with the notation "Rep (1949)." On the current edition of this chart (now No. 68—14th ed., Sept. 1943; Revised 4/28/69), the notation is no longer evident, but no additional soundings are indicated. Identical soundings are also shown on H. O. Chart No. 523 (Revised 11/12/73). U.S. Coast and Geodetic Survey Chart No. 9302, Bering Sea, Eastern Part (17th ed., rev. 1956) also shows these two soundings but without notation. Although none of these charts indicated the presence of any depression, the paucity of soundings did not necessarily preclude its possible existence.

Supporting evidence for the depression is still evident on the Japan Maritime Safety Agency Chart No. 804, Bering Sea, (1938, Rev. 1972), which indicates soundings of 320 m near lat.61°35'N, long.175°W, and 318 m near lat.61°W, long.174°W. No other data are given within 150-200 km to the north or west of these soundings to indicate the extent of depths greater than normal shelf depth (200 m), and the chart bears the inscription "Compiled chiefly from the British Chart, 1937 with corrections from the U.S.S.R. and United States Charts."

In October 1973, during a visit to the Far Seas Fisheries Research Laboratory, Shimizu, Japan, I had an opportunity to discuss the possible existence of this depression with Captain Takeji Fujii, RV *Oshoro Maru*, Faculty of Fisheries, Hokkaido University. For over two decades annual summer training cruises have been conducted in the Bering Sea aboard the *Oshoro Maru* and, from 1964-68, cruises had been conducted in the general area of the supposed depression. Captain Fujii kindly compiled and forwarded to me the soundings that had been obtained. No sounding in excess of 100 m was recorded, and two are particularly significant: on 3 August 1967 a sounding of 76 m was obtained near lat.61°33'N, long. 173°50'W; and, on 4 August 1968 a sounding of 91 m was obtained near lat.61°31'N, long.175°00'W. Thus, it would appear that another riddle of the sea has been resolved, particularly, in view of the fact that recent Soviet maps do not show any evidence of the depression. However, a potentially interesting fishing ground has been eliminated.

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MFR PAPER 1102

Fishing intensity over artificial reefs is thousands of times that over natural habitat.

Effects of Artificial Reefs on a Marine Sport Fishery off South Carolina

CHESTER C. BUCHANAN, RICHARD B. STONE, and R.O. PARKER, JR.

ABSTRACT—Two artificial reefs created recreational reef fisheries off Murrells Inlet, S.C. These reefs attracted additional anglers to the area and provided better fishing than existed before the reefs were built. However, fishing success was not as high over the artificial reef as over nearby live bottom habitat because of high fishing intensity on the small area covered by reef material. The reefs did not increase surface fishing success.

INTRODUCTION

By providing or improving reef-fish habitat accessible to anglers, construction of artificial reefs affords considerable promise for enhancement of recreational fishing. Before the full potential of artificial reefs for recreational fishing can be realized, we must determine their impact on fishing success and effort. Several investigations have considered these effects, but their findings were inconclusive (Buchanan, 1972; Elser, 1960; Turner, Ebert, and Given, 1964; Wickham, Watson, and Ogren, 1973). The purpose of this study, which encompassed the summer (June-September) of 1972 and the summer and fall (June-November) of 1973, was to compare fishing success, species composition, and fishing effort on artificial and natural habitats off Murrells Inlet, S.C. Results of the survey in the summer and fall of 1973 are presented and compared with results from the 1972 survey reported by Buchanan (1973).

There are two artificial reefs located off Murrells Inlet: Paradise Artificial Reef, begun in 1963 and located 3 miles from the Inlet; and Pawleys Island Artificial Reef, begun in early summer of 1973 and located 5 miles from the Inlet (Fig. 1). Paradise Artificial Reef, the larger of the two, is composed of several thousand car tires and four vessels. Pawleys Island Artificial Reef consists only of two landing craft. The reefs, together, cover about 0.01 square mile and protrude 1 to 10 feet above the bottom. The reefs are rich with sessile and motile invertebrates such as tunicates, barnacles, oysters, sponges, hydroids, sea urchins,

