SEASONAL STANDING CROP OF FISHES FROM AN OPEN COASTAL BEACH AT MUSTANG ISLAND, TEXAS

William N. McFarland[1]

Institute of Marine Science, Port Aransas, Texas

INTRODUCTION

The paucity of information concerning vertebrates characteristically associated with outer coastal beach environments has been pointed out by Gunter, 1958. Fishes from beaches in the vicinity of Beaufort, North Carolina were reported by Pearse, Humm, and Wharton, 1942, while the vertebrates on the outer beach at Mustang Island, Texas, have been reported by Gunter, 1945 and 1958. These studies indicate the seasonal fluctuations in the fish faunas of subtemperate beach environments, wherein the populations decline both in total numbers of fish and in species composition during winter. Further, Pearse, et al, and Gunter's studies reveal that from 60 to 80 per cent of the fish fauna is represented by relatively few species on both the south Atlantic and Texas beaches.

No data appear to be available on the standing crops of fishes characteristic of these beaches. In the following paper the species composition, numbers of individuals, and the standing crop of fishes are reported for the period May, 1960 through July, 1961. The environment sampled, at Mustang Island, Texas is the same outer coast beach studied by Gunter, 1945 and 1958. The information that has accrued on this stretch of coastline, therefore, makes it one of the better known beaches of North America.

MATERIALS AND METHODS

Equipment

Estimation of the standing crops of fishes throughout the period from May, 1960 through July, 1961 was obtained by setting a large beach seine over a specified area of the surf fringe. The net measured 633 feet in length and was designed to lay into the beach profile. The beach profile, at least in the area of the study, maintains a relative constancy throughout the year (Hedgpeth, 1957; McFarland, 1962). As a result the wings of the net were tapered from two feet deep to ten feet deep, where the wings joined the cross piece (relaxed webbing

---

[1]Present address, Dept. of Zoology, Cornell University, Ithaca, N.Y.

measurements). Webbing was Number 9 Nyak twine woven to 3/4-inch stretch size (3/8-inch bar). Plastic three-inch styrofoam floats were placed one foot apart. Because of the stong wave action often encountered, heavy floating was required to keep the net constantly at the surface.

The lead line consisted of a continuous galvanized link chain weighing one-half pound to the foot. Examination of the lead line action by diving suggested that the bottom of the net continually scoured the sand bottom both on the longshore bars and in the troughs. Escapement of fish beneath the lead line, if it occurred, probably took place only when the lead line was pulled over small holes.

Specific dimensions of the net were: wings each 200 feet long; crosspiece 185 feet long; bag 48 feet wide, throat size 25 feet wide by 8 feet deep, depth of sock 25 feet. The bag was placed in a corner between the cross piece and one of the wings. Because of the longshore currents the bag was set downstream so that it would open into the net. The depth of the sock was reduced to ten feet after initial test hauls to lessen the amount of drag on the net.

The net was set from a surf skiff with an over-all length of 18 feet. The beam was five foot on the bottom and seven foot at the gunale. The bow, transom, and sides were sharply flared, while the bottom was flat, but drastically bowed fore and aft to lift over combers. A well piercing the transom was utilized to mount a 25 horsepower outboard motor to propel the vessel. The net was stacked in the flat, with the corks to one side and the lead line to the other side, in a well located midship.

The net was payed over a rack located above the transom and directly over the motor operator's head. Early attempts to pay out the net in a roped condition led to twisting of the net. The addition of the rack solved this problem and further assisted in the rehandling of the net on the beach and at the washing and drying rack. The entire rig was capable of being propelled in about one foot of water, the draft of the skiff being about six to seven inches loaded and only three to four inches empty.

Method of Setting the Net

Theoretically an ideal set of the net would cover a rectangular area with the long dimension perpendicular to the surf fringe (224 feet) and the short dimension parallel to the beach (185 feet). The cross piece, thus, usually lay in water of the second longshore trough at a depth of six to eight feet. The surface area of water enclosed under ideal conditions represent 0.951 surface acres and about 4,550 cubic meters volume. Because of the strong longshore currents this ideal

was seldom achieved. More often the outward course of the skiff was at a slight angle in the direction of the longshore current. In addition, a degree of net drift occurred before the entire net was payed out. As a result the acreage of water surface covered most often exceeded 0.951 acres.

To account for this deviation, at each sampling a distance of 185 feet was marked out along the beach. The corners of the wings and cross piece of the net were marked with white floats and changes in course were always made at these positions. An individual on shore paced off course changes from the marker posts and transcribed these to a board marked with the ideal course. As a result, with the known dimensions of the net and the measured deviation from the theoretical course, the actual area enclosed could be calculated. For the 25 samplings reported in this paper the average area covered was 1.10 acres.

A set, from start to enclosure of the area, normally took less than two minutes. Once set, the net was immediately hauled upon the beach by pulling first on the upstream wing and crosspiece. A slight pull was maintained on the downstream wing to keep the bag opened into the current. The net was pulled with seine lines snapped to the lead line and attached to two trucks. Inward surf action and the longshore current assisted in relieving tension on the net. The net was beached with its catch within ten minutes or less in all samplings.

Escapement

The effectiveness of the chain in reducing escapement of fishes beneath the lead line has been indicated. On several occasions in setting the net the closing wing was ended 50 to 60 feet out from the beach and thus provided a potential route of escape for fishes. However, the presence of a seine line, the fact that the water in this location was only about one foot deep, and the rapid closure of the area from hauling of the net is believed to have cut off escapement. At no time were fishes observed to use this route.

Escapement over the float line occurred with two species of fish, i.e., Mugil cephalus and Trachinotus carolinus. This occurred only on three occasions and was unusual in that both species are predilected toward jumping. Losses were accounted for by counting the number of fish jumping the net. The number that escaped were added to the actual catch and their weight estimated by sampling members of the species actually caught.

