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RSMAS, University of Miami
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Magnitude and Utilization of the Incidental Catch of the South Carolina Shrimp Fishery

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ABSTRACT

The quantity of fish caught incidental to shrimping activities in South Carolina was estimated by determining fish/whole shrimp ratios from commercial catches. The overall median fish/shrimp weight ratio was 1.94:1; however, the median ratio varied seasonally being smaller from September to December (1.24:1) than from May to August (3.58:1). The confidence interval for this estimate was defined by the 25th and 75th percentiles. An estimated fish catch of between 3.4 and 15.2 million kg was derived from expansion of detailed ratio estimates derived from this study. Sciaenids were the predominant family during the study except for the months of January and April when clupeids and gadids, respectively, comprised the greatest percentage of the catch. In general, fish caught incidental to shrimping were small; mean total lengths of 25 species ranged from 6.90 to 18.58 cm. At the present time, only a fraction of the total incidental catch is landed; the majority is discarded at sea. This apparently reflects a lack of demand for most species captured. It is estimated that 74% of the flounder catch is landed and sold as food fish compared to less than 2% of the sciaenids and scombrids.

INTRODUCTION

Shrimp represent the most valuable commercial fishery resource of South Carolina in terms of exvessel dollars (South Carolina Landings, 1974, 1975). In 1975, 4,005,595 kg (8,812,309 lb) of shrimp (heads-on) were landed having a value to the fishermen of $10,745,504 (Fisheries Statistics Division, Office of Conservation and Management, South Carolina Wildlife and Marine Resources Department). While trawling for shrimp, fishermen catch large quantities of fish. These fish were for many years considered "trash" and discarded. In the last 20 years, however, industrial fisheries have developed in the Gulf of Mexico

(Gutherz, et al., 1975; Haskell, 1961; and Roithmayr, 1965), California (Best, 1959), New England (Edwards and Lux, 1958) and North Carolina (Fahy, 1966; Wolff, 1972). In general, the fish are canned for pet food or frozen for mink food or crab pot bait. Bullis and Carpenter (1968) estimated that the United States Atlantic coast south of Cape Hatteras has a resource potential of 2,790 million lb of industrial fish annually; this was more than 300 times the 1968 level of commercial fishery production. North Carolina is the only state in the region with facilities for processing industrial species. The majority of fish processed in North Carolina were caught incidental to finfish trawling activities; fish caught incidental to shrimping are generally discarded (Wolff, 1972). Likewise, in South Carolina, Georgia, and Florida, shrimpers discard large quantities of fish.

Early estimates (Lunz, 1944) indicated that an average of 36% of shrimp trawl catches in South Carolina consisted of "non-usable fish, crabs and other scrap." The objectives of this investigation were to obtain an estimate of the quantity of fish discarded by the shrimp fleet during each shrimping season and to identify the predominant species in the catch. This information will be utilized to evaluate the economic potential of the nearshore fishery resource of South Carolina.

METHODS

Sampling Design

The major commercial shrimping area extends from Georgetown south to Calibogue Sound. Accordingly, the South Carolina coastline was divided into four sampling areas to encompass this region (Fig. 1). Boats fished primarily in Bulls Bay, Area 1; off Sullivan and Morris Islands, Area 2; Folly Beach to South Edisto River, Area 3; and South Edisto River to Calibogue Sound, Area 4. In 1974, sampling included commercial shrimp boats docked at piers in Georgetown, McClellanville, Mt. Pleasant, Folly Beach, Rockville, and Beaufort; however, in 1975, sampling was restricted to ports in McClellanville, Mt. Pleasant, Rockville, and the Beaufort area.