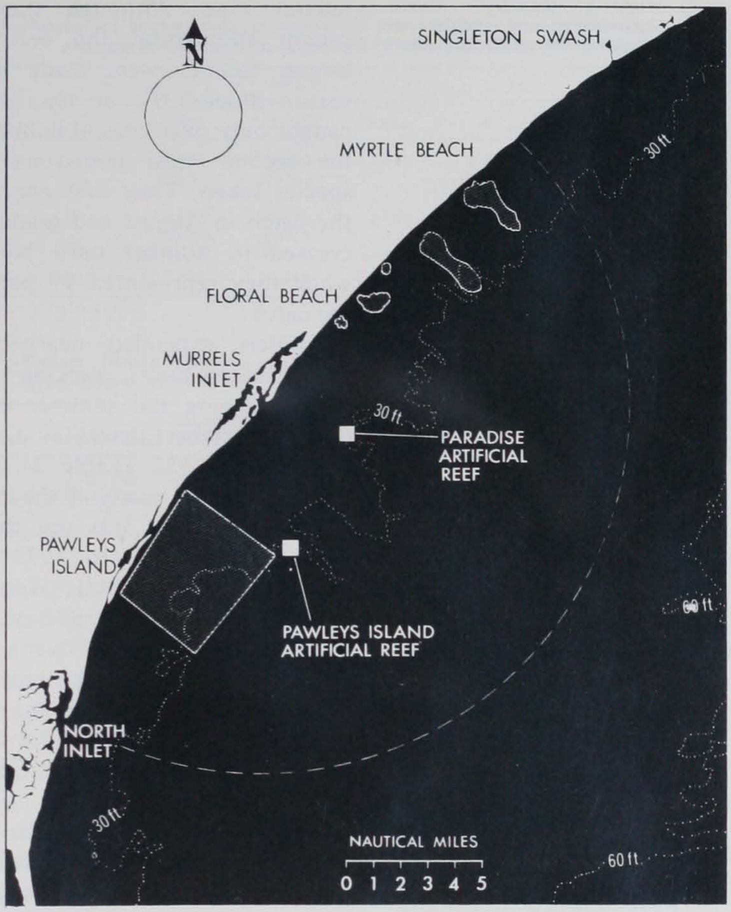

Figure 1.—The location of artificial reefs and live bottom (shaded area) within the survey area (dotted line) off Murrells Inlet, S.C.

crabs, and shrimp. Only private boat anglers use these reefs.

According to Struhsaker (1969), natural bottom off South Carolina is classified as either coastal or live bottom habitat. Coastal habitat, characterized by smooth, sandy-mud bottom, covers about 264 square miles of our survey area. Live bottom, characterized by low profile rock outcrops rich with sessile invertebrates, such as sponges, soft corals, and sea fans (Fig. 2), is restricted to several locations within the survey area and collectively totals about 22 square miles.

METHODS

Fishing effort, measured in angler-hours, was calculated from boat counts and number of anglers and angler-hours per boat. Boat-days each month were estimated by expanding the number of private boats leaving the Inlet during stratified randomly selected periods. Boats were counted by personnel of the South Carolina Wildlife Resources Department. They sampled 6 week days and 2 weekend days each month. Each day was divided into 2 half-days, from 0600 to 1200 hours and 1200 to 1800 hours. The number of anglers was estimated by multiplying the estimated number of boat-days by the mean number of anglers per boat. The number of angler-hours was estimated by multiplying the estimated number of anglers by the mean number of hours fished per angler, obtained from dockside interviews.

We interviewed anglers at dockside to determine where they fished, what baits they used, the number of hours they fished, the number of fish they caught and the composition of their catch (Fig. 3). Using a systematic sampling design, we interviewed anglers during 5 consecutive days (3 week days and 2 weekend days) each month from 1100 hours to 1800 hours. We counted and identified the fish of each party we interviewed. We used CPUE (catch per unit of effort), calculated from catch and fishing effort data, as a measure of fishing success.

To simplify our presentation we combined data for similar species. We called black sea bass (*Centropristis striata*) and rock sea bass (*Centropristis philadelphica*)—sea bass; summer flounder (*Paralichthys dentatus*) and southern flounder (*Paralichthys lethostigma*)—flounder; pinfish (*Lagodon rhomboides*), spottail pinfish (*Diplodus holbrooki*), longspine porgy (*Stenotomus caprinus*), and scup (*Stenotomus chrysops*)—porgy; weakfish (*Cynoscion regalis*) and spotted seatrout (*Cynoscion nebulosus*)—seatrout, and blue runner (*Caranx crysos*) and greater amberjack (*Seriola dumerili*)—jack.

SURFACE FISHING

We estimated that private boat anglers expended over 30,000 angler-hours (64 percent of the total effort)

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Figure 2.—Patches of live bottom scattered throughout the survey area provide a hard, irregular habitat for many species of demersal fishes.

