have been described as nocturnal plankton feeders (Hobson 1965; Starck and Davis 1966), although some diurnal feeding activity by *Decapterus* and *Sardinella* was observed by us and others (Klima and Wickham 1971). During daylight hours at Stage II, from about 0500 to about 1800 CST, extensive schools of *H. pensacolae* were present around and under the platform, and, at times, were so dense that they darkened the area below (Figure 3). Relatively large numbers were present at the census stations during most daylight dives, but none was observed during any of the night censuses. Similar records were obtained for *D. punctatus*, although the numbers present were considerably less than for *H. pensacolae*. In addition, *D. punctatus* may have left the vicinity of the platform earlier in the evening (about 1500 CST).

The other pelagic species are, in most cases, large predators and are continually on the move in the upper water column surrounding the platforms, occasionally darting into the schools of smaller fishes to feed. Some, such as *Seriola dumerili*, were often seen near the bottom as well. Most of these pelagic predators probably feed to some extent at night as well as during the day, and may follow the bait species, as the bait species disperse at night. However, studies indicate that many such piscivorous fishes are primarily crepuscular, with peaks of feeding activity at dawn and dusk (Hobson 1965, 1968, 1972, 1974; Starck and Davis 1966).

Only *Caranx crysos* was consistently present in the station counts (but only in Station 2 near the surface). These counts show a pattern similar to that of *H. pensacolae*, with fairly large numbers present during daylight hours and none present at night. Possibly this jack followed the *Harengula* as they dispersed, to continue feeding through the night.

A large number of benthic reef species occupy the bottom below the platform and also the area immediately surrounding the stage, where much litter has accumulated, apparently discarded by workmen on the platform above. Other benthic species were observed on the pilings and cross-members of the platform structure, where encrusting invertebrates and algae provided food and hiding places for smaller species. In addition, habitat for benthic species may be provided by accumulations of shell hash at the bases of the pilings, probably broken loose from the pilings by storms or by the grazing of fishes or predation by other organisms. Some of the more important benthic species at the stages are *Gymnothorax nigromarginatus, Opsanus pardus, Antennarius ocellatus, Ogcocephalus radiatus, Centropristis ocyurus, Diplectrum formosum, Serranus subligarius, Rypticus maculatus, Apogon pseudomaculatus, Equetus lanceolatus, E. umbrosus, Chaetodon ocellatus, Pomacentrus variabilis, Halichoeres caudalis, Blennius marmoreus*, and *Hypleurochilus geminatus*. A few of these, such as *S. subligarius, R. maculatus*, and *P. variabilis,* seemed to be equally at home on the pilings at all levels of the water column, while others were found only near the bottom (*G. nigromarginatus, Opsanus pardus, Antennarius ocellatus, Ogcocephalus radiatus, Centropristis ocyurus, D. formosum, Apogon pseudomaculatus, E. lanceolatus, E. umbrosus,* and *Halichoeres caudalis*) or only on the pilings (*Hypleurochilus geminatus*).

An interesting contrast was noticed among members of the families Pomacentridae and Labridae at Stage I. Those species which are characteristic and permanent members of the northern gulf reef fauna (*Chromis enchrysurus, C. scotti, P. variabilis,* and *Halichoeres caudalis*) were most numerous on the bottom in association with platform supports and other objects. In contrast, species which are not permanent residents of reefs in this area, but are apparently tropical species carried north by currents (*Abudefduf saxatilis, P. partitus*, and *Thalassoma bifasciatum*) were never observed near the bottom, but were always associated with the pilings and cross-members within about 10 m of the surface. These are shallow-water species which apparently do not occur at the greater depths at Stage I (32 m).

At least two species, *G. nigromarginatus* and *Mystriophis intertinctus*, were usually seen partially buried in the substrate, often with only their heads protruding.

Several other species occurring on the bottom were most numerous over the open sandy areas surrounding the stages. *Stenotomus caprinus, Leiostomus xanthurus, Paralichthys albigutta,* and *Lactophrys quadricornis* are examples.

This benthic group includes both diurnal and nocturnal species. Species which are active and apparently feed at night are *R. maculatus, Apogon pseudomaculatus,* and *E. umbrosus.* Benthic species which are diurnal and inactive at night are *Centropristis ocyurus, D. formosum, Serranus subligarius, Chaetodon ocellatus, Pomacentrus variabilis*, and *H. caudalis.* The other species were not observed enough to determine activity patterns.

