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SPECIES COMPOSITION OF THE NORTH CAROLINA INDUSTRIAL FISH FISHERY

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ABSTRACT

The North Carolina industrial fish fishery produces an average annual catch of 8 to 11 million pounds of fish caught incidental to regular fishing operations. Although pound nets and long-haul seines are used in this fishery, about 95 percent of the catch is obtained from trawl nets operating in sounds and coastal ocean waters. About 90 percent of the catch is processed into fish meal, 2 percent into pet food, and the remainder frozen as feed for use on fur farms and for crab-pot bait.

About 80 percent of the trawl catch, both in weight and number of fish, consists of young-of-the-year edible fish species, especially croaker, spot, butterfish, and gray sea trout (weakfish). In the long-haul and pound-net fishery, about 80 percent of the catch by weight and number of fish consists of nonedible forms, and all fish are somewhat larger than those caught by trawling.

Species (croaker and spot) contributing most heavily to the weight of the catch do so consistently throughout the year. Some species are caught in quantity in only one month out of the year.

INTRODUCTION

In most commercial fishing operations, fish are caught incidentally that are not marketable as food fish; those may be nonedible species or the young of edible species. In the process of being caught, especially in an operation like trawling, most small fish are killed. Formerly considered a nuisance and shoveled overboard, in some areas these dead or dying fish are now brought to port as marketable industrial species for processing in dehydrating plants to the advantage of fishermen and plant operator alike. In North Carolina those fish are known as "trash" or "scrap", and the industry built around the use of them is called the trash-fish industry.

The North Carolina industrial fish fishery is relatively small when compared to the larger ones in New England and the Gulf of Mexico where 70 to 96 million pounds are processed annually. The New England industry is similar to that of North Carolina in that both are supplied by trash fish caught incidental to regular fishing operations; the larger industry in the Gulf of Mexico is supplied by a fleet operating solely for industrial species.

Because of public concern about reported landings of large numbers of the young of edible and sport fishes, the North Carolina Department of Conservation and Development provided funds to the University of North Carolina Institute of Fisheries Research to conduct a survey of the industrial fish fishery in 1962 and 1964. Those surveys were designed to provide information concerning the species composition of: (1) the industrial fish catch by weight, (2) industrial fish catch by number of individuals, and (3) the industrial fish catch by month; in 1962 provision was made for determining the species composition of the industrial fish catch by gear used.

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THE FISHERY

FLEET AND LOCATION OF GROUNDS: The industrial fish fishery is prosecuted by approximately 80 shrimp-trawler type boats from 32 to 85 feet in length, operating in sounds and coastal ocean waters from depths of 1 to 21 fathoms, from Wimble Shoals north of Cape Hatteras southward to Swansboro Inlet.

Fig. 1 - Double-rigged shrimp trawlers operating in coastal ocean waters near Beaufort Inlet, North Carolina.

CATCH AND PROCESSING: Throughout the year three dehydrating plants and one freezing plant operate in two North Carolina coastal counties. During the months of March through May the amount of industrial fish processed decreases because the season of the winter-trawl fishery ends in March and the shrimping season begins in mid-May. In 1962, the industrial fish catch totaled 8,064,968 pounds, 91 percent of which was processed into fish meal for use in poultry feed, 2 percent into pet food, and 7 percent frozen for feed on fur farms and for crab-pot bait. In 1964, the total was 11,202,895 pounds, 90 percent; 2 percent, and 8 percent respectively, was processed as above.

HANDLING OF FISH: In trawling operations the net is brought aboard, emptied on deck, and the catch culled for undesirable material (seashells, large sharks and skates, and debris), shoveled into the fish hold, and iced. Most vessels return to port at the end of the day when the catch is hoisted from the hold and transported by hand truck or conveyor to the sorting table of a fish plant. Here marketable edible fish are sorted according to species and trash fish are discarded into wooden fish boxes. The trash fish are iced and sent by truck to a processing plant.

Any vessel that has already separated its trash fish from edible species at sea often unloads its trash fish directly at the processing plant. Here the fish are shoveled from the boat to a conveyor running into the plant.

In the long-haul and pound-net segment of the industrial fish fishery, the catch is culled of undesirable material and iced down in the hold of the relatively small, shrimp-trawler type boat. Later, while still on the fishing grounds, the catch is transferred from the fishing boat

to the hold of a buy-boat. This boat transports the iced catch to the fish plant where edible species are separated from the trash fish. The trash fish are iced and transported to a processing plant.

