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The New Industrial Fisheries Industry of the North Central Gulf of Mexico Area

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THE TITLE "INDUSTRIAL FISHERIES," as used in this paper, does not include menhaden. For many years it has been customary to speak of the small non-food fish discarded from shrimp trawling catches as "trash fish," and with the establishment of an entirely new commercial enterprise based on the use of these small non-food species, the term "trash fish" persisted. Now that this industry has attained some financial and commercial stature, persons concerned feel that we should designate it as "the industrial fish industry."

This industrial fish industry is based on the catch, mostly by former shrimp boats of the Pascagoula-Biloxi area, of the following species, in order of importance:

1. Croakers, *Micropogon undulatus*
2. Silver eels (cutlass fish), *Trichiurus lepturus*
3. Anchovies, *Anchoa hepsetus*
4. Spot, *Leiostomus xanthurus*
5. Razor belly herring, *Harengula pensacolae*
6. Round herring, *Etrumeus teres*
7. White trout (lesser weakfish), *Cynoscion sp.*

In addition, the following species are often taken in the nets:

1. Thread herring, *Opisthonema oglinum*
2. Silversides, *Menidia sp.*
3. Butterfish, *Poronotus triacanthus*
4. Shad, *Pomolobus chrysochloris*
5. Sea robin, *Prionotus sp.*
6. Sea bass, *Diplectrum sp.*
7. Ground mullet, *Menticirrhus americanus*
8. Star drum, *Stellifer lanceolaotus*
9. Menhaden, *Brevoortia patronus*

With the establishment of the Technology Laboratory at Pascagoula in June, 1957, there was already in existence an industrial fish industry in the form of two large pet food plants, established during 1952-53, and producing thousands of cases daily of a pet food containing approximately seventy to seventy-five per cent fish. Two additional plants had more recently made pilot runs and were attempting to secure contracts to pack for national brands. This pet food industry was able to pay approximately $35 per ton for these industrial fish, but limited the trawlers on the amount of fish to be delivered each week. The two operating plants, both located in the immediate Pascagoula area, gave employment to several hundred boatmen, plant workers, and workers in supporting industries, such as ice plants and motor repair shops.

During the spring of 1958 there was a sudden spurt of interest in these industrial fish as a source of protein in animal foods. One of the pet food pilot plant operators secured a large production contract for thousands of cases of pet food per week with a company marketing a well-known national brand. The other pilot plant operator obtained contracts from brokers which would enable him to operate full time. Thus, there are four large scale pet food plants operating at present.

Some additional usage of these fish has been made in the fur farming industry, especially for the feeding of mink. Here, certain technological problems arise. Some species contain appreciable amounts of an enzyme, thiaminase, which inhibits the absorption of, or prevents utilization of, thiamine present in the diet. (Lee, Nilson and Clegg, 1955.) This enzyme produces, rather quickly, a temporary sterility in mink and other fur-bearing animals. In addition, continued feeding of these thiaminase-positive species of fish will produce lusterless fur, lack of appetite, and general malaise due to lack of the vitamin thiamine in the daily diet. Ultimately, the animal may succumb due to onset of Chaste's paralysis. The Bureau of Commercial Fisheries Technological Laboratories at Boston, Seattle, and College Park have made enough experimental quantitative analyses to give an indication as to which species contains this enzyme in detrimental amounts. The Pascagoula Laboratory may be able to further amplify the available information on this subject sometime in 1959. Thiaminase is not a problem in the pet food industry, since the enzyme is destroyed by the high temperatures of processing the canned product.

The greatest potential for growth in this industry is being explored in a new direction, that of fish protein for the poultry broiler industry. It may be now commercially feasible to produce fish meal from these industrial fish with no attempt to extract oil. The present price of fish meal for poultry feed has stimulated several individuals to apply their technological knowledge to a more economical production of fish meal. We have two plants in production in the Pascagoula area which use a continuous-flow type of dehydration of industrial fish to produce a dried meal acceptable to the local broiler industry. Four additional plants are either in the blueprint or construction stage, and are expected to be in production on fish meal by 1959.