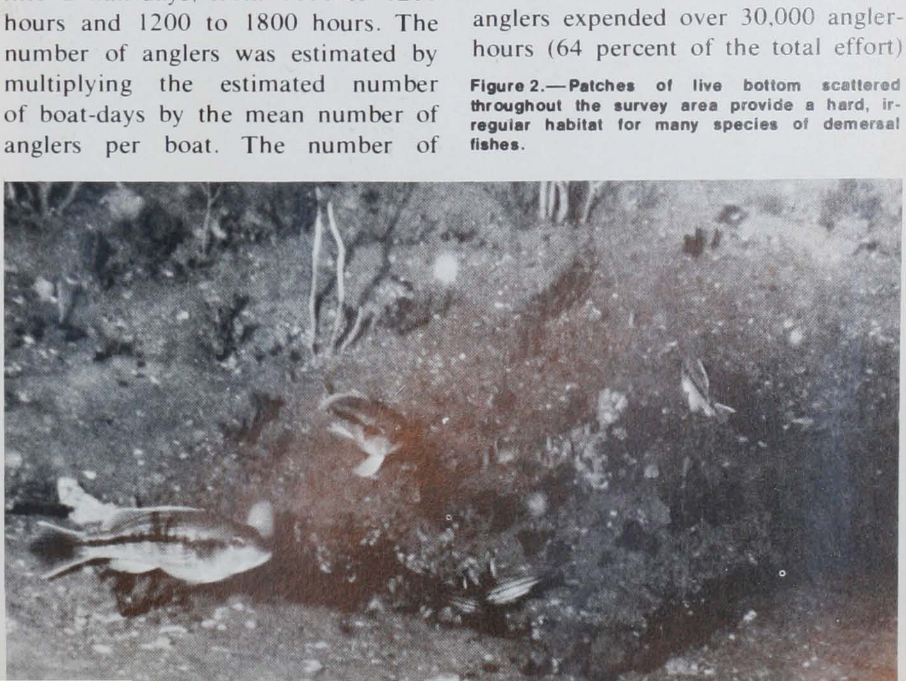

Figure 3.—Biologist (right) interviewing an angler at dockside for catch and effort data.

for pelagic species off Murrells Inlet (Fig. 4). Eighty-nine percent was expended over coastal habitat, 9 percent over the reefs, and 2 percent over live bottom. Peak effort occurred over coastal habitat in August and over the reefs in June and September. Live bottom was fished only in August and September.

CPUE for pelagic fishes was higher over coastal habitat than over the reefs (Mann-Whitney U test: $U = 1{,}334$, $P < 0.00003$). On the average during the season, private boat anglers caught 1.9 fish per angler-hour over coastal habitat and only 0.1 fish per angler-hour over the reefs. We did not compare CPUE over coastal habitat to that over live bottom habitat because of insufficient data. Monthly CPUE's, while fluctuating considerably, were consistently higher over coastal habitat than over the reefs (Fig. 5).

We estimated that private boat anglers caught nearly 52,000 fish representing 10 species (Table 1). Most of the species caught were pelagic. As in 1972, Spanish mackerel (*Scomberomorus maculatus*) constituted over 90 percent of the catch from each habitat type. Although they were caught throughout the season, the largest catches were made in mid-season. Bluefish (*Pomatomus saltatrix*), caught only over coastal habitat, were the second most numerous pelagic species taken. They first appeared in the catch in August and gradually increased in number until November when they represented 99 percent of the catch.

Anglers expended nearly 14,000 more angler-hours seeking pelagic species during the summer of 1973 (June-September) than they did in the summer of 1972 (Table 2). Coastal habitat received nearly all the increase.

Fishing success was not the same for both summers. In 1973 anglers had their highest CPUE over coastal habitat, whereas in 1972 they had about the same CPUE over all habitats. CPUE over artificial habitat was higher in 1972 and 1973; 0.1 fish per angler-hour in 1973 and 1.8 in 1972 (Mann-Whitney U test: $U = 247$, $P < 0.007$).

Our estimates of surface fishing success may not be appropriate for evaluating the reefs, since anglers do not randomly fish for pelagic recreational fishes, but visually search for surface schools. Thus, a system of controlled fishing over each habitat type may provide the most satisfactory method of evaluating reefs. Wickham, Watson, and Ogren (1973), using controlled fishing techniques, showed that midwater structures in the Gulf of

Table 1.—Estimated percentage of species caught by private boat anglers in 1973 while surface fishing different habitats: (A) artificial, (LB) live bottom, and (C) coastal.