Generally counts of the nocturnal species were higher during the nocturnal observations. *Rypticus maculatus* was more numerous in Station 1 on the bottom under cross-members or other sheltering objects, but was counted in Station 2 near the surface three times, during each of the nocturnal counts between about 1730 and 0215 CST. Hiding places on the pilings are rather limited and can, in most cases, accommodate only small individuals, so apparently these soapfish were moving up the pilings at night to feed. Other references also report noctural feeding in the grammistids (Hobson 1965; Starck and Davis 1966).

Apogon pseudomaculatus, when observed at night, was active, swimming about in open areas near the bottom, while those observed during the day were always inactive, hiding among shells or other debris or under the stage cross-members. On one occasion a group of about 15 juvenile *Apogon* was seen associated with a diadematid sea urchin below a cross-member at Stage I. These small cardinal fish remained motionless among the long spines of the urchin. Cardinal fishes in general are nocturnal predators (Hobson 1965; Starck and Davis 1966; Livingston 1971).

Species of *Equetus* (or the related *Pareques*) have been reported to remain in small groups in sheltered areas by day, and then feed individually in the immediate vicinity at night (Hobson 1965; Starck and Davis 1966). Similar observations were made during this study for *E. umbrosus*, which was present during almost every observation at Station 1.

The smaller demersal sea basses (family Serranidae) observed at the stages were relatively inactive fishes which did not exhibit obvious day-night changes in behavior. However, counts of *Centropristis ocyurus* and *S. subligarius* decreased at night, possibly indicating that some had taken shelter under objects or within shells or crevices. Literature records indicate that these and related sea basses are diurnal (Starck and Davis 1966; Bortone 1971).

Chaetodon ocellatus was usually seen swimming about near the bottom during the day and frequently in pairs. One individual observed at night resting on the bottom next to a piling exhibited the typical nocturnal color pattern described by Starck and Davis (1966).

Counts of *Pomacentrus variabilis* and *H. caudalis* at Station 1 were considerably higher during the daylight observations than at night. Daylight counts for *P. variabilis* (10-14) were less variable than those for *H. caudalis* (6-22). *Pomacentrus variabilis* is territorial and probably remains at the same general location throughout the day while *H. caudalis* is less sedentary and tends to move about more. Starck and Davis (1966) stated that *P. variabilis* and other pomacentrids are diurnal feeders which seek shelter at night in sponges, rocks, coral, or other close cover. Most of those at the stage may have taken shelter in and among the many empty mollusk shells which cover much of the bottom at the base of the stage. *Halichoeres caudalis* has not been studied previously, but several species of labrids, including *H. bivittatus* which was also present at times at Stage II, have been reported to bury themselves in sand at night (Breder 1951; Hobson 1965; Starck and Davis 1966), and this may also be the case with *H. caudalis*.

The numerous species of free-swimming fishes occupying the various levels of the water column under the platform apparently include several distinct groups based upon activity patterns and feeding habits. *Mycteroperca microlepis* is a large predator which appeared to be continually moving about under or around the stage, usually near the bottom, but a few inactive individuals were observed at night on the bottom resting against the pilings. Such species are normally described as being opportunistic feeders with peaks of feeding activity during twilight periods when the changeover of activity patterns in prey species makes them more vulnerable (Starck and Davis 1966; Collette and Talbot 1972; Hobson 1972).

Lutjanus griseus (Starck 1971), *Haemulon aurolineatum*, and *Orthopristis chrysoptera* are apparently nocturnal feeders, which utilize the stage only as a shelter during daylight hours, and move out into surrounding areas at night to feed. *Lutjanus griseus* was normally seen schooling during the day in the lower-to-middle water column under the platform. *Haemulon aurolineatum* and *O. chrysoptera* were two of the most numerous fishes in Station 1 at Stage II (Figure 4), although both were rare or absent during the nighttime observations. There may be a difference in the time of major movement for these two species. *Haemulon aurolineatum* apparently began to disperse and move out of the area at or shortly after sunset, and returned shortly after sunrise. *Orthopristis chrysoptera* possibly leaves the area under the stage earlier in the evening (just before sunset) and also may return earlier in the morning. Apparently these grunts feed at night in the open areas surrounding the stage and school under the stage as a defense against diurnal predators (Hobson 1965; Starck and Davis 1966).