Fishermen receive one dollar a box for trash fish averaging 125 pounds per box.

SAMPLING METHOD

Sampling of the industrial fish catch was planned so that normal handling procedure at the fish plant was not hindered. A sample consisted of one wooden commercial fish box of trash fish; during the years of the study samples varied from 86 to 150 pounds. A sample box was filled directly from the sorting table. If the load had already been sorted prior to arrival of the investigator, the first full box encountered on the truck or loading platform was taken as the sample. When samples were taken from vessels unloading at a dehydrating plant, trash fish were shoveled from the boat into a box. The fish were sorted according to species; this species subsample was weighed, the number of individuals counted, and the information recorded.

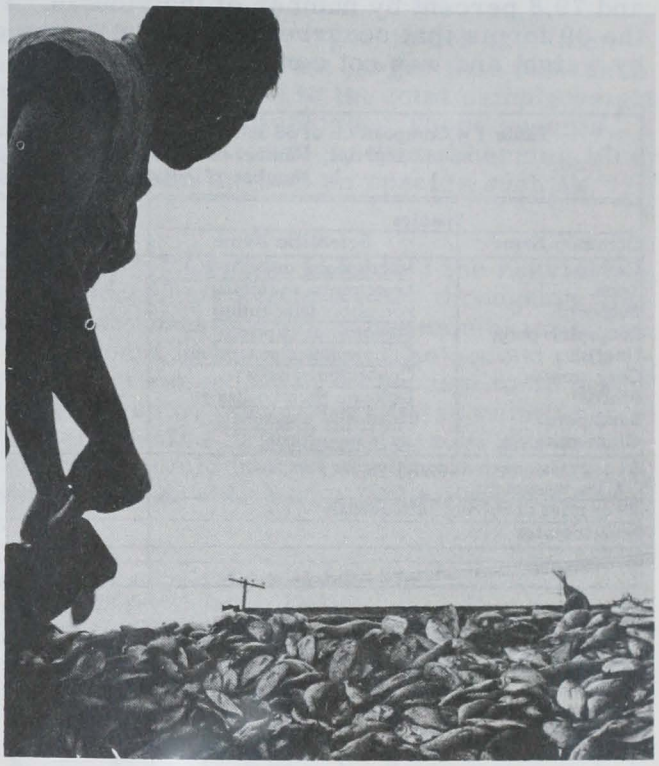

Fig. 2 - Trash fish caught incidental to regular fishing operations being shoveled from trawler at dock.

THE 1962 SURVEY

Although the sample year extended from February 1962 through January 1963, it is considered to represent 1962. A total of 104 samples was collected, 53 from trawling operations and 51 from long-haul and pound-net operations. A total of 108,217 individual fish were counted with a total weight of 13,020 pounds. This weight represents almost 0.2 percent of the industrial fish catch. Samples from long-haul and pound-net operations were not separated according to gear because catches from these two were mixed aboard the buy-boats. Samples from trawling operations were taken throughout the sample year, but those from long-haul and pound-net operations were taken through most of the May-October fishing season. At least 95 percent of all trash fish landed was taken by trawlers, therefore, it would be unrealistic to consider samples from the long-haul and pound-net fishery equally representative with trawl samples in describing the industrial fish catch. Data from long-haul and pound-net samples are presented only to provide a comparison of species composition of catch according to gear used.

SPECIES COMPOSITION OF THE CATCH IN THE TRAWL FISHERY: Table 1 gives the species composition of 53 samples from the trawl fishery. A total of 79 fish species were caught. Nine species, each accounting for 1.0 percent or more of the total sample weight (column 4), are listed individually; these comprised 85.0 percent by weight and 86.4 percent by number of individuals of the total trash sample. Thirty-one species, each accounting for less than 1.0 percent by weight of all samples and shown collectively, constitute 8.8 percent by weight and 8.4 percent by number of individuals. Thirty-nine species, each occurring infrequently, collectively contributed 2.3 percent of the weight and 5.0 percent of the number of individuals. Invertebrates, chiefly nonedible crabs and squid, contributed 3.9 percent of the trash sample by weight.

The first three species--croaker, spot, and butterfish--are edible species and comprised 67.5 percent of the catch by weight and 68.7 percent by number of individuals. Three other edible species included in the first nine--hogfish, gray sea trout, and sand perch--accounted for an additional 9.3 percent of the sample by weight and 8.6 percent by number of individuals.