Escapement through the mesh of the net occurred with very small fishes. Specific losses depended upon the individual species and the respective abilities to swim through the 3/8-inch bar mesh. On several occasions a small fine mesh net was used to surround the bag of the larger net prior to hauling it from the surf. Fishes which escaped from the larger net under these conditions seldom exceeded 40 mm. in standard length and more often were under 30 mm. standard length. As a result all data in this report ignore the fish populations in the surf under 40 mm. in standard length. This is regrettable, but unfortunately the extreme size of the net precluded the possibility of using a finer mesh size because of the drag resistance of the net, and the strong longshore currents encountered. In addition, smaller mesh size would have seriously reduced the strength of the net.

All fish collected were identified to species with the exception of the genus Anchoa and the filefish taken on one occasion. Specimens were weighed individually, but where the numbers of the species were large, a series of subsamples of 20 individuals each were weighed at random and the total numbers and weight calculated. The actual catch and the estimated area covered were corrected to a one acre basis. All values reported, thus, represent numbers or pounds of fish per acre.

TYPES AND NUMBERS OF FISHES CAUGHT

A total of 47 species of fish were caught during the sampling year. The species caught and the numbers of each species per acre for each sampling are compiled in Table 1. During the winter months the total numbers of species represented in the collections ranged from a low of two to a high of eight and averaged four. During the rest of the year the number of species ranged from 11 to 21 and averaged 16.

On a few occasions considerable numbers of one species were seined. The most exceptional example was the capture on March 1, 1961, of 35,881 specimens of the marine catfish Galeichthys felis per acre. Throughout the rest of the year this species was represented on individual catches by less than 104 specimens per acre. The high numbers are believed to reflect a breeding movement or aggregation of the populations shoreward. That this movement was general was demonstrated by the capture of large numbers of this species with a smaller net during the afternoon and evening of March 1, 1961. Similarly, large numbers of the striped mullet, Mugil cephalus, were taken on December 15, 1960. This is not unusual at this time of year since the species is known to migrate from Texas bays in large schools during the fall. Another example of unusually large numbers of a species was encountered on May 26, 1961,

when the haemulid, Conodon nobilis, was taken in the surf. At no time in the author's experience had this species been taken from the beach, although it is common in trawl hauls from deeper water off of the beach. Gunter, 1945, 1958, does not report C. nobilis from the surf. Examination of the gonads revealed that many of the specimens were ripe, but whether Conodon's presence on the beach represents a breeding movement remains conjecture.

The average total number of fish captured per acre during winter was 82 and ranged from 16 to 151 specimens, whereas during spring and summer the average increased to 1,143 fish per acre and ranged from 290 to 2,830. In establishing these estimates, the unusually high abundance of catfish on March 1, 1961, has been ignored.

STANDING CROPS OF FISHES

The weight of each species per acre for each sampling and the total weight of fishes per acre are given in Table 2. Total standing crop during the various seasons is shown in Figure 1. An increase in standing crop from the winter lows to the spring-summer highs is evident, although considerable variation occurs from sample to sample. Average total standing crop for the winter months when the species composition of the catch was lowest was 25.8 pounds per acre (the catches of December 15, 1960 and of March 1, 1961, when high numbers of mullet and catfish were taken have been ignored), and ranged from a low of 5.3 pounds to a high of 48 pounds per acre. During the spring-summer samplings the total catch ranged from a low of 32.5 pounds to a high of 271.8 pounds per acre with a mean of 103.2 pounds. Thus, weight of fish per acre or total standing crop increases fourfold from winter to summer. The number of species represented also increased fourfold for the same periods. However, the average increases in total numbers of fishes for this period was fourteenfold and reflects the recruitment of smaller fish, as well as smaller species, into the beach populations during the spring-summer period.

SEASONAL CHARACTERISTICS OF FISH POPULATIONS

The primary characteristic of the fish populations is the seasonal change in abundance. An identical result stems from the work of Gunter, 1958, for the same beach environment. In addition to the seasonal changes, the results can be utilized to indicate the tendencies for some of the species to be present through more of the seasons than other species. In general, the 47 species of fishes collected through the year can be classified as: (1) all year residents, (2) spring-summer residents, (3) summer residents, (4) winter-spring residents, and (5) sporadics.

All Year Residents

Of the 47 species, three were obtained in most of the collections throughout the year. The striped mullet, Mugil cephalus, was present in all collections and usually represented ten per cent or more of the catch. Both Galeichthys felis and Lagodon rhomboides were caught throughout the year, although they were not taken during ocassional hauls (see Tables 1 and 2). Neither of these fishes were as abundant as M. cephalus and, with the exception of the abundance of G. felis for the February 17 and March 1, 1961 collections, they normally represented something less than five per cent of the catch.

Spring-Summer Residents

During the spring and into the summer a variety of fishes entered the beach populations as subadults and increased in size throughout the summer. The pompano, Trachinotus carolinus, is an exception. This species first appeared during March and was represented only by large adults. By the end of March large fish were no longer taken. Throughout the rest of the summer subadult pompanos increasingly entered the catches. The spawning history of this species is fairly well documented for the Texas coast and the seasonal changes encountered in this study agree with spawning and growth habits of pompano (see Gunter, 1958; Springer and Pirson, 1958).

On a basis of weight of fishes per acre nine of the sixteen species which can be classed as spring-summer residents are amongst the twenty most abundant species for the collecting year.

Summer Residents

Nine species can be classed as summer residents (Table 3). Of the nine, five are amongst the twenty most abundant fishes. Caranx hippos, Chloroscombrus chrysura, Micropogon undulatus, Scomberomerus maculatus, and Peprilus paru enter the beach populations as summer progresses.

Winter-Spring Residents

One species, Bairdiella chrysura, was found to occur as a resident only during the winter and spring periods. Its absence during summer is unique since it is common in the bays and from trawl hauls from deeper water of the gulf shelf.

Sporadics

Of the total number of species captured, 18 occurred in the catches in a sporadic manner (Table 4). Most of the sporadic

occurrences were encountered during the summer months. All of the elasmobranchs and Sciaenops ocellata are common just outside the surf zone. The redfish is taken commonly by anglers in the surf and night seining with smaller nets did yield increased numbers of redfish. Why the catch was low during daytime seine hauls in unknown, but the results suggest that the redfish may move into the shallow surf water primarily at night or are adept at escaping a seine during daylight hours (possible as a result of motor noise).