Other species (such as *H. plumieri, Diplodus holbrooki, Lagodon rhomboides, Kyphosus sectatrix, Chaetodipterus faber, Holacanthus bermudensis, Acanthurus chirurgus, Balistes capriscus,* and *Monacanthus hispidus*) seemed to feed mostly on benthic organisms attached to the pilings or other objects, and may move up and down in the water column, grazing upon this material. However, some of these were more numerous near the surface (such as *D. holbrooki, L. rhomboides,* and *K. sectatrix*) while others normally remained near the bottom (such as *Haemulon plumieri, C. faber, Holacanthus bermudensis*, and *B. capriscus*). Most of these species are apparently diurnal and become inactive at night. A few *L. rhomboides, H. bermudensis,* and *B. capriscus* were observed near the bottom at night, either resting on the bottom or in protected places below cross-members or between pilings and adjacent objects. *Kyphosus sectatrix* was inactive at night, but remained in the upper water column. In contrast, *Haemulon plumieri* is nocturnal but seemed to remain in the same general area near the bottom throughout the day and night. Such

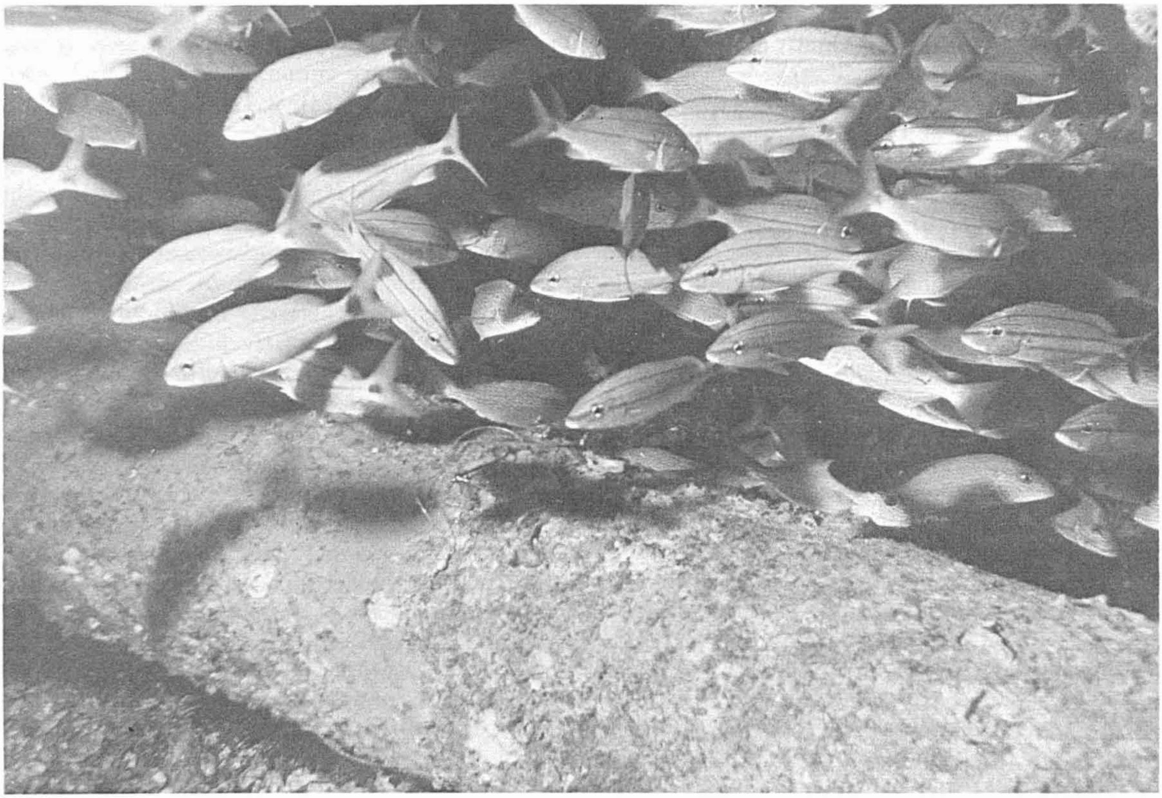

FIGURE 4.—*Haemulon aurolineatum* and *Orthopristis chrysoptera* near the bottom at Stage II off Panama City, Fla.

behavior was also noted by Starck and Davis (1966).

Starck and Davis (1966) emphasized the importance of nocturnal foraging migrations and plankton feeding to the coral reef trophic structure. Similar feeding patterns may contribute to the economy of artificial reef structures such as these offshore platforms, where abundant species of the families Clupeidae, Carangidae, Lutjanidae, and Pomadasyidae feed at night in adjacent areas, but return to the reef by day, and thus contribute to the biomass of the community.

In conclusion, the platform pilings and crossmembers, with their encrusting organisms and associated motile invertebrate fauna, provide food and shelter for numerous fish species. In addition, several diurnally schooling species are abundant beneath the platforms during the day, where they are afforded some protection from predation, but disperse into surrounding open areas at night to feed. Large numbers of piscivorous species also are attracted to the platform habitat to feed on the numerous smaller fishes associated with the structure. As the water temperature drops, many species migrate away from the platforms during the colder months. Repopulation occurs in the spring and summer.

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