Species	Habitat	Jun	Jul	Aug	Sep	Oct	Nov	Season
Bluefish	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	LB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	C	0.0	0.0	0.1	3.6	9.7	99.4	7.9
King mackerel	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	LB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	C	13.8	4.1	0.5	0.4	9.0	0.0	1.0
Spanish mackerel	A	94.4	0.0	100.0	100.0	0.0	0.0	96.4
	LB	0.0	0.0	100.0	100.0	0.0	0.0	100.0
	C	83.9	93.9	99.3	96.0	80.6	0.6	90.5
Others	A	5.6	0.0	0.0	0.0	0.0	0.0	3.6
	LB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	C	2.3	2.0	0.1	0.0	0.7	0.0	0.6
Estimated Number	A	240	0	19	101	0	0	360
	LB	0	0	134	78	0	0	212
	C	1,138	2,054	35,285	6,525	2,434	3,557	50,993

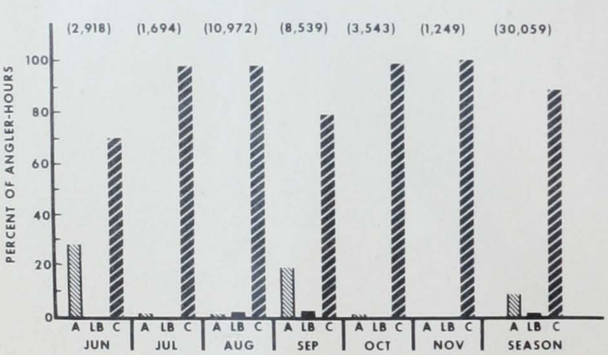

Figure 4.—Estimated number and percent of angler-hours expended by private boat anglers surface fishing over artificial (A), live bottom (LB), and coastal (C) habitats off Murrells Inlet, S.C., 1973.

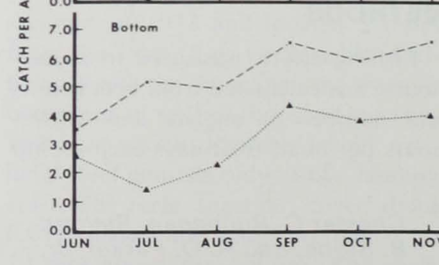

Figure 5.—Catch per angler-hour while surface fishing and bottom fishing (with cut bait only) over coastal (open circles), live bottom (solid circles), and artificial (solid triangles) habitats from June through November 1973.

Table 2.—Number of angler-hours expended off Murrells Inlet over artificial (A), live bottom (LB), and coastal (C) habitats, by method of fishing, and year, June - September.

Fishing Method	1972			1973			
	A	LB & C	Total	A	LB	C	Total
Surface	2,632 (23%)	8,810 (77%)	11,442	2,779 (11%)	505 (2%)	21,983 (87%)	25,267
Bottom	4,553 (47%)	5,134 (53%)	9,687	8,909 (70%)	2,927 (23%)	891 (7%)	12,727
Total	7,185	13,944	21,129	11,688	3,432	22,874	37,994

Table 3.—Bottom fishing intensity by habitat type, June-November, 1973.

Habitat	Angler-hours	Square miles	Angler-hours/ sq mile
Artificial	11,268	0.01	1,126,800
Live Bottom	4,379	22.00	199
Coastal	1,554	264.00	6

Mexico increased the CPUE of several pelagic recreational fishes.

Certain pelagic fishes, such as king mackerel (*Scomberomorus cavalla*) and little tunny (*Euthynnus alletteratus*), are attracted to a reef by the presence of prey fishes (i.e., scads, herrings), while other pelagic fishes, such as dolphin (*Coryphaena hippurus*), cobia (*Rachycentron canadum*), and greater barracuda (*Sphyraena barracuda*) are attracted by the structure (Wickham, et al., 1973). During our surveys of the reefs in 1972, we often observed schools of both scads (*Decapterus* sp.) (Fig. 6) and Spanish mackerel at or near the surface. But in 1973 we observed few schools of either species. Spanish mackerel are probably attracted to the scads rather than the reef structure and the poor success for that species over the reefs in 1973 may have been due to the low number of prey.

BOTTOM FISHING

We estimated that private boat anglers expended over 17,000 angler-hours (36 percent of the total effort) for demersal species from June through November 1973 (Fig. 7). Sixty-six percent was expended on the reefs, 25 percent on live bottom, and 9 percent on coastal habitat. Fishing intensity (angler-hours per square mile of habitat) on the reefs was almost 6,000 times that on live bottom and 200,000 times that on coastal habitat (Table 3). Anglers fished for demersal species on artificial and live bottom habitats during the entire season, expending their peak effort in September, and on coastal habitat from June through October, expending their peak effort in October. They fished more intensively on the reefs than over coastal or live bottom habitats, even though the reefs consisted of less than 0.01 percent of the survey area.