Among the 31 species, each accounting for less than 1.0 percent by weight of all samples, 11 are edible and contributed 2.9 percent of the sample by weight and 2.5 percent by number of individuals. Thus, 17 edible forms comprised 79.7 percent of the industrial fish catch by weight and 79.8 percent by number of individuals. The contribution of 9 edible species found among the 39 forms that occurred infrequently was estimated to be less than 0.1 percent of the catch by weight and was not considered.

Table 1 - Composition of 53 Industrial Fish Samples from 1962 Trawl Fishery in North Carolina, Showing by Species and Categories, Number of Individuals Counted, Weight in Pounds, Percent Composition of Samples by Number of Individuals and Weight, and Average Weight of Individuals

Species		No. of Ind.	Wt. in Lbs.	% Comp. by No.	% Comp. by Wt.	Avg. Wt. Ind. (Oz.)
Common Name	Scientific Name					
Croaker	Micropogon undulatus	26,417	2,765.9	40.6	42.6	1.7
Spot	Leiostomus xanthurus	12,327	1,129.8	19.0	17.4	1.5
Butterfish	Poronotus triacanthus	5,891	490.9	9.1	7.5	1.3
Longspine porgy	Stenotomus caprinus	3,893	324.2	6.0	5.0	1.3
Hogfish	Orthopristis chrysopterus	2,868	277.2	4.4	4.3	1.5
Gray trout	Cynoscion regalis	1,916	203.4	2.9	3.1	1.7
Pinfish	Lagodon rhomboides	1,928	126.9	3.0	1.9	1.1
Sand perch	Bairdiella chrysura	856	125.2	1.3	1.9	2.3
Clear-nose ray	Raja eglanteria	67	82.7	0.1	1.3	19.7
31 species, each accounting for less than 1.0% by weight		5,523	571.7	8.4	8.8	-
39 species occurring infrequently		3,323	149.6	5.0	2.3	-
Invertebrates		-	251.3	-	3.9	-
Totals		65,009	6,498.8	99.9	100.0	-

Nonedible species of fish and invertebrates comprised the remaining 20.3 percent of the trash fish by weight and 20.2 percent by number of individuals. Of those, the longspine porgy, pinfish, and clear-nose ray accounted for almost one-half, both in weight and number of individuals.

If the pounds sampled for a given species are divided by the number of individuals counted for that species, an estimate of the average size of individual fish can be obtained. The last column in table 1 provides this estimate of size in ounces for the nine species listed separately. The smallest species, pinfish, averaged 1.1 oz. and the largest, the clear-nose ray, averaged 19.7 percent. With the exception of this ray the remaining eight ranged in average from 1.1 to 2.3 oz. For these species such a weight indicated young-of-the-year.

SPECIES COMPOSITION OF CATCH IN LONG-HAUL AND POUND-NET FISHERY: In table 2 eight species appearing most frequently in this fishery are listed in the same manner as those in table 1. These species accounted for almost 91 percent of the sample weight in this fishery and about 94 percent by number of individuals.

Table 2 - Eight Species Occurring Most Frequently in 51 Industrial Fish Samples from 1962 Long-Haul and Pound-Net Fishery Showing Number of Individuals Counted, Weight of Sample, Percent Composition of Samples by Weight and by Number of Individuals, and Average Weight of Individuals

Species		No. of Ind.	Wt. in Lbs.	% Comp. by No.	% Comp. by Wt.	Avg. Wt. Ind. (Oz.)
Common Name	Scientific Name					
Menhaden	Brevoortia tyrannus	14,384	2,799.9	33.3	42.9	3.1
Pinfish	Lagodon rhomboides	17,236	1,968.2	39.9	30.2	1.8
Thread herring	Opisthonema oglinum	3,470	443.6	8.0	6.8	2.0
Bluefish	Pomatomus saltatrix	1,313	223.1	3.0	3.4	2.7
Spot	Leiostomus xanthurus	1,956	185.9	4.5	2.8	1.5
Hogfish	Orthopristis chrysopterus	1,325	179.2	3.1	2.7	2.2
Sand perch	Bairdiella chrysura	563	71.2	1.3	1.1	2.0
Croaker	Micropogon undulatus	353	65.1	0.8	1.0	2.9
Percent of sample represented by above species				93.9	90.9	

Three nonedible species--menhaden, pinfish, and thread herring--accounted for 79.9 percent of the total sample by weight and 81.2 percent by number of individuals. Five edible species--bluefish, spot, hogfish, sand perch, and croaker--accounted for 11.0 percent by weight and 12.7 percent by number of individuals. The remainder of the long-haul and pound-

et catch consisted of species occurring rather infrequently. Thus, about 80 percent of the atch in this fishery, both by weight and by number of individuals, consisted of nonedible spe-ies, just the reverse of the trawl fishery results.