ABUNDANCE OF THE VARIOUS SPECIES OF FISHES

In his study of the fishes of the Mustang Island surf, Gunter, 1958, indicated the dominance of several species based on the numbers of each species present. Similar measures of abundance can be established from the present data. Neither the numbers of fishes nor standing crop is a complete index to dominance of a given species in an environment. However, of the two measures standing crop contains more ecological information. Therefore, the absolute and relative abundance of fishes in the surf zone at Mustang Island is reported mainly in terms of pounds of fish per acre. Obviously when but a few large specimens of a species are encountered they will bias the data on abundance. However, when the figures are averaged for an entire year the bias is reduced. The twenty most abundant fishes taken during the year are indicated in Table 5. In establishing the results the enormous catch of catfish on March 1, 1961, has been disregarded since it constitutes almost 65 per cent of the entire weight of all fishes caught during the collecting period.

The standing crops reveal that Mugil cephalus is by far the most abundant fish and on a percentage basis represents 46 per cent of the standing crop. The next four most abundant species, Polydactylus octonemus, Menticirrhus littoralis, Conodon nobilis, and Trachinotus carolinus, when included with M. cephalus constitute 70 per cent of the yearly catch. Conodon nobilis cannot be considered as a typical resident of the surf, since it most often is not taken in beach seining. If it is ignored, the other four species still constitute the major bulk of all fishes taken from the surf (63.4 per cent).

When the per cent representation in all catches is expressed on a number of individuals basis (Table 5) the order of abundance is slightly changed. However, the three most abundant species on the basis of standing crop are still represented amongst the four most numerous species.

Although the values for standing crop provide a more usable estimate of the potential ecologic impact of a species than numbers, a qualitative index of the relative "dominance" of each species can be obtained by taking both numbers and standing crop into consideration.

This has been done in the last column of Table 5. The values are obtained by the completely arbitrary convention of dividing the product of the total number and standing crop of each species by 1,000. In the last analysis an absolute index to "dominance", in the real meaning of the term, could only be obtained if the food requirements, metabolic physiology and the behavior of each species were known.

The crude index does, however, reveal tendencies which can be correlated with some of the information that has been accumulated on the productivity of the environment. First both Mugil cephalus and Polydactylus octonemus have high index values compared to all the other species. Both species are predominatly plankton feeders (M. cephalus is more often considered a grazer, Darnell, 1958). On a pure weight basis, M. cephalus and P. octonemus constitute 53.61 per cent of the total yearly catch. If their average standing crops are considered for only the months of June, July, and August, they still constitute 47.76 per cent of the standing crop.

Of the remaining 17 species listed in Table 5 only Harengula pensacolae, Anchoa sp., and possibly Menidia beryllina can be classed as plankton feeders. Menticirrhus littoralis has an index considerably lower than either M. cephalus or P. octonemus, but distinctly larger than all other species (Table 5). M. littoralis feeds primarily on bottom invertebrates (Dartnall, 1958). The great bulk of the remaining 14 species are bottom feeders also, living off various crustaceans and molluscs or in a few instances other fishes. However, many of the fishes have been observed qualitatively to consume large quantities of zooplankton when it is abundant in the surf. Direct examination of the stomach contents of Mugil cephalus, Trachinotus carolinus, Caranx hippos, and Chloroscombrus chrysurus revealed that their stomachs were often full of crustacean larvae. How generalized plankton feeding might be to many of the surf fishes that normally feed on bottom dwelling forms, is not known; it is also not known whether cropping occurs during periods when zooplankton are not abundant in the surf, such as during mid-summer.

A comprehensive analysis of the food habits of the fishes in the surf at the various seasons would be valuable in establishing whether the smaller standing crops of bottom feeding fishes relative to plankton feeding fishes are related to an inability to utilize plankton or to a much lower availability of the bottom fauna or both.

COMPARISON WITH PREVIOUS WORK

In his 1958 paper, Gunter was able to demonstrate for the year 1947-1948 that a seasonal succession occurred in the fish populations on the Gulf beach. Two species, Trachinotus carolinus and Harengula pensacolae constituted approximately 68 per cent of the open beach catch, while Mugil curema which was the third most abundant species, if included, raises the representation to 74 per cent. The results reported by Gunter are for the most part representative of fishes smaller than 100 mm. in total length. Net selectivity in the current studies eliminated most of the fishes smaller than 40 mm. standard length. As a result the present study overlaps Gunter's findings and extends them to include the larger fishes. The most conspicuous difference in the two studies is the relatively lower representation of H. pensacolae in the current collections. For example on July 19, 1960, only one specimen is reported in the catch (Table 1), but 734 individuals were taken by the small fine mesh net used to surround the bag prior to beaching the large net. Since escapement probably occurred throughout the hauling of the large net these small fishes have been ignored. Most certainly they would constitute a considerable portion of the standing crop.

Gunter, 1958, suggests that during any given season the species composition might fluctuate from year to year and gives examples for the years of 1945 and 1947-1948. The heavy representation of Trachinotus carolinus, Harengula pensacolae, and Polydactylus octonemus that he reports are certainly characteristic of the more abundant species for this study (Table 5), even though H. pensacolae probably constituted a greated bulk of the total population than indicated. Thus, in spite of the changes in species composition from year to year, the more abundant species tend to be represented constantly in the beach populations. It is considered of prime importance that most of the characteristic species are either plankton feeders or are potentially capable of feeding on zooplankton when it is available.

SUMMARY

(1) The seasonal abundance of fishes with respect to numbers and standing crop for the surf zone fringe at Mustang Island, Texas, is reported for the year 1960-1961. Results reveal that both species composition and total abundance are lowest in winter and increase during the spring-summer periods.

(2) During winter an average of four species of fishes is taken by seining, whereas the summer average increases to sixteen species. A total of 47 species was captured during the collecting year and are classified as all year, spring-summer, summer, and winter-spring residents or as sporadic occurrences.

(3) The average standing crop of fishes during winter was 25.8 pounds of fish per surface acre of surf fringe and increased to an average of 103.2 pounds during the summer.