We found 30 species represented in the catch and estimated that anglers caught nearly 58,000 fish (Table 4). Most of the species caught were demersal. Nearly 97 percent were from the reefs and live bottom. Sea bass, porgy, and flounder constituted over 75 percent of the catch from artificial and live bottom habitats and only 3 percent of the catch from coastal habitat. The catch from live bottom was largely sea bass (55 percent) while the catch from the reefs was mostly porgy (Table 4). Sea bass accounted for a larger percentage of the monthly catch from live bottom than from the reefs. Porgy, which we observed on the reefs throughout the season, represented a larger and more consistent proportion of the monthly catch from the reefs than from live bottom (Table 4). No sea bass or porgy were reported caught over coastal habitat. Flounder represented nearly 22 percent of the catch from the reefs and less than 1 percent from live bottom. Bluefish was the most numerous species caught over coastal habitat (43 percent), even though they occurred in the catch only during September and October.

Sea bass, although appearing throughout the season in catches from artificial and live bottom habitats, were most abundant in early summer and again in fall (Table 4). On the basis of underwater observations, life history information (Cupka, 1972), and catch and effort data, we believe that immigration from surrounding areas during these periods caused peaks of abundance both on the reefs and in catches.

There were monthly differences in the relative composition of sea bass and porgy in catches from the reefs and live bottom. Porgy were more abundant on the reefs and sea bass more abundant on live bottom. These differences could be the result of: (1) the sea bass stock on the reefs being reduced faster by high fishing intensity than the stock on live bottom, (2) porgy having a greater affinity than sea bass for high profile objects,

Figure 6.—Scads schooling around Paradise Artificial Reef in 1972.

Table 4.—Estimated percentage of species caught by private boat anglers in 1973 while bottom fishing different habitats: (A) artificial, (LB) live bottom, and (C) coastal.

Species	Habitat	Jun	Jul	Aug	Sep	Oct	Nov	Season
Atlantic	A	0.0	0.5	2.9	0.0	0.0	0.0	0.4
croaker	LB	0.0	0.5	5.0	23.7	0.8	0.0	9.0
	C	0.0	0.0	0.0	0.0	6.1	0.0	5.2
Bluefish	A	1.9	2.4	0.0	2.0	1.1	0.0	1.5
	LB	0.0	0.0	3.5	0.0	0.0	2.5	0.8
	C	0.0	0.0	0.0	25.0	49.0	0.0	42.9
Flounder	A	10.1	33.3	16.5	38.8	5.5	0.0	21.6
	LB	2.7	2.3	0.0	0.3	0.0	0.0	0.5
	C	0.0	0.0	0.0	0.0	3.1	0.0	2.6
Pigfish	A	13.6	5.2	23.5	1.0	11.9	26.3	9.8
	LB	2.7	13.6	1.0	3.9	0.0	0.0	3.2
	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Porgy	A	49.7	38.1	38.2	35.6	47.3	29.5	40.5
	LB	6.7	20.7	49.2	23.7	5.5	0.0	19.3
	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sea bass	A	13.6	14.3	7.6	20.1	27.9	38.8	20.3
	LB	80.0	59.7	34.2	31.1	81.2	85.1	55.1
	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seatrout	A	2.8	1.0	6.5	0.2	1.3	0.0	1.6
	LB	0.0	0.0	2.5	14.8	10.0	8.3	8.8
	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sharks	A	3.5	1.4	0.6	0.0	0.4	0.0	0.8
	LB	5.3	2.8	1.0	0.0	0.0	0.8	0.8
	C	80.0	83.0	100.0	25.0	0.0	0.0	10.2
Others	A	4.8	3.8	4.2	2.3	4.6	5.4	3.5
	LB	2.6	0.4	3.6	2.5	2.5	3.3	2.5
	C	20.0	17.0	0.0	50.0	41.8	0.0	39.1
Estimated	A	4,156	3,417	3,259	10,394	7,117	1,936	30,279
Number	LB	987	2,992	3,812	8,742	6,265	2,931	25,729
	C	66	83	38	107	1,542	0	1,836

Table 5.—Bottom fishing statistics for anglers interviewed at dockside from June through November, 1973.