Column 5 shows the size range of the eight species to be 1.5 oz. (spot) to 3.1 oz. (men-aden). Generally, the average individual size appears to be somewhat larger than fish taken the trawl fishery. Although pinfish contributed considerably less to the total sample weight an menhaden, this species contributed the highest number of individuals. Those species cupying the surface and middle layers of the water, such as menhaden, thread herring, blue-sh, and perhaps pinfish, were more evident in the catch than the bottom species such as oaker, sand perch, hogfish, and spot.

SPECIES COMPOSITION OF THE TRAWL CATCH BY MONTH: In table 3 the heaviest ntributor to the total trash fish catch, the croaker, contributed consistently throughout the ear; in March only 3 percent of the trash fish weight was croaker, but in other months the con-ibution varied from 17 percent in November to 79 percent in December. The second prin-ipal species, spot, was low in December at 2 percent but ranged from 10 percent to 39 per-ent in other months. Species such as butterfish and longspine porgy contributed relatively rge amounts only in two or three months. Still other species like gray sea trout and sand erch owe their consideration as principal species to relatively heavy contributions in one two months. Some spcies like sand perch contributed less than (<) 1.0 percent of the mple weight in most months of the year.

Table 3 - Species Composition of Industrial Fish Samples from Trawl Fishery in Percent of Weight by Month during Sample Year, February 1962 through January 1963[1]

Species	Jan.	Feb.	Mar.	May	June	July	Sept.	Oct.	Nov.	Dec.
roaker	53	19	3	52	57	46	45	24	17	79
pot	10	24	10	17	17	16	14	20	39	2
utterfish	13	5	23	5	2	2	<1	9	25	<1
ongspine porgy	4	2	<1	<1	6	8	6	17	<1	1
ogfish	6	8	1	8	3	1	7	9	1	1
ray trout	1	3	16	4	2	3	3	<1	2	1
infish	<1	<1	5	3	<1	4	2	3	2	<1
nd perch	<1	16	10	0	<1	<1	0	<1	<1	<1
ear-nose ray	<1	<1	<1	2	2	2	2	3	2	<1
other fish	10	21	27	7	6	8	12	12	11	14
vertebrates	2	2	4	2	5	10	8	2	<1	1
mber of samples	4	4	3	7	12	8	1	5	4	5

[1] Samples unavailable in April and August.

When trash fish are being supplied from the shrimp fishery from May through September, e amount of "all other fish" decreases (6-12 percent) and the weight of invertebrates in-eases (2-10 percent).

THE 1964 SURVEY

It was originally planned that the sample year for 1964 would be February 1964 through nuary 1965, but owing to stormy weather and little fishing activity, samples were not avail-le in February. Therefore, the sample year extended from March 1964 through February 965. Since the trawl fishery accounts for 95 percent or more of the industrial fish catch, mpling effort was directed entirely towards this fishery. A total of 82 samples was col-cted from which 112,493 individual fish, weighing 10,780 pounds, or almost 0.1 percent of e total industrial fish catch were identified and counted.

SPECIES COMPOSITION OF THE CATCH: There were 77 species collected in 1964, and breakdown by species or groups is presented in table 4. Twelve species listed separately counted for 83.8 percent by weight and 85.3 percent by number of individuals. Nineteen ecies, each accounting for less than 1 percent by weight of all samples, are shown collec-vely to constitute 6.1 percent by weight and 5.7 percent by number of individuals. Forty-x species, each occurring infrequently, combined to constitute 4.6 percent by weight and

8.9 percent by number of individuals. Invertebrates, mostly nonedible crab species, squid, sea-stars, and sand dollars, comprised 5.5 percent by weight of the samples.