(4) The striped mullet, Mugil cephalus, constituted 46 per cent of the total catch on a weight basis and was by far the most abundant fish. The next five most abundant fishes were Polydactylus octonemus, Menticirrhus littoralis, Conodon nobilis, Trachinotus carolinus, and Pogonias chromis. Together they constituted 27.61 per cent of the total catches.

(5) The relative dominance of the most abundant fishes are compared with previous work and it is concluded that the basic species composition is maintained from year to year, although a particular species may vary in its rank from year to year.

(6) The standing crop of fishes and their theoretical energy requirements are calculated and related to the availability of energy in the plankton. It is concluded that the recruitment of plankton is at least several orders of magnitude in excess of the energy requirements of the fishes.

LITERATURE CITED

Darnell, R.M. 1958. Food habits of fishes and larger invertebrates of Lake Ponchartrain, Louisiana, an estuarine community. Publ. Inst. Mar. Sci. Univ. Tex. 5: 353-416.

Gunter, G. 1945. Studies on Marine Fishes of Texas. Pub. Inst. Mar. Sci. Univ. Tex. 1 (1): 1-190.

Gunter, G. 1958. Population studies of the shallow water fishes of an outer beach in south Texas. Pub. Inst. Mar. Sci. Univ. Tex. 5: 186-193.

Hedgpeth, J.W. 1957. Sandy Beaches, Chap. 19, In: Treatise on Marine Ecology and Paleoecology, Vol. 1, Ed. by J.W. Hedgpeth. Geol. Soc. Amer., Mem. 67, 1296 p.

McFarland, W.N. 1962. Seasonal plankton productivity in an offshore south Texas beach. Non-published Report to Texas Game and Fish Commission.

Pearse, A.S., H.L. Humm, and G.W. Wharton. 1942. Ecology of sand beaches at Beaufort, North Carolina, Ecol. Mongr. 12:135-140

Springer, V.G. and L. Pirson. 1958. Fluctuations in the relative abundance of sport fishes as indicated by the catch at Port Aransas, Texas. 1952-1956. Publ. Inst. Mar. Sci. Univ. Tex. 5: 169-185.

FIGURE 1. Seasonal standing crop of fishes in pounds per acre of surf fringe at Mustang Island, Texas.

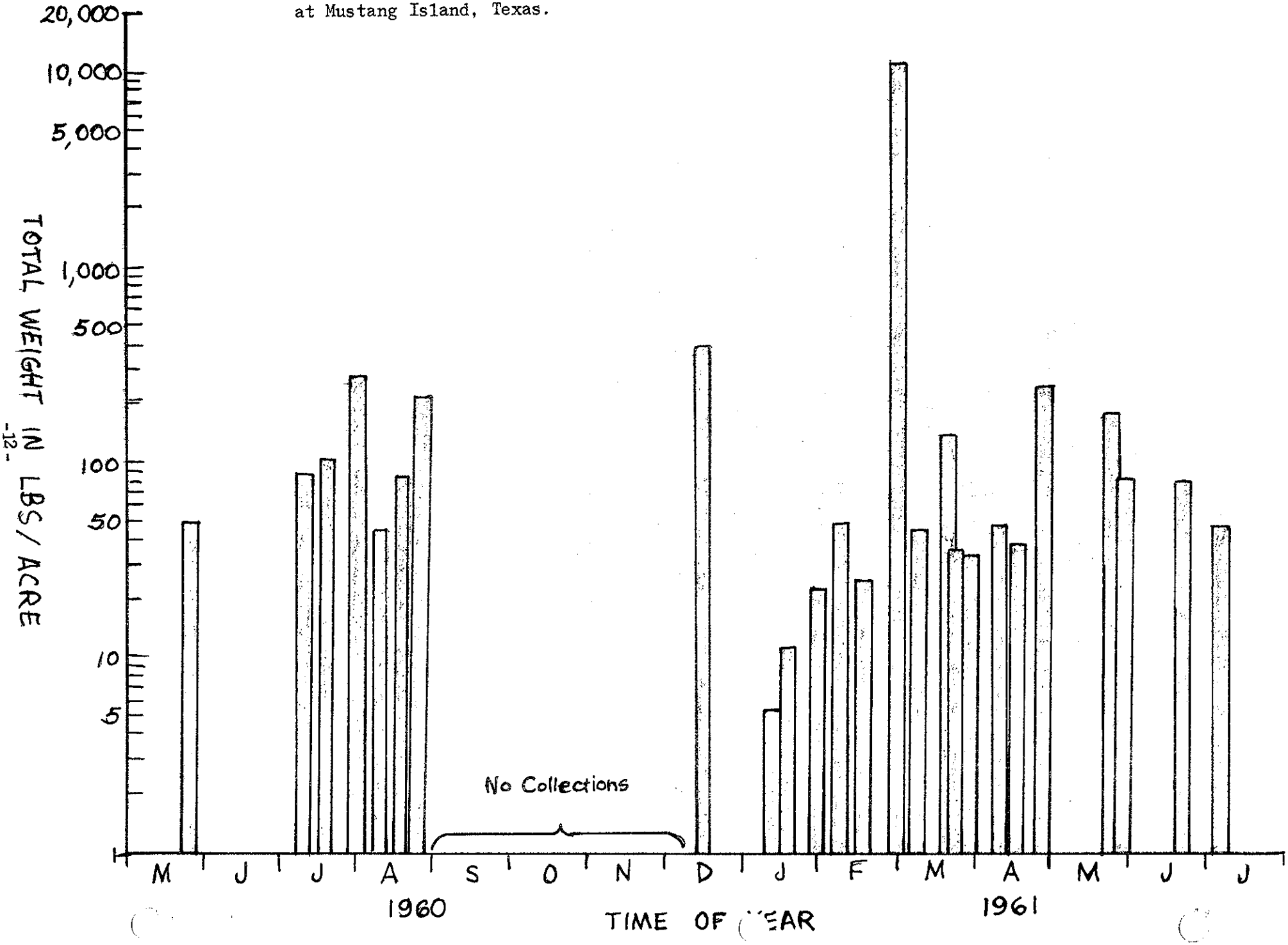

TABLE 1. Total numbers of each species and of all species at various seasons of the year.