In addition to these possible applications of industrial fish, the Fishery Technology Laboratory at Pascagoula has recently received several inquiries concerning other forms of protein from fish available for human and animal food. One firm has expressed an interest in a method for the extraction of fish flour for human consumption. Another firm is interested in the production of "fish solubles" from these industrial fish species.

Last March the Technological Laboratory began work on a project to develop data on the quantitative chemical analysis of these industrial fish in order to help the growing industry to control its output more closely from season to season. To further our knowledge of species variability, samples of industrial fish are being obtained by our chemists from three or four boats each week. Analyses are made on the lot as it comes from the boat, for fat, moisture, protein, and ash. Pet food producers had previously noted that seasonal variations occur in composition and that the constituents may vary from different areas. By periodic sampling of major areas, we will enable the industry to forecast the oil, protein, moisture, and ash content of a boatload of fish, from a given area, at a given date. In addition to the analysis of the gross load, we have a biologist, from the Gulf Exploratory Group, sort out by species the fish of a five pound lot from a boat, and proximate analyses are made on each species. From these data we can estimate more closely the possible oil and meal yield of a mixed load by estimating the percentages of each species present. Table 1 gives a cross section of the percentage of various species present and the analytical results of the mixed loads, determined by chemists in the Pascagoula Laboratory. Tables 2-5 show the results of analyses on the more common species used in the industrial fisheries during recent seasons. (Thompson, 1958.)

Table 6 demonstrates the species having the greatest variations of fat and moisture from season to season. The following general observations may be made from these analyses:

1. Oil Content
   a. Largest variability by species was that of spot, *Leiostomus xanthurus*, with 5.5 per cent oil for winter and 16.5 per cent oil for summer.
   b. Most species will fall in the 2 to 6 per cent range of variability in oil content from winter to summer.
2. Protein Content
   a. Does not vary greatly within the same species from season to season.
   b. Catches of certain species from unmixed schools will show marked seasonal variations in composition between the species, *e.g.*, small butterfish in May showed 14 per cent protein, while spring shad had 19.5 per cent protein.
3. Moisture Content
   a. Moisture usually varies inversely with oil values; *e.g.*, winter spot, 76.5 per cent moisture and 5.5 per cent oil; summer spot, 64 per cent moisture and 16.5 per cent oil.
   b. Moisture ranges for different species may be economically significant with 81 per cent for immature spring butterfish and only 64 per cent spring spot.
   c. Most species fall in the 70 to 77 per cent range with mixed loads at about 73 per cent.
4. Ash Content
   a. Depends on the size of the fish for most species.
   b. Extreme ranges show 2.3 per cent for summer cutlass fish and 8.3 per cent for large winter silversides.
   c. Most species and mixed loads will average 3 to 4.5 per cent ash.

The value of technological studies in this industry was pointed up recently by the sudden appearance in local trawls of huge catches of small immature butterfish, *Poronotus triacanthus*. These fish, containing proportionately larger amounts of skin, gave a darker, more gelatinous petfood than usual. Since the moisture content of these fish was approximately 81 per cent, rather than the 73 per cent of the usual mixed load, the canned product contained more than the label declaration of water. Analytical data secured by the laboratory at that time was quickly made available to the entire industry with a warning that loads of 100 per cent small butterfish might contain too much moisture for the usual canning procedures. Dry meals, such as soy bean meal, could be used to adjust the moisture of the canned product and maintain normal food values.

At the present time, we are analyzing dry fish meals from loads of known history to provide data for estimating meal yields. It is easy to see that a load of butterfish with 81 per cent moisture might not warrant the same price per ton for meal as would a mixed species load at 73 per cent moisture.