	Habitat Type					
	Artificial Bait		Live bottom Bait		Coastal Bait	
	Live	Cut	Live	Cut	Live	Cut
Number of angler-hours	180.5	378.8	0	234.3	0	88.3
Number of fish	368	1,116	0	1,343	0	115
Catch per angler-hour	2.0	3.0	0	5.7	0	1.3
Species	*Percent of Catch*					
Atlantic croaker	0.0	0.5	0.0	6.9	0.0	5.2
Bluefish	2.7	0.6	—	0.7	—	42.9
Flounder	67.0	2.5	—	0.6	—	2.6
Pigfish	0.5	14.7	—	3.0	—	0.0
Porgy	7.4	50.8	—	17.8	—	0.0
Sea bass	11.0	23.6	—	57.6	—	0.0
Seatrout	7.0	0.7	—	7.7	—	0.0
Sharks	1.3	0.9	—	1.0	—	10.2
Spanish mackerel	0.3	0.0	—	0.3	—	0.8
Others	2.0	5.3	—	4.0	—	38.2

such as the vessels on the reefs, and sea bass having a greater affinity than porgy for the low profile of live bottom, and (3) porgy having a greater preference than sea bass for encrusting organisms on the reefs.

Flounder, which appeared in the catch from June through October, were caught most frequently in the summer. This was also the period we observed their greatest abundance around the reef. We suspect flounder were as abundant on live bottom habitat as on artificial habitat and that the small catch on live bottom was due to a lack of a specific, live bait fishing effort for flounder.

We recognized two possibilities for bias in our estimates of CPUE's for bottom fishermen on different habitats. First, CPUE on a particular habitat could be influenced by the relative numbers of novice and experienced anglers, and second, CPUE for a particular species could be influenced by the type of bait used. We defined experienced parties as those with the largest catches and whose combined catch represented approximately 50 percent of the total bottom catch with cut bait (Rupp, 1961). Cut bait was defined as any kind of dead natural bait and live bait as any living bait.

The experienced fisherman's efficiency per unit of effort is greater than that of the novice fisherman, probably because he knows the area and is skilled in fishing. This would result in the CPUE for a habitat with a relatively large number of experienced fishermen being higher than the CPUE for a habitat with a relatively small number of experienced fishermen. Only 12 percent of the parties that fished over the reefs were experienced, as contrasted with 20 percent over live bottom. This difference probably is not large enough to affect our conclusion. The reefs attracted more novice anglers because they are easy to locate, are close to shore, are well buoyed, and have received much publicity in local news media during the past few years. Most of the live bottom patches are located farther from the Inlet and their exact positions are known to only a small group of fishermen.

To determine if the bait a fisherman used influenced the species composition of his catch, we compared the catch of reef fishermen using cut bait with the catch of those using live bait. Nearly 90 percent of the flounder were caught on live bait while 86 percent of the sea bass and 96 percent of the pigfish (*Orthopristis chrysoptera*) and porgy were caught on cut bait (Table 5). Since almost 32 percent of the reef fishermen's effort was with live bait and none of the live bottom fishermen used live bait, a higher catch of flounder would be expected on the reefs. Fishermen using cut bait averaged about 2.7 more fish per angler-hour over live bottom than over the reefs (Mann-Whitney U test: $U = 465.5$, $P < 0.003$) (Table 5). Monthly CPUE's for cut bait fishermen were consistently higher over live bottom than over the reefs (Fig. 5).

Over 3,000 more angler-hours were

expended bottom fishing in the summer of 1973 than in the summer of 1972 (Table 2). Effort on the reefs doubled between 1972 and 1973, whereas effort on natural habitat decreased by 25 percent.

CPUE of bottom fishermen on the reefs was about the same for both summers (Mann-Whitney U test: U = 1,063, P = 0.2946), but the relative composition of the catch was not (Fig. 8). Fishermen caught 3.0 fish per angler-hour in the summer of 1972 and 2.4 fish per angler-hour in the summer of 1973. The relative composition of pigfish and porgy (combined) in the catch differed by only 2 percent between summers. In 1973, jack decreased by 11 percent, sea bass by nearly 10 percent; flounder increased by 20 percent. The large number of flounder caught from the reefs in 1973 may have resulted from an increase in effort with live bait and an increase in the abundance of flounder. Although we did not separate effort by bait categories in 1972, we suspect that less than 25 percent of the effort was with live bait. During underwater surveys of the reefs, we observed that flounder were more abundant in 1973.

Fishing success in 1973 was better on the reefs than on coastal habitat and less productive than on live bottom. These differences were not observed in 1972 because of a possible masking effect caused by combining data from highly successful fishing over live bottom with data from relatively unsuccessful fishing over coastal habitat. The relative abundance of each species in the catch from natural habitat is not comparable between summers because the data from live bottom and coastal habitats were pooled in 1972.

Our estimates of bottom fishing success may not be appropriate for evaluating the reefs, since the reefs and live bottom were of different sizes and received different fishing intensities. We believe the efficiency of artificial reefs for enhancing a marine recreational fishery can best be evaluated by an experimental program of controlled fishing over natural and artificial habitats of equal size.