The South Carolina shrimp fishery is seasonal in nature. The season officially opens in May and closes in December. Species composition of the fishery fluctuates during the year. Large "roe" white shrimp support the fishery from May to June, young-of-the-year brown shrimp from June to early August, and young-of-the-year white shrimp from mid-August to the end of the season (McKenzie, 1974). In this study, a total of 208 catches of commercial shrimp trawlers were sampled in 1974 from May to December and 86 in 1975 from May to August. Sampling was more intensive from June to August of each year, when two teams of two investigators each sampled a total of four different boats a week, than from September to December when one team sampled on a weekly basis. Species composition of the inshore waters was monitored biweekly from January to May 1975 with the Division's 51-ft vessel, the R/V **Carolina Pride**. The number of trawls made per day by commercial boats ranged from one to six, depending upon abundance of shrimp. Frequency of sampling in each area

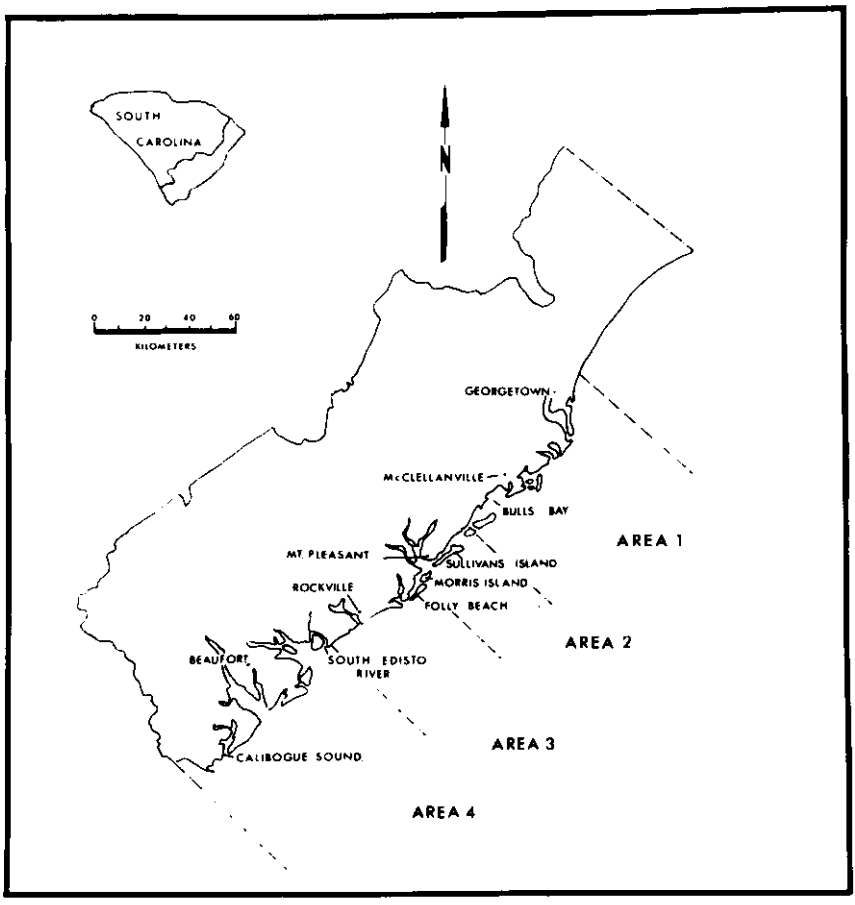

Fig. 1. Map of the South Carolina coastline indicating the four sampling areas. Shaded area of inset indicates South Carolina coastline.

was dependent upon the activity of the shrimp fleet. If few boats were fishing, it was difficult to make arrangements for on-board sampling. When this occurred, commercial catches were sampled in other areas. Vessels sampled during the survey ranged in length from 39 to 75 ft and all, except one, were double-rigged. In 1973, double-rigged vessels accounted for 68% of the licensed shrimp boats in South Carolina (Rhodes, 1974) and, presumably, catch the majority of the shrimp landed in South Carolina. No correlation was found between boat length and engine size; vessels 61 to 65 ft in length were powered by engines ranging from 175 to 335 hp. Nets towed by commercial vessels sampled ranged from 35 to 90 ft, headrope length, whereas the R/V **Carolina Pride** towed two 20-ft try nets for 0.5 h.