As to the future potential of this industry, and the estimated effects of this fishery on supply, we must quote the biologists, and we feel that theirs is but an educated guess. It was estimated by U. S. Fish and Wildlife Service biologists at the 1950 meeting of the Gulf States Marine Fisheries Commission that 500 million pounds of "trash fish" were picked out and discarded annually by shrimp trawlers alone. It is worth noting at this point that, although sport fishermen complain bitterly about this industry's harmful effect on the game and food fish such as red fish, speckled trout, sheephead, and the like, rarely, if ever, can we find even one member of these species in a trawl of this industry. One of the few exceptions is white trout, *Cynoscion sp.*, occasionally found scattered through a load. Our biologists estimate that the white trout never amount to 2 per cent of any load, and most often is entirely missing. At rare intervals, small flounder, snapper, grunt, and mullet will appear in the mixed loads. If a study of the effects of this fishery on the marine biology of the area could be initiated now, we would have a more firm basis for promulgation of future regulations to prevent overfishing. Data gathered now will form the base from which to judge the effects of both fishing and other harmful influences in the future. The data now being gathered by the chemists at Pascagoula, while actually of technological nature, will reflect any wide variations of biological nature by changes in the percentages of the various species encountered in sampling from the trawl boats.

The extended area from the east coast of Florida to Mexico, including the Caribbean, apparently contains huge amounts of these small non-food fish. Since they are apparently caught during the second and third year of life and, since only a relatively small area of the Gulf is now fished, there should be no diminution of supply forecast in the foreseeable future. Also, these industrial fish, once discarded or avoided by the shrimp fleet, are now being utilized to provide financial returns along the north central Gulf.

Thus, in future years, as the world's population outgrows the ability of the land to produce its food, interested fishermen, plant owners, and allied industries will have a foothold in the world's greatest source of food for human and animal use, the ocean.

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TABLE 1
THE COMPOSITION OF INDUSTRIAL FISH OF THE NORTH CENTRAL GULF, 1958

Sample	Date	Type of Catch	Location	% Moisture	% Protein	% Fat	% Ash
1	3/24	85% Thread fin 15% mixed	Chandeleur Island	77.6	14.7	4.7	2.95
2	4/24	75% Croakers 20% Silver eels 5% Spots & Flatfish	Between Grand Isle and Ship Shoal	78.2	14.9	4.8	2.49
2a	4/24	5% Spots & Flatfish	Between Grand Isle and Ship Shoal	77.7	14.9	4.5	2.87
3	4/25	75% Croakers 20% Silver eels 5% Flatfish	Between Grand Isle and Ship Shoal	75.1	15.9	5.2	3.45
4	4/28	100% Menhaden	North Gulf	67.7	13.6	14.1	2.10
5	5/6	98% Croakers 2% White trout	Off Mouth of Mississippi River	75.9	18.4	4.6	3.61
6	5/12	100% Butterfish	Chandeleur Island	80.7	14.4	2.3	3.06
7	5/17	95% Croakers & Spots 5% Silver eels	Mississippi River	79.2	14.5	6.9	2.76
8	5/18	50% Silver eels 50% Mixed Croaker, Spots, Herring and Flatfish	Gulfport Channel	79.1	14.5	3.4	4.07
9	5/27	Even mixture of Silver eels, White trout, Croaker, Spots, Mackerel minnow (anchovies) Razor bellies	Mississippi River	73.4	15.3	6.5	4.28
10	6/17	50% Croakers 50% Eels, Anchovies, Thread herring	Breton Island	78.5	13.7	3.7	3.89
11	6/19	100% Star drum	Horn Island	76.3	15.0	3.8	4.11
12	6/25	50% Star drum 50% Mixed Silver eels, Razor bellies and White trout	Horn Island	78.7	14.5	4.4	3.27