DISCUSSION AND CONCLUSIONS

The reefs off Murrells Inlet increased bottom fishing opportunities by providing a reef fishery within easy access of the Inlet. During the summers of 1972 and 1973, bottom fishing anglers expended nearly 50 percent or more of their effort on the reefs. Effort on the reefs, which probably was intensified as the result of publicizing the reefs in the local news media, increased nearly 100 percent between summers, while effort in the whole survey area increased only 32 percent. Even though the reefs covered considerably less surface area than live bottom, they received a fishing intensity several thousand times greater than that on live bottom. Coastal habitat received only a small portion of the effort.

We expected bottom fishing success to be similar over artificial reefs and live bottom since these habitats share many characteristics. However, fishermen caught fewer fish per angler-hour over the reefs than over live bottom. We believe the lower CPUE on the reefs resulted from the combined effects of high fishing intensity, numerous novice anglers, and the small area covered by the reefs. High fishing intensity caused greater competition

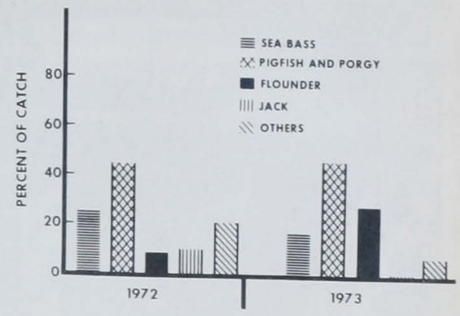

Figure 8.—Catch, in percent, of major species groups by private boat anglers bottom fishing on artificial habitat off Murrells Inlet, June-September 1972 and 1973.

among the reef fishermen. The lack of knowledge of the area and of fishing skills by novice anglers also reduced the overall CPUE. Replenishment of the reefs stock by immigration from surrounding areas will cushion the effect of high fishing intensity, but immigration is limited by the size and behavior of peripheral stocks. Until fishing intensity on the reefs is reduced by decreased effort or an increase in reef habitat, CPUE for demersal fishes on the reefs off Murrells Inlet will probably remain lower than that on live bottom. To correct this situation, not only off Murrells Inlet but along the whole South Carolina coast, the South Carolina Wildlife Resources Department is actively expanding a number of artificial reefs to meet the needs of reef fishermen. In early 1974, the State added two landing craft to each of the reefs off Murrells Inlet (Fig. 9).

The reefs did not increase surface fishing success and received only about 20 percent of the effort expended for pelagic recreational fishes. Although the total number of angler-hours increased by 121 percent between the summers of 1972 and 1973 the number of angler-hours on the reefs increased by only 13 percent. In 1972 there was no difference in the success for pelagic recreational fishes among habitats, while in 1973 success was highest over coastal habitat. The difference in fishing success over the reefs between summers may have resulted from the presence or absence of prey.

To improve surface fishing success over an artificial reef, we need to incorporate in the reef design features that attract and hold prey. Our knowledge of the appropriate design for

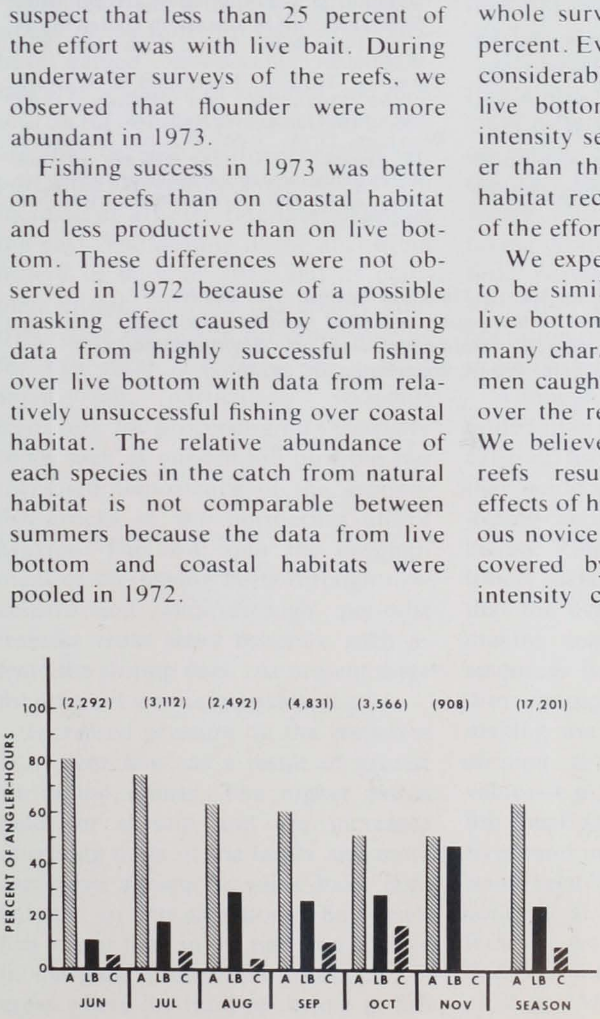

Figure 7.—Estimated number and percentage of angler-hours expended by private boat anglers bottom fishing over artificial (A), live bottom (LB), and coastal (C) habitats off Murrells Inlet, S.C., 1973.