SPECIES	DATE OF COLLECTION												
	May 25	July 12	July 19	July 29	Aug 10	Aug 18	Aug 26	Dec 15	Jan 13	Jan 18	Jan 31	Feb 9	Feb 17
S. terrae-novae	-	-	-	-	-	-	-	-	-	-	-	-	-
S. tiburo	-	-	-	-	-	-	-	-	-	-	-	-	-
N. braziliensis	1	1	-	1	-	2	1	-	-	-	-	-	-
D. americana	-	-	-	-	-	-	9	-	-	-	-	-	-
D. sabina	1	1	3	-	15	39	90	-	-	-	-	-	-
R. bonasus	-	-	-	-	-	8	8	-	-	-	-	-	-
E. saurus	4	-	4	8	1	5	3	-	-	-	-	6	-
H. pensacolae	-	-	1	-	-	-	-	-	-	-	-	-	-
B. patronus	2	19	1	-	-	2	9	-	-	-	-	-	-
Anchoa sp.	-	-	-	-	-	-	-	-	-	-	-	3	-
G. felis	7	19	-	-	19	24	60	38	1	10	-	9	104
S. marinus	-	1	1	-	-	1	1	-	-	-	-	-	-
Sygnathus sp.	-	-	-	-	-	-	-	-	-	-	-	-	6
M. cephalus	20	93	13	75	17	4	345	480	7	15	45	72	4
M. beryllina	-	-	-	-	-	-	-	-	-	-	-	-	-
P. octonemus	277	1061	2503	2197	47	83	55	-	-	-	-	-	-
C. unidecimalis	1	-	-	-	-	-	-	-	-	-	-	-	-
P. saltatrix	4	-	-	-	-	-	-	-	-	-	-	-	-
E. bipinnulutus	-	-	-	-	-	3	-	-	-	-	-	-	-
T. carolinus	124	55	40	-	34	23	62	-	-	-	-	-	-
C. bartholomaei	-	1	-	49	-	-	-	-	-	5	-	-	-
C. hippos	-	-	38	47	3	2	12	-	-	-	-	-	-
C. chrysurus	8	-	-	-	3	-	-	-	-	-	-	-	-
S. vomer	2	-	-	-	2	-	1	-	-	-	-	-	-
E. argenteus	-	-	-	-	-	-	-	-	-	-	-	-	-
C. nobilis	-	-	-	-	-	-	-	-	-	-	-	-	-
B. chrysura	-	-	-	-	-	-	-	-	8	8	-	42	-
S. ocellata	-	1	-	-	1	-	1	-	-	-	-	-	-
L. xanthurus	75	-	10	26	42	27	57	-	-	-	-	-	-
M. undulatus	2	7	-	-	-	-	-	-	-	-	-	-	-
M. americanus	23	-	-	-	-	-	-	-	-	-	-	-	-
M. atlanticus	-	-	-	-	-	-	-	-	-	-	-	-	-
M. littoralis	-	36	136	154	247	54	401	-	-	-	-	-	8
P. chromis	2	1	-	2	2	3	2	-	-	-	-	-	-
C. nebulosus	3	39	-	5	5	-	2	-	-	-	-	-	-
L. rhomboides	-	-	3	2	3	6	2	2	-	3	26	10	-
A. probatocephalus	1	1	-	-	1	2	1	-	-	-	-	-	-
C. faber	-	-	-	-	-	-	-	-	-	-	-	-	-
T. lepturus	-	1	-	-	1	2	-	-	-	-	-	-	-
S. maculatus	-	-	-	-	-	-	-	-	-	-	-	-	-
P. paru	11	-	-	-	1	1	-	-	-	-	-	-	-
P. lethostigma	-	-	-	-	-	-	-	-	-	-	-	-	-
Filefish	-	-	-	-	-	-	-	-	-	-	-	-	-
L. tricornis	-	-	-	-	-	-	-	-	-	-	-	-	-
S. nephelus	-	-	-	-	-	-	-	25	-	3	-	-	-
Q. beta	-	-	-	-	-	-	-	-	-	-	-	8	-
H. histrio	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTALS	568	1335	2754	2564	444	290	1126	547	16	44	71	151	122

TABLE 1. (continued)

	Mar 1	Mar 10	Mar 20	Mar 24	Mar 29	Apr 11	Apr 18	Apr 28	May 26	May 31	June 22	July 7
S. terrae-novae	-	-	-	-	-	-	-	-	1	-	8	-
S. tiburo	-	-	-	-	-	-	-	-	-	-	4	-
N. braziliensis	-	-	-	-	-	-	-	-	-	-	-	-
D. americana	-	-	-	-	-	-	-	-	-	-	-	-
D. sabina	-	-	-	-	1	-	14	18	13	-	41	20
R. bonasus	-	-	-	-	-	-	-	-	-	-	-	-
E. saurus	-	-	-	-	-	-	-	-	7	-	1	-
H. pensacolae	-	-	7	284	133	1	4	-	3	11	6	74
B. patronus	-	-	-	-	-	-	-	-	-	-	-	-
Anchoa sp.	-	8	9	148	32	167	9	-	-	-	16	-
G. felis	a*	27	2	2	2	-	1	-	15	5	-	23
S. marinus	-	-	-	-	-	-	-	-	-	-	-	-
Sygnathus sp.	-	-	-	1	-	1	1	2	-	-	-	-
M. cephalus	8	9	3	32	60	99	7	605	25	16	10	19
M. beryllina	-	-	1919	-	-	132	99	205	-	-	5	-
P. octonemus	-	-	-	85	330	1118	275	-	143	1923	-	38
C. unidecimalis	-	-	-	-	-	-	-	1	-	-	-	-
P. saltatrix	-	-	-	-	-	-	11	6	9	6	2	-
E. bipinnulutuss	-	-	-	-	-	-	-	-	-	-	-	-
T. carolinus	4	14	68	2	-	-	1	13	-	5	57	42
C. bartholomaei	-	1	-	-	-	-	-	-	-	-	-	-
C. hippos	-	-	-	-	-	-	-	1	1	20	8	47
C. chrysurus	-	-	-	1	-	-	-	31	220	780	20	5
S. vomer	-	-	-	-	-	-	-	1	2	-	-	-
E. argenteus	-	-	-	-	-	-	-	-	-	-	-	1
C. nobilis	-	-	-	-	-	-	-	-	429	-	-	15
B. chrysura	-	16	13	1	12	1	22	2	-	-	-	-
S. ocellata	-	-	-	-	-	-	-	-	-	-	-	-
L. xanthurus	-	-	26	-	-	-	-	-	10	-	-	-
M. undulatus	-	3	-	-	-	-	-	-	-	-	-	-
M. americanus	-	5	-	-	-	-	-	-	-	-	-	-
M. atlanticus	3	-	-	-	-	-	-	-	1	-	200	-
M. littoralis	-	-	11	16	31	10	25	77	40	25	111	77
P. chromis	-	-	53	4	4	-	1	1	2	3	3	4
C. nebulosus	17	-	-	-	-	-	-	-	1	-	1	1
L. rhomboides	-	1	59	1	4	9	7	13	91	25	2	28
A. probatocephalus	-	1	1	1	1	-	2	7	-	-	6	3
C. faber	-	-	-	-	5	1	11	13	4	-	-	19
T. lepturus	-	-	-	-	-	-	2	-	-	-	-	-
S. maculatus	-	-	-	1	-	-	-	-	1	-	10	-
P. paru	-	-	-	-	-	-	168	-	-	-	-	-
P. lethostigma	-	-	1	-	-	6	2	5	2	-	-	-
Filefish	-	-	-	-	-	-	-	-	-	-	-	3
L. tricornis	-	-	-	-	-	-	-	-	-	-	1	-
S. nephelus	-	2	-	-	2	-	-	-	-	-	-	-
O. beta	-	-	-	-	-	-	-	-	-	-	-	-
H. histrio	-	-	-	-	-	-	-	-	-	11	-	-
TOTALS	35913	87	2172	579	617	538	662	1001	1020	2830	508	419