TABLE 2

Common Industrial Fish Analysis — Winter 1958

Fish	Date	Location	No. of* Determ.	Type Meas.	Length in cm Rge.	Length in cm Ave.	Weights in gm Rge.	Weights in gm Ave.	% Moisture Rge.	% Moisture Ave.	% Protein Rge.	% Protein Ave.	% Fat Rge.	% Fat Ave.	% Ash Rge.	% Ash Ave.
Silver eels (Cutlass fish) *Trichiurus*		Miss.			36.7		25.4		75.0		17.9		4.1		2.63	
lepturus	Feb.	Sound	4 (4)	Overall	45.8	42.8	48.6	37.6	75.8	75.4	18.2	18.1	4.4	4.3	3.23	2.96
Spots		Miss.			18.8		81.4		76.4		13.8				3.96	
Leiostomus xanthurus	Feb.	Sound	2 (2)	Forktail	20.2	19.5	90.2	85.8	76.5	76.5	14.2	14.1	5.5	5.5	4.21	4.09
Thread herring		Miss.			13.4		36.8		68.4		18.5		7.8		2.57	
Opisthonema oglinum	Feb.	Sound	4 (4)	Forktail	15.4	14.3	52.8	43.8	70.1	69.3	19.2	18.9	8.3	8.1	3.66	3.24
Anchovies *Anchoa sp.*	Feb.	Miss.	4		5.0		1.4		75.6		16.3		3.3		3.33	
		Sound	(72-93)	Forktail	7.0	6.0	4.0	2.5	76.1	75.9	16.7	16.4	3.9	3.5	3.53	3.45
Silver sides		Miss.	4		7.5		4.4		67.1		17.2		5.6		7.74	
Menidia sp.	Feb.	Sound	(26-28)	Forktail	9.8	8.7	9.2	6.3	68.1	67.5	17.6	17.4	6.1	5.9	8.84	8.23
Round herring		Miss.			14.5		35.5		73.6		18.3		2.2		3.39	
Etrumeus teres	Feb.	Sound	4 (3)	Forktail	17.1	15.6	59.0	47.0	74.1	73.8	19.3	18.9	2.7	2.5	4.09	3.82
Butterfish		Miss.			12.5		53.5		77.1		14.6		1.6		2.56	
Poronotus triacanthus	Feb.	Sound	6 (2)	Forktail	16.8	14.7	100.	75.4	80.3	79.3	16.2	15.1	3.4	2.2	3.26	2.82
Croaker		Miss.			18.6		61.0		75.9		14.5		1.6		4.59	
Micropogon undulatus	Feb.	Sound	6 (2)	Forktail	21.1	19.8	116.	77.2	78.5	77.2	15.8	15.2	2.8	2.2	6.42	5.98
Razor bellies		Miss.			13.1		21.0		66.2		18.2		6.5		6.1	
Harengula pensacolae	Feb.	Sound	6 (6)	Overall	15.9	35.4	42.5	14.8	68.0	67.1	19.7	18.9	9.3	7.7	8.1	7.1
Anchovies		Miss.	4		10.9		13.3		75.3		16.3		2.5		3.44	
Anchoa hepsetus	Feb.	Sound	(12-13)	Forktail	12.9	11.7	25.1	19.0	76.3	75.7	17.9	17.3	2.8	2.6	3.76	3.53

NOTES: Numbers in parentheses indicate number of fish in each sample.
All samples frozen on board vessel.