The leading four species--croaker, spot, gray sea trout, and butterfish--are edible species accounting for 68.0 percent by weight of the sample. Among the eight remaining individually-named species four--sand perch, hogfish, puffer, and rock sea bass--are edible and combined accounted for 8.6 percent of the weight of the trash fish and 6.1 percent of the number of individuals. Among the 19 species, each accounting for less than 1.0 percent by weight of all samples, eight are edible and contributed 1.9 percent of the trash fish weight and 2.4 percent by number of individuals; of the 46 species occurring but infrequently only three are edible and it was estimated they contributed no more than 0.1 percent of the trash fish weight and 0.3 percent by number of individuals. Thus, 78.6 percent of the total trash fish catch by weight and 81.9 percent by number of individuals were comprised of edible fish species.

Table 4 - Composition of 82 Industrial Fish Samples from 1964 Trawl Fishery in North Carolina, Showing by Species and Categories Number of Individuals Counted, Weight in Pounds, Percent Composition of Samples by Number of Individuals and Weight, and Average Weight of Individuals

Species		No. of Ind.	Wt. in Lbs.	% Comp. by No.	% Comp. by Wt.	Avg. Wt. Ind. (Oz.)
Common Name	Scientific Name					
Croaker	Micropogon undulatus	33,841	3,262.2	30.1	30.3	1.5
Spot	Leiostomus xanthurus	19,170	1,742.2	17.0	16.2	1.5
Gray trout	Cynoscion regalis	7,241	1,215.8	6.4	11.3	2.7
Butterfish	Poronotus triacanthus	22,062	1,104.6	19.6	10.2	0.8
Sand perch	Bairdiella chrysura	3,184	415.1	2.8	3.8	1.1
Longspine porgy	Stenotomus caprinus	4,866	339.1	4.3	3.2	1.1
Hogfish	Orthopristis chrysopterus	2,025	215.1	1.8	2.0	1.7
Puffer	Sphaeroides maculatus	875	181.1	0.8	1.7	3.3
Clear-nose skate	Raja eglanteria	176	176.4	0.2	1.6	16.0
Filefish	Monocanthus hispidus	593	132.6	0.5	1.2	3.6
Pinfish	Lagodon rhomboides	1,250	128.7	1.1	1.2	1.6
Rock sea bass	Centropristes philadelphicus	807	114.6	0.7	1.1	2.3
19 species, each accounting for less than 1.0% by weight		6,405	661.0	5.7	6.1	-
46 species, occurring infrequently		9,998	495.3	8.9	4.6	-
Invertebrates		-	596.7	-	5.5	-
Totals		112,493	10,780.5	99.9	100.0	-

Column 5 in table 4 provides an estimate of the average size of individual fish. Although gray sea trout placed third among principal species by weight they were relatively large individuals (2.7 oz.) and ranked fourth in percentage of number of individuals. Butterfish, ranking fourth in percentage of weight, was quite small in average size (0.8 oz.) and ranked third in percentage by number of individuals.

The small size of the individuals comprising the bulk of the catch indicates that the industrial fishery depends upon young-of-the-year fish.

SPECIES COMPOSITION OF THE CATCH BY MONTH: The dominant species, croaker, contributed quite consistently throughout the year with low contributions only in February (8 percent) and April (5 percent) (table 5). Spot, the second ranking species, had low contributions in three months. The next two species, gray sea trout and butterfish, contributed heavily to the trash fish in only 6 months of the year or less. Other species made significant contributions in only a few months and rock sea bass owed its appearance in the list to a 17-percent contribution in February. Those 12 species account for a low of 48 percent of the catch by weight in February and a high of 96 percent in April. In the warmer months when shrimping operations were supplying trash fish there was evidence of a decline in the amount of "all other fish" and in the same period (June through September) an increase was apparent in the amount of "invertebrates".