Boats fished in depths ranging from 3 to 10 m (10 to 33 ft); the average fishing depth was 5.3 m (17 ft). Tow duration was between 0.5 and 3.3 h.

On-board Sampling Procedure

The trawl catch was subsampled by filling a standard 1-bushel wire basket. A representative subsample was obtained by using a flat shovel to sample the catch from at least four areas of the deck. The catch was classified as: fish, commercial shrimp, tunicates, echinoderms, miscellaneous crustaceans, soft corals, scyphozoans, sponges, and horseshoe crabs. Each group of organisms was weighed and the weight recorded directly on computer coding sheets along with the tow location, time of tow, length of tow, boat horsepower, boat length, and net size. The fish fraction of the sample was identified to species and each species weighed and enumerated when time permitted. When large numbers of a species were present, the total number was determined by subsampling. In addition, the total length of at least 25 randomly chosen individuals of the 3 most abundant species was measured to the nearest centimeter.

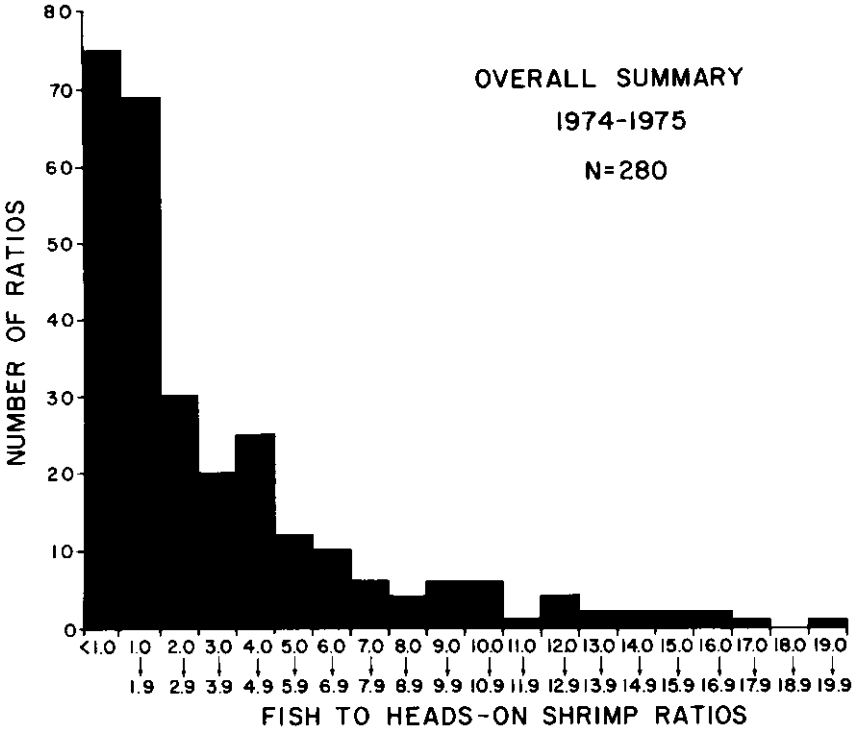

Fig. 2. Distribution of fish/heads-on shrimp ratios (by weight) calculated from commercial shrimp catches, May to December 1974 and May to August 1975 (11 highest ratios not plotted).

Treatment of Data

Ratio Estimates: The ratio of the weight of fish to the weight of heads-on shrimp in the samples was calculated for 291 of 294 trawls (in three samples, no shrimp were present). The distribution of these ratios was markedly skewed (Fig. 2). Following the recommendation of Dr. Omer Jenkins, Statistics Institute, Texas A&M University, the data were log-transformed and the mean and confidence interval were calculated from the transformed data (Fig. 3).