a* - 35,881 catfish

TABLE 2. Total weight of each species and of all species at various seasons of the year

SPECIES	DATE OF COLLECTION								
	May 25	July 12	July 19	July 29	Aug 10	Aug 18	Aug 26	Dec 15	Jan 13
S. terrae-novae	-	-	-	-	-	-	-	-	-
S. tiburo	-	-	-	-	-	-	-	-	-
N. braziliensis	.6	-	-	.8	-	1.3	.4	-	-
D. americana	-	-	-	-	-	-	5.8	-	-
D. sabina	.3	.3	1.4	-	1.9	12.0	16.1	-	-
R. bonasus	-	-	-	-	-	22.7	16.7	-	-
E. saurus	2.1	-	1.4	6.6	.5	4.7	2.6	-	-
H. pensacolae	-	-	.1	-	-	-	-	-	-
B. patronus	.1	2.0	.1	-	-	.2	4.9	-	-
Anchoa sp.	-	-	-	-	-	-	-	-	-
G. felis	.9	1.1	-	-	1.2	1.3	4.6	17.6	.2
S. marinus	-	.2	.2	-	-	.2	.1	-	-
Sygnathus sp.	-	-	-	-	-	-	-	-	-
M. cephalus	14.9	26.4	4.2	198.2	5.8	2.0	92.5	373.1	3.2
M. beryllina	-	-	-	-	-	-	-	-	-
P. octonemus	1.2	37.7	59.4	28.0	2.1	2.4	3.9	-	-
C. unidecimalis	1.9	-	-	-	-	-	-	-	-
P. saltatrix	.2	-	-	-	-	-	-	-	-
E. bipinnulutus	-	-	-	-	-	.1	-	-	-
T. carolinus	1.6	4.1	2.9	-	2.9	2.7	8.1	-	-
C. bartholomaei	-	.1	-	3.3	-	-	-	-	-
C. hippos	-	-	2.2	.7	.2	.1	1.7	-	-
C. chrysurus	1.0	-	-	-	.4	-	-	-	-
S. vomer	.1	-	-	-	.2	-	.1	-	-
E. argenteus	-	-	-	-	-	-	-	-	-
C. nobilis	-	-	-	-	-	-	-	-	-
B. chrysura	-	-	-	-	-	-	-	-	1.9
S. ocellata	-	2.1	-	-	2.2	-	2.4	-	-
L. xanthurus	16.6	-	2.8	6.6	9.9	7.2	14.1	-	-
M. undulatus	.5	1.7	-	-	-	-	-	-	-
M. americanus	2.1	-	-	-	-	-	-	-	-
M. atlanticus	-	-	-	-	-	-	-	-	-
M. littoralis	-	6.2	25.8	24.6	8.6	10.2	25.3	-	-
P. chromis	-	-	-	-	-	-	3.9	-	-
C. nebulosus	1.2	-	1.6	-	4.3	5.7	7.6	2.8	-
L. rhomboides	.6	4.0	-	.6	.6	-	.2	.1	-
A. probatocephalus	-	-	.2	2.4	3.5	9.0	2.4	-	-
C. faber	.3	.2	-	-	.3	.6	.2	-	-
T. lepturus	-	-	-	-	-	-	-	-	-
S. maculatus	-	.8	-	-	.2	1.1	-	-	-
P. paru	-	-	-	-	-	-	-	-	-
P. lethostigma	1.8	-	-	-	.2	1.4	-	-	-
Filefish	-	-	-	-	-	-	-	-	-
L. tricornis	-	-	-	-	-	-	-	-	-
S. nephelus	-	-	-	-	-	-	-	2.1	-
O. beta	-	-	-	-	-	-	-	-	-
H. histrio	-	-	-	-	-	-	-	-	-
TOTALS	48.0	86.9	102.3	271.8	45.0	84.9	213.6	395.7	5.3

TABLE 2. (continued)