SUMMARY AND CONCLUSIONS

It appears to be characteristic for an industrial fish fishery to depend upon relatively few species for the bulk of the catch by weight. Thus, in the industrial fish fisheries of New

Table 5 - Species Composition of Industrial Fish Samples from Trawl Fishery in Percent of Weight by Month during Sample Year, March 1964 through February 1965[1/]

Species	Jan.	Feb.	Mar.	Apr.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Croaker	20	8	30	5	47	43	39	47	25	24	18
Spot	11	5	28	7	22	21	30	11	13	15	1
Gray trout	19	0	15	43	6	1	2	4	1	21	31
Butterfish	10	<1	7	21	7	5	3	4	23	24	7
Sand perch	9	<1	3	0	<1	<1	0	1	<1	1	25
Pinfish	<1	<1	<1	<1	<1	<1	1	<1	7	<1	<1
Longspine porgy	<1	<1	2	0	2	8	<1	3	6	<1	4
Hogfish	11	6	1	<1	<1	<1	<1	1	1	<1	<1
Puffer	2	<1	2	20	<1	<1	<1	2	2	1	2
Clear-nose ray	2	9	<1	0	2	<1	<1	1	2	2	2
Filefish	<1	1	<1	0	<1	<1	<1	4	2	<1	4
Rock sea bass	1	17	<1	0	<1	<1	<1	<1	<1	<1	0
All other fish	12	42	9	3	7	9	12	11	10	7	3
Invertebrates	1	10	2	0	5	11	11	10	7	3	1
No. of samples	10	4	8	2	10	11	6	6	9	9	7

1/Samples unavailable in May.

England (Edwards and Lux 1958; Edwards 1958), Gulf of Mexico (Haskell 1961), and California (Best 1959), about 75 percent or more of the catch was provided by three or four species. Similarly in North Carolina in 1962 and 1964, four species supplied 73 and 68 percent, respectively, of the catch by weight.

In most studies of industrial fish fisheries, information concerning the number of individual fish sampled is not considered. Snow (1950) sampled the catch of one boat according to number of individuals, but Best (1959) counted and measured individual fish to determine length composition of the catch by species. In the North Carolina study individual fish were counted to establish species composition of the catch in percentage of number of individuals and to provide an estimate of size of individual fish. In each year of study four species are shown to account for 75 and 73 percent of the catch by number of individuals.

The New England fishery (Edwards and Lux 1958) is based upon nonedible fish or edible fish used on occasion. The Gulf of Mexico fishery is based principally upon croaker and spot, but in that area those species are not considered desirable as food fish (Haskell 1961). In California the fishery is based upon two nonedible species and one species of limited use as food (Best 1959). In the North Carolina fishery in 1962, three edible species constituted 67.5 percent of the catch by weight and a total of 17 edible species accounted for 79.7 percent. In 1964, four edible species contributed 68 percent of the catch by weight and a total of 19 edible species contributed 78.6 percent. The catch depends on those edible species to a slightly greater extent on the basis of number of individuals than on weight.

Thus the North Carolina industrial fish fishery differs from those previously reported in that marketable fish form the source of supply. However, it must be noted that all trash fish are caught merely incidental to regular fishing operations. Whether trash fish is processed into marketable byproducts or shoveled overboard, the trash fish are dead or dying. Further, individuals of all edible species are indicated to be young-of-the-year, and among such, natural mortality could be expected to be high.

The small size of fish comprising the bulk of the catch as shown in the last column of tables 1 and 4 indicates strongly young-of-the-year individuals. In general the fish of 1964 are slightly smaller than those of 1962.

Economic factors can influence the make-up of trash fish according to species and size. For example, if small gray sea trout (weakfish) as marketable food fish have temporarily glutted the market, the next catch of small trout would be routed to a dehydrating plant and processed into meal. This action "increases" the amount of an edible species in the trash fish and also tends to increase the average individual size of the species.

In monthly contributions to the industrial fish catch those species contributing most to the total catch by weight apparently contribute consistently throughout the year. Some im-

portant contributors make significant contributions in only 6 months or even fewer. Some species contribute heavily to the trash fish in only 1 month of the year. When trash fish are being supplied from the winter trawl fishery (October through March), there appears to be a greater amount of trash fish contributed by "all other fish" and a lesser amount by "invertebrates."

In 1962, the differences in species composition and average individual size between catches from the trawl and the long-haul and pound-net fishery are shown in tables 1 and 2. The trawls catch primarily edible fish of small size but the long-haul seines and pound-nets catch mostly nonedible species of larger size. Interestingly enough the heaviest contributor to the trawl catch, croaker, is one of the least important in the other; conversely, menhaden which hardly appears in the trawl fishery is the main species in the long-haul and pound-net fishery and at the same contribution level (43 percent) as croaker was in the trawl fishery. In this study the differences between these two gear fisheries have little significance because 95 percent or more of the trash fish is supplied by trawlers. However, these differences should be noted to serve as guides for future studies involving different types of fishing gear

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