TABLE 3

COMMON INDUSTRIAL FISH ANALYSIS — SPRING 1958

Fish	Date	Location	No. of* Determ.	Type Meas.	Length in cm Rge.	Length in cm Ave.	Weights in gm Rge.	Weights in gm Ave.	% Moisture Rge.	% Moisture Ave.	% Protein Rge.	% Protein Ave.	% Fat Rge.	% Fat Ave.	% Ash Rge.	% Ash Ave.
Spots *Leiostomus xanthurus*	May	Grand Isle	4 (2)	Forktail	19.0 21.0	20.0	109.8 143.5	125.	63.3 64.4	63.9	15.5 16.2	15.8	16.0 16.8	16.5	3.27 4.17	3.74
Shad *Pomolobus chrysochloris*	Mar	North Fla.	4 (2)	Forktail	18.6 21.7	20.0	82.6 128.2	106.7	72.7 74.9	73.6	19.4 19.6	19.6	2.0 4.4	3.2	2.01 3.23	2.52
Butterfish *Poronotus triacanthus*	May	Chandeleur Snd.	4(37-41)	Forktail	5.8 9.7	6.7	3.8 16.3	6.0	80.5 80.9	80.7	14.1 15.0	14.4	2.1 2.5	2.3	2.85 3.31	3.06
Anchovies *Anchoa hepsetus*	Mar	North Fla.	4(13-14)	Forktail	9.5 11.7	10.8	10.6 20.6	15.	75.0 75.9	75.6	16.9 17.1	17.0	2.9 3.2	3.0	3.21 3.43	3.36
Thread herring *Opisthonema oglinum*	Mar	North Fla.	4 (2)	Forktail	17.0 19.6	18.3	77.2 115.5	95.6	69.9 70.8	70.4	19.4	19.4	4.8 5.4	5.0	4.46 4.94	4.59

*NOTE: Numbers in parentheses indicate number of fish in each sample.
All samples with exception of the iced spots and butterfish were frozen on board vessel.

TABLE 4

COMMON INDUSTRIAL FISH ANALYSIS — SUMMER 1958

Species	Date	Location	No. of* Determ.	Type Meas.	Length in cm Rge.	Length in cm Ave.	Weights in gm Rge.	Weights in gm Ave.	% Moisture Rge.	% Moisture Ave.	% Protein Rge.	% Protein Ave.	% Fat Rge.	% Fat Ave.	% Ash Rge.	% Ash Ave.
Silver eels (Cutlass fish) *Trichiurus lepturus*	June	Grand Isle	4 (3)	Overall	38.3-54.7	48.5	26.4-99.8	62.5	77.2-78.8	77.9	15.9-16.6	16.3	2.3-2.8	2.6	1.90-2.91	2.26
Spots *Leiostomus xanthurus*	July	Cat Island	4 (2)	Forktail	17.7-19.5	18.5	84.7-112.3	98.3	67.1-70.4	68.1	14.8-15.6	15.2	11.6-13.7	12.9	2.85-3.78	3.39
Thread herring *Opisthonema oglinum*	Aug.	Cat Island	4 (1-2)	Forktail	18.1-18.8	18.5	89.0-109.9	100.1	73.4-75.2	74.4	18.3-18.8	18.6	3.2-3.9	3.5	2.76-4.19	3.27
Butterfish *Poronotus triacanthus*	June	Grand Isle	4 (2-4)	Forktail	9.7-15.0	11.6	19.0-90.9	42.2	74.2-78.5	76.0	15.0-15.9	15.6	4.9-7.4	6.2	1.49-3.12	2.36
Croaker *Micropogon undulatus*	June	Grand Isle	4 (2)	Overall	17.9-21.0	19.4	65.6-111.3	88.1	67.1-73.0	69.9	15.6-16.3	15.9	6.3-10.0	8.6	4.29 5.60	4.85
Croaker *Micropogon undulatus*	July	Cat Island	4 (2)	Overall	20.2-26.0	22.2	81.4-181.7	118.5	75.0-77.8	76.0	16.4-16.9	16.7	2.8-4.5	3.6	2.37-3.41	3.05
Razor bellies *Harengula pensacolae*	June	Breton Island	4 (4)	Forktail	11.0-15.0	12.9	22.8-60.1	37.5	70.9-73.4	71.8	17.1-18.9	18.4	4.4-5.4	5.0	3.64-5.61	4.81
Anchovies *Anchoa hepsetus*	June	Breton Island	4(14-16)	Forktail	10.1-11.8	10.8	8.4-19.4	12.3	76.9-77.6	77.3	17.1-17.3	17.2	2.2-3.3	2.6	3.20-3.44	3.29
Star drum *Stellifer lanceolatus*	June	Horn Island	4(9-10)	Overall	10.9-13.9	12.5	10.8-29.4	20.2	75.1-76.9	76.3	14.4-15.2	15.0	3.4-4.0	3.8	3.89-4.28	4.11

*NOTE: Numbers in parentheses indicate number of fish in each sample.