	Jan 18	Jan 31	Feb 9	Feb 17	Mar 1	Mar 10	Mar 20	Mar 24	Mar 29
S. terrae-novae	-	-	-	-	-	-	-	-	-
S. tiburo	-	-	-	-	-	-	-	-	-
N. braziliensis	-	-	-	-	-	-	-	-	-
D. americana	-	-	-	-	-	-	-	-	-
D. sabina	-	-	-	-	-	-	-	-	.3
R. bonasus	-	-	-	-	-	-	-	-	-
E. saurus	-	-	-	-	-	-	-	-	-
H. pensacolae	-	-	2.6	-	-	-	.1	3.0	2.3
B. patronus	-	-	-	-	-	-	-	-	-
Anchoa sp.	-	-	.1	-	-	.2	.1	2.7	.5
G. felis	.3	-	.1	20.6	a*	3.0	.1	.3	1.3
S. marinus	-	-	-	-	-	-	-	-	-
Sygnathus sp.	-	-	-	2.0	-	-	-	.1	-
M. cephalus	8.3	21.3	32.2	1.7	8.3	7.0	12.6	10.4	2.3
M. beryllina	-	-	-	-	-	-	33.1	-	-
P. octonemus	-	-	-	-	-	-	-	.4	6.0
C. unidecimalis	-	-	-	-	-	-	-	-	-
P. saltatrix	-	-	-	-	-	-	-	-	-
E. bipinnulutus	-	-	-	-	-	-	-	-	-
T. carolinus	-	-	-	-	8.4	28.2	31.6	.1	-
C. bartholomaei	.4	-	-	-	-	.2	-	-	-
C. hippos	-	-	-	-	-	-	-	-	-
C. chrysurus	-	-	-	-	-	-	-	.1	-
S. vomer	-	-	-	-	-	-	-	-	-
E. argenteus	-	-	-	-	-	-	-	-	-
C. nobilis	-	-	-	-	-	-	-	-	-
B. chrysura	1.6	-	11.3	-	-	.4	1.6	.1	3.8
S. ocellata	-	-	-	-	-	-	-	-	-
L. xanthurus	-	-	-	-	-	-	4.8	-	-
M. undulatus	-	-	-	-	-	.8	-	-	-
M. americanus	-	-	-	-	2.7	1.4	-	-	-
M. atlanticus	-	-	.9	-	-	-	-	-	-
M. littoralis	-	-	-	.4	-	-	3.4	3.4	5.1
P. chromis	-	-	-	-	-	-	39.2	12.6	6.1
C. nebulosus	-	-	-	-	18.5	-	-	-	-
L. rhomboides	.1	.7	.5	-	-	.5	.8	.1	1.1
A. probatocephalus	-	-	-	-	-	2.3	4.3	2.2	2.4
C. faber	-	-	-	-	-	-	-	-	1.0
T. lepturus	-	-	-	-	-	-	-	-	-
S. maculatus	-	-	-	-	-	-	-	.1	-
P. paru	-	-	-	-	-	-	-	-	-
P. lethostigma	-	-	-	-	-	-	3.8	-	-
Filefish	-	-	-	-	-	-	-	-	-
L. tricornis	-	-	-	-	-	-	-	-	-
S. nephelus	.3	-	-	-	-	.2	-	-	.3
O. beta	-	-	.3	-	-	-	-	-	-
H. histrio	-	-	-	-	-	-	-	-	-
TOTALS	11.0	22.0	48.0	24.7	10,689.6	44.2	135.5	35.6	32.5

*a - 10,651.7 lbs/acre

67.

TABLE 2. (continued)

	Apr 11	Apr 18	Apr 28	May 26	May 31	June 22	July 7
S. terrae-novae	-	-	-	1.2	-	18.0	-
S. tiburo	-	-	-	-	-	6.5	-
N. braziliensis	-	-	-	-	-	-	-
D. americana	-	-	-	-	-	-	-
D. sabina	-	5.3	5.0	5.3	-	20.0	9.4
R. bonasus	-	-	-	-	-	-	-
E. saurus	-	-	-	2.3	-	.6	-
H. pensacolae	.1	.1	-	.2	1.6	.1	.9
B. patronus	-	-	-	-	-	-	-
Anchoa sp.	1.0	.1	-	-	-	.2	-
G. felis	-	.1	-	2.3	1.2	-	1.4
S. marinus	-	-	-	-	-	-	-
Sygnathus sp.	.2	.1	.2	-	-	-	-
M. cephalus	39.2	2.5	164.6	7.8	7.8	.4	7.5
M. beryllina	1.7	2.5	2.7	-	-	.1	-
P. octonemus	.7	4.1	-	3.1	21.9	-	1.7
C. unidecimalis	-	-	17.8	-	-	-	-
P. saltatrix	-	1.0	.6	1.5	1.2	.4	-
E. bipinnulutus	-	-	-	-	-	-	-
T. carolinus	-	1.4	3.2	-	.9	6.7	2.1
C. bartholomaei	-	-	-	-	-	-	-
C. hippos	-	-	.1	.1	8.6	3.4	.5
C. chrysurus	-	-	.2	7.3	31.3	3.1	.2
S. vomer	-	-	.2	.1	-	-	-
E. argenteus	-	-	-	-	-	-	.1
C. nobilis	-	-	-	117.9	-	-	1.9
B. chrysura	.5	3.2	.1	-	-	-	-
S. ocellata	-	-	-	-	-	-	-
L. xanthurus	-	-	-	2.5	-	-	-
M. undulatus	-	-	-	-	-	-	-
M. americanus	-	-	-	-	-	-	-
M. atlanticus	-	-	-	.9	-	.9	-
M. littoralis	.7	7.3	12.3	8.0	1.6	2.6	4.7
P. chromis	-	.5	11.6	1.4	1.4	5.0	2.8
C. nebulosus	-	-	-	.3	-	1.0	.5
L. rhomboides	2.4	1.6	2.7	9.1	3.1	.3	3.8
A. probatocephalus	-	2.3	13.1	-	-	9.0	3.2
C. faber	.1	1.0	3.6	1.2	-	-	3.1
T. lepturus	-	.1	-	-	-	-	-
S. maculatus	-	-	-	.1	-	.6	-
P. paru	-	4.6	-	-	-	-	-
P. lethostigma	.2	.1	.1	.1	-	-	-
Filefish	-	-	-	-	-	-	.1
L. tricornis	-	-	-	-	-	.1	-
S. nephelus	-	-	-	-	-	-	-
O. beta	-	-	-	-	-	-	-
H. histrio	-	-	-	-	2.3	-	-
TOTALS	46.8	37.9	238.1	172.7	80.6	79.0	43.9

TABLE 3. Seasonal Occurrence of Resident Fishes in the Surf at Mustang Island, Texas

Resident fishes are defined as forms which are relatively abundant or occur on several occasions during a season. Bracketed numbers refer to the abundance rank of a species on the basis of weight.