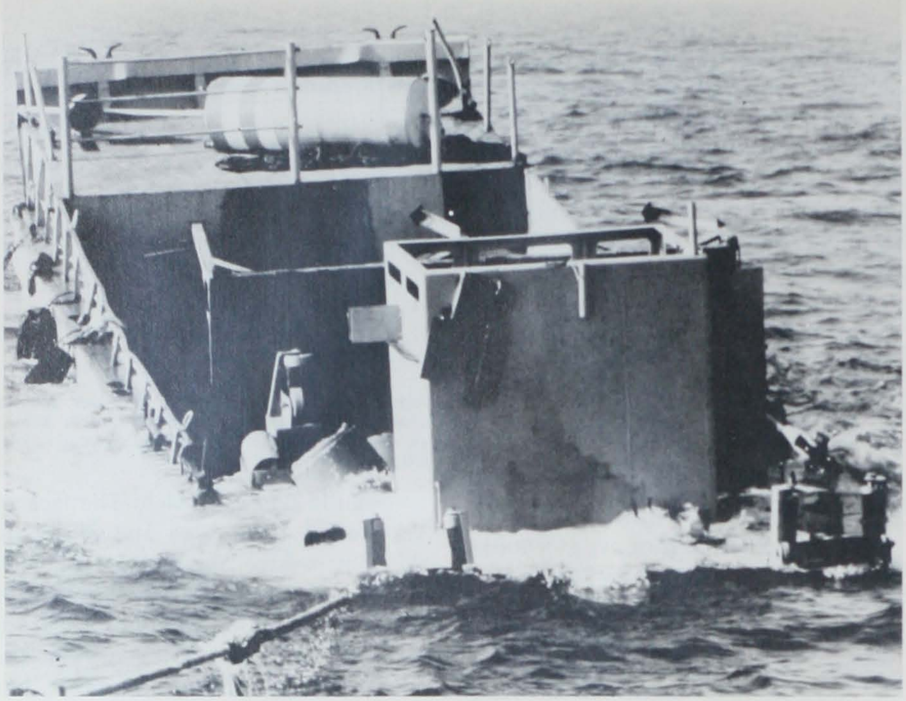

Figure 9.—The sinking of an LCM on Paradise Artificial Reef in the winter of 1973-74 by the South Carolina Wildlife Resources Department. Photo courtesy of South Carolina Wildlife Resources Department.

this purpose is incomplete. Although in general high profile reefs attract more prey and pelagic predators than low profile reefs, a low profile reef off Georgia consistently attracted large numbers of prey and pelagic predators, and a high profile reef off Florida attracted only a few pelagic predators. Placing midwater structures, similar to those discussed by Wickham, et al. (1973), on the reefs may improve surface fishing success by attracting and holding a number of pelagic species in the area for a period of time. Additional studies are needed to determine what structural characteristics influence the reef's attractiveness to pelagic fishes.

Paradise Artificial Reef and Pawleys Island Artificial Reef created recreational reef fisheries in areas where previously none existed. They attracted additional anglers to the areas, resulting in an increase in the gross economic impact of private boat anglers on nearby communities (Buchanan, 1973). Bottom fishermen extensively used the reefs and caught more fish per angler-hour than they did before the reefs were built. Success, however, was not as high as over nearby live bottom. We expect a higher quality bottom fishery to develop once the reefs are enlarged sufficiently to support the fishing pressure they receive. Surface fishing success should also increase once the structural features that attract and hold pelagic fishes become known and can be incorporated with the reefs. As the reefs are expanded and improved, the number and rate at which reef fishes are harvested, the number of angler-hours on the reefs, and the economic growth of nearby communities should increase.

ACKNOWLEDGMENTS

We would like to acknowledge the South Carolina Wildlife Resources Department for its assistance with many phases of our study and several staff members of the Atlantic Estuarine Fisheries Center for suggestions and review of the manuscript.

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MFR Paper 1102. From Marine Fisheries Review, *Vol. 36, No. 11, November 1974. Copies of this paper, in limited numbers, are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235.*