TABLE 5

COMMON INDUSTRIAL FISH ANALYSIS — SUMMER 1958

Species	Date	Location	No. of* Determ.	Type Meas.	Length in cm Rge.	Length in cm Ave.	Weights in gm Rge.	Weights in gm Ave.	% Moisture Rge.	% Moisture Ave.	% Protein Rge.	% Protein Ave.	% Fat Rge.	% Fat Ave.	% Ash Rge.	% Ash Ave.
Harvest fish *Peprilis sp.*	July	Cat Island	4 (1-2)	Forktail	13.0-16.2	14.8	83.9-129.9	111.2	70.4-76.9	73.0	16.1-16.8	16.4	4.8-9.0	7.5	2.08-2.69	2.31
Threadfin *Polynemus sp.*	July	Cat Island	4 (8)	Forktail	10.4-12.2	11.3	15.9-27.9	20.7	76.2-77.3	76.6	16.9-17.6	17.3	1.6-2.1	1.8	3.52-4.15	3.98
Bumper *Chloroscombrus chrysurus*	July	Cat Island	4 (2)	Forktail	15.4-17.2	16.5	50.7-71.1	61.0	70.3-73.0	71.3	18.6-18.9	18.7	4.8-6.9	6.0	3.42-5.15	4.22
Hardheads *Galeichthys felis*	June	Grand Isle	4 (1)	Forktail	22.1-24.2	23.3	149.8-204.2	182.6	70.5-72.1	71.0	16.6-17.5	17.0	6.1-7.2	6.7	2.70-5.06	4.14
White trout *Cynoscion sp.*	July	Cat Island	4 (1-2)	Overall	17.6-29.9	22.2	55.1-128.0	87.8	73.1-76.5	74.3	17.0-18.1	17.5	3.3-6.3	5.0	2.56-3.76	3.09
Menhaden *Brevoortia sp.*	Aug.	Chandeleur Island	4 (1-2)	Forktail	15.9-19.5	17.4	82.2-161.4	110.3	60.5-66.8	63.3	14.1-16.1	14.9	13.1-20.5	17.8	3.30-4.08	3.66

*NOTE: Numbers in parantheses indicate number of fish in each sample.

TABLE 6

SEASONAL CHANGES IN MOISTURE AND FAT CONTENT

Species	Moisture Change Winter to Spring	Moisture Change Spring to Summer	Moisture Change Winter to Summer	Fat Change Winter to Spring	Fat Change Spring to Summer	Fat Change Wint. to Sum.
Spots *Leiostomus xanthurus*	-12.6%	+4.2%	-8.4%	+11.0%	-3.6%	+7.4%
Butterfish *Poronotus triacanthus*	+1.4	-4.7	-3.3	+0.1	+3.9	+4.0
Anchovies *Anchoa hepsetus*	-0.1	+1.7	+1.6	+0.4	-0.4	0.0
Thread Herring *Opisthonema oglinum*	+1.1	+4.0	+5.1	-3.1	-1.5	-4.6
Silver eels (Cutlass fish) *Trichiurus lepturus*	—	—	+2.5	—	—	-1.7
Croaker *Micropogon undulatus*	-7.3*	+6.1*	-1.2*	+6.4*	-5.0*	+1.4*
Razor Bellies *Harengula pensacolae*	—	—	+4.7	—	—	-2.7

*Time of Catch: Winter to Early Summer to Late Summer, 1958