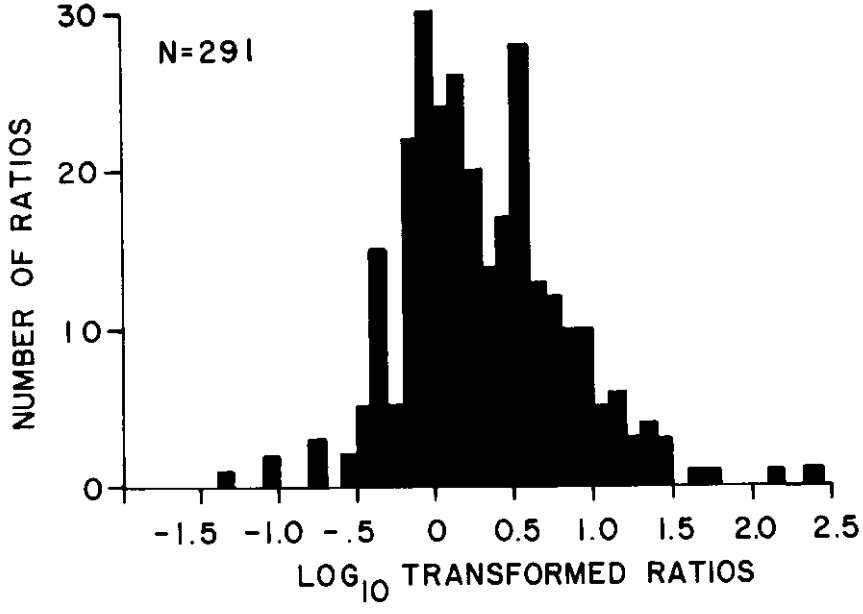

Fig. 3. Plot of $\log_{10}$ transformed fish/heads-on shrimp ratios (by weight) from commercial shrimp trawlers from May to December, 1974, and May to August, 1975.

RESULTS

Ratio Estimates

Fish/shrimp weight ratios ranged from 0.05 to 265.36. Only 11 of 291 ratios, however, exceeded 20.0:1. These high fish/shrimp ratios were not characteristic of any class of boats and were preceded or followed by ratios considerably smaller (Fig. 4). Most of the high ratios occurred on either the first or the second tow of the day. Only in one instance did a boat return to port after catching a very small amount of shrimp. The variability in ratios was indicated by the catch ratios of one 65-ft boat whose fish/shrimp ratios were uniform from one tow to the next on one sampling day in June (Fig. 4,A'), but fluctuated widely on another day in that month (Fig. 4, A).

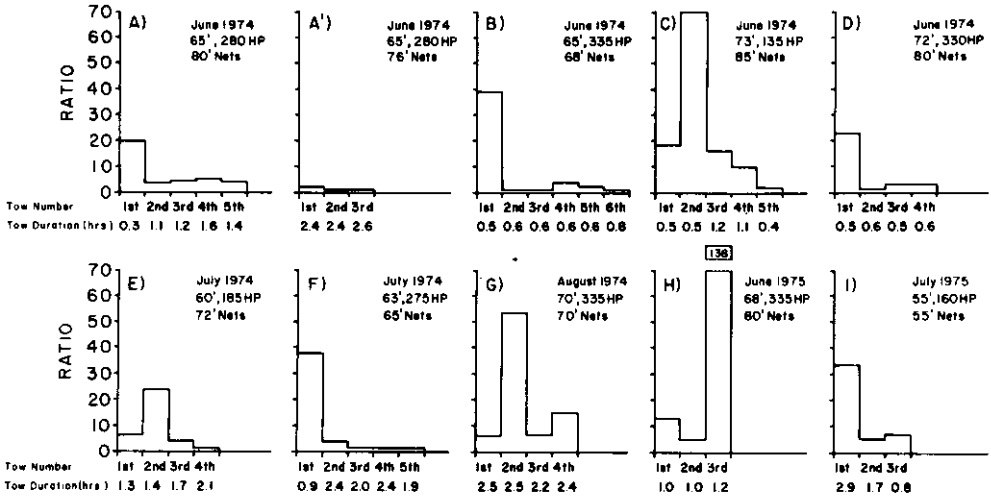

Fig. 4. A to I illustrate the variation among those tows having high fish/shrimp ratios and other tows by the same boat during that day. A' illustrates that at other times fish/shrimp ratios may be uniform from one tow to the next (A and A' information is from the same boat on different sampling days).