All year residents	Spring-summer residents	Summer residents	Winter-spring residents
Galeichthys felis (9)	Dasyatis sabina (7)	Rhinoptera bonasus (14)	Bairdiella chrysura
Mugil cephalus (1)	Harengula pensacolae	Elops saurus (16)	
Lagodon rhomboides	Anchoa sp.	Brevoortia patronus	
	Menidia beryllina (13)	Caranx hippos (19)	
	Polydactylus octonemus (2)	Chloroscombrus chrysurus (11)	
	Pomatomus saltatrix	Leiostomus xanthurus (8)	
	Trachinotus carolinus (5)	Micropogon undulatus	
	Caranx bartholomaei	Scomberomerus maculatus	
	Menticirrhus americanus	Peprilus paru	
	Menticirrhus atlanticus		
	Menticirrhus littoralis (3)		
	Pogonias chromis (6)		
	Cynoscion nebulosus (12)		
	Archosargus probatocephalus (10)		
	Chaetodipterus faber (20)		
	Paralichthys lethostigma		

TABLE 3. Seasonal Occurrence of Resident Fishes in the Surf at Mustang Island, Texas

Resident fishes are defined as forms which are relatively abundant or occur on several occasions during a season. Bracketed numbers refer to the abundance rank of a species on the basis of weight.

All year residents	Spring-summer residents	Summer residents	Winter-spring residents
Galeichthys felis (9)	Dasyatis sabina (7)	Rhinoptera bonasus (14)	Bairdiella chrysura
Mugil cephalus (1)	Harengula pensacolae	Elops saurus (16)	
Lagodon rhomboides	Anchoa sp.	Brevoortia patronus	
	Menidia beryllina (13)	Caranx hippos (19)	
	Polydactylus octonemus (2)	Chloroscombrus chrysurus (11)	
	Pomatomus saltatrix	Leiostomus xanthurus (8)	
	Trachinotus carolinus (5)	Micropogon undulatus	
	Caranx bartholomaei	Scomberomerus maculatus	
	Menticirrhus americanus	Peprilus paru	
	Menticirrhus atlanticus		
	Menticirrhus littoralis (3)		
	Pogonias chromis (6)		
	Cynoscion nebulosus (12)		
	Archosargus probatocephalus (10)		
	Chaetodipterus faber (20)		
	Paralichthys lethostigma		

TABLE 4. Seasonal Occurrence of Sporadic Representation of Fishes in the Surf at Mustang Island, Texas.

Numbers refer to the rank of the individual species on the basis of total weight captured during the year. Sporadic fishes are defined as species that occur on but few occasions during a season.

Spring-summer sporadics	Summer sporadics	Winter and winter-spring sporadics
Syngnathus sp.	Scoliodon terrae-novae (18)	Spheroides nephelus
	Sphyrna tiburo	Opsanus beta
	Narcine brazilienis	
	Dasyatis americanus	
	Strongylura marinus	
	Centropomis unidecimalis (17)	
	Elagatis bipinnulatus	
	Selene vomer	
	Eucinostomus argenteus	
	Conodon nobilis (4)	
	Sciaenops ocellata	
	Trichiurus lepturus	
	Filefish	
	Lactophrys tricornis	
	Histrio histrio	

TABLE 5. Percentage abundance of fishes during an entire year for weight and numbers per acre and an arbitrary abundance index which occured in the surf at Mustang Island, Texas.[1]

SPECIES	Standing Crop (lbs. fish/acre) per cent of all catches	cumulative per cent
M. cephalus	46.07	46.07
P. octonemus	7.54	56.61
M. littoralis	6.56	60.17
C. nobilis	5.24	65.41
T. carolinus	4.58	69.99
P. chromis	3.69	73.68
D. sabina	3.38	77.06
L. xanthurus	2.82	79.88
G. felis	2.52	82.40
A. probatocephalus	2.46	84.86
C. chrysurus	1.91	86.77
C. nebulosus	1.90	88.67
M. beryllina	1.75	90.42
R. bonasus	1.72	92.14
L. rhomboides	1.44	93.58
B. chrysura	1.07	94.65
E. saurus	0.91	95.56
C. unidecimalis	0.86	96.42
S. terrae-novae	0.84	97.26
C. hippos	0.77	98.03

1 - Data are for the 20 most abundant fishes of the 47 species taken.

7/

Table 5. (continued)

SPECIES	Numbers of fish/acre	
	per cent of all catches	cumulative per cent
P. octonemus	44.53	44.53
M. beryllina	11.51	56.04
M. cephalus	10.16	66.20
M. littoralis	7.12	73.32
C. chrysurus	5.21	78.53
T. carolinus	2.65	81.18
H. pensacolae	2.59	83.77
C. nobilis	2.17	85.94
Anchoa sp.	1.91	87.85
G. felis	1.80	89.65
L. rhomboides	1.63	91.28
L. xanthurus	1.33	92.61
D. sabina	1.25	93.86
M. atlanticus	0.99	94.85
C. hippos	0.87	95.72
B. chrysura	0.61	96.33
P. chromis	0.39	96.72
C. faber	0.29	97.01
C. bartholomaei	0.27	97.28
A. probatocephalus	0.19	97.47

Table 5. (continued)

SPECIES	Abundance index (No./acre) (Wt./acre) 1,000
M. cephalus	2,196.0
P. octonemus	1,575.0
M. littoralis	219.0
M. beryllina	94.0
T. carolinus	57.0
C. nobilis	53.0
C. chrysurus	47.0
G. felis	21.0
L. xanthurus	18.0
L. rhomboides	11.0
P. chromis	6.0
H. pensacolae	6.0
C. hippos	3.0
B. chrysura	3.0
D. sabina	2.0
A. probatocephalus	2.0
Anchoa sp.	2.0
C. nebulosus	1.0
P. paru	0.7
E. saurus	0.6