The distribution of the individual ratios varied from month to month (Fig. 5). With the exception of 3 months, the average monthly ratios ranged from 1:1 to 3:1; however, the variation between individual ratios within a month as indicated by the 95% confidence limit varied considerably (Table 1). The wide confidence interval for June in both years suggests that ratios in that month typically exhibit wide variation. In the months of September, October, November, and December, the majority of the ratios were less than 2:1 and the confidence limit around the mean in these months was comparatively narrow.

The mean ratio estimate had a wide 95% confidence interval. By excluding the 11 highest values (< 4% of the sample and possibly anomalous values), the 95% confidence interval of the log-transformed fish/shrimp ratio was reduced from $0.19 \leq 2.24 \leq 25.96$ to $0.23 \leq 1.98 \leq 17.40$. Using the latter figures, I estimated that an average of 6,687,000 kg (14,711,400 lb) of fish were caught incidental to shrimping in 1974 and 7,930,000 kg (17,447,760 lb) in 1975.

Species Composition and Length-frequency

General Trends: A total of 105 species of fish representing 45 families and 15 orders were identified from shrimp trawl samples (Keiser MS). Eleven families comprised the majority of the yearly catch (97.54%) (Table 2). Sciaenidae, Engraulidae, and Clupeidae contributed to the total catch throughout the year while other families represented a sizeable fraction of the catch only in certain months (Table 2). The total number of species in trawls varied markedly during the year, ranging from a low of 25 species in May 1974, to a high of 63 in June

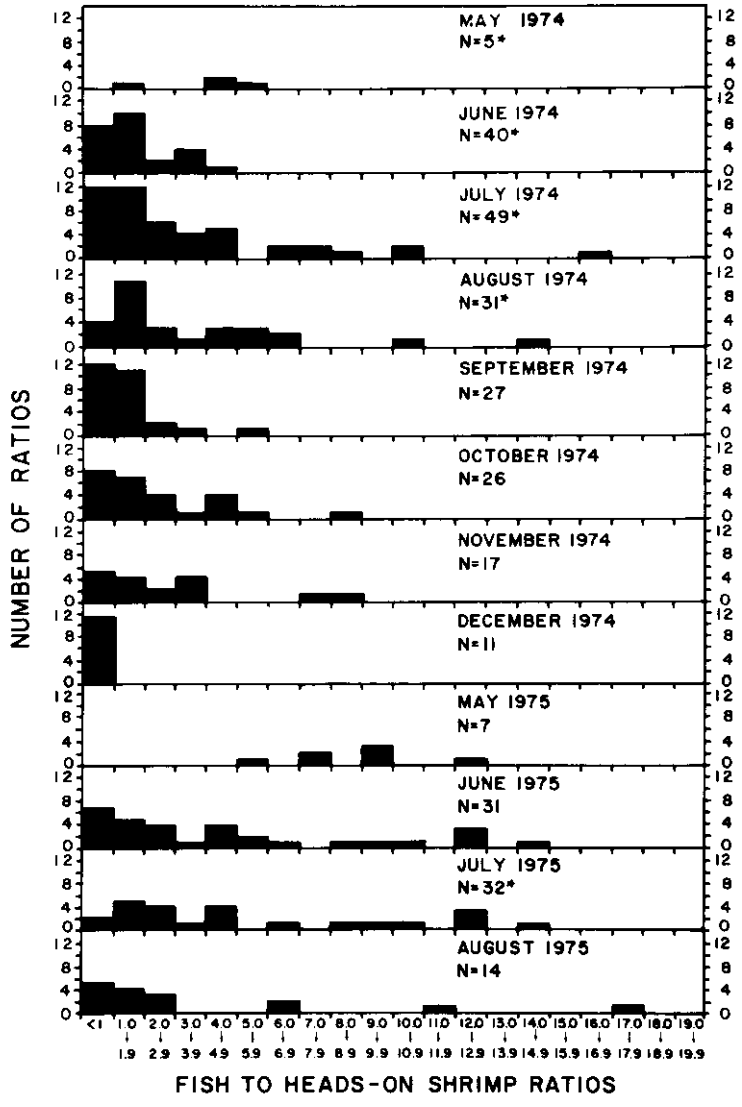

Fig. 5. Monthly variation in fish/heads-on shrimp ratios derived from commercial shrimp trawler catches. (*) indicates some ratios were greater than 20:1.

1975 (Table 3). Although there was a wide variety of species in the catches, characteristically, only a few species comprised the majority of the catch (Table 4); 10 species comprised 81.9% (by wt) of the samples during the shrimping season, May to December (Table 4). In general, fish caught incidental to shrimping are small; mean total lengths of 25 species measured during the study ranged from 6.90 to 18.58 cm.

Seasonal Variation: Sciaenids were the predominant family in all months except January and April, when clupeids and gadids, respectively, comprised the greatest percentage of the catch (Fig. 6, Table 2). Clupeid representation in the catch fluctuated in an apparent random manner throughout the year. The percentage of gadids in the catch increased gradually from January to April and then decreased rapidly from May to June; after July, they disappeared entirely from the catches. Engraulids comprised 16% or more of the samples from September to January (Table 2) and were most abundant in the samples during October and November. From December to April, the percentage of cynoglossids in the catch ranged from 3.16 to 8.62%; however, they were uncommon in other months. The precentage of carangids in the samples was less than 1% except for the months of July, September, October, and November. In September, carangids represented 16.81% of the catches.

Sport Fishes Captured by Shrimp Trawlers

Of 40 species listed by Bearden and McKenzie (1972) as sport fishes in South Carolina, 14 were found in shrimp trawl samples (Table 5). However, only four of these (Southern kingfish, *Menticirrhus americanus;* Atlantic croaker, *Micropogon undulatus;* weakfish, *Cynoscion regalis;* spot, *Leiostomus xanthurus*) represented more than 1% (by number) of the annual samples. In general, these fish were of small size; however, spot, Spanish mackerel (*Scomberomorus maculatus*) and summer flounder (*Paralichthys dentatus*) were occasionally of marketable size and were culled from the catch for sale.

Table 1. Average monthly fish/heads-on shrimp ratio estimates and associated 95% confidence intervals ($\pm t_{.05}$ standard deviations) calculated from $\log_{10}$ transformed data; ratios greater than 20:1 excluded from computations

Month	$-t_{.05}s$	Mean	$+t_{.05}s$	Minimum Ratio	Maximum Ratio	n
1974						
May	1.18	6.37	34.38	4.08	20.00	5
June	0.19	2.28	27.16	0.15	18.14	36
July	0.30	2.06	14.21	0.33	16.37	47
August	0.31	2.21	15.68	0.30	14.92	29
September	0.23	1.08	5.01	0.17	5.78	27
October	0.24	1.56	9.98	0.33	8.78	26
November	0.31	1.78	10.24	0.61	8.34	17
December	0.04	0.23	1.21	0.05	0.41	11
1975						
May	4.50	8.40	15.68	5.28	12.60	7
June	0.21	2.39	27.71	0.24	12.85	31
July	0.71	3.36	16.01	0.54	15.00	30
August	0.25	2.16	18.82	0.49	17.09	14

Table 2. Percent contribution (by number) of 11 families to the monthly shrimp trawl samples (May through August represents a composite of 1974 and 1975 samples)[(–) indicates none in samples during the month]

Family	Months												Overall
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Sciaenidae	22.56	68.63	45.52	36.68	45.48	77.79	71.05	62.29	50.55	51.22	45.50	50.44	60.46
Engraulidae	19.71	10.25	4.26	3.83	5.61	6.34	10.39	9.86	16.96	21.06	21.73	16.35	9.16
Clupeidae	40.21	4.41	15.09	2.20	20.90	6.19	5.18	8.24	3.35	5.09	16.37	10.82	8.26
Gadidae	4.33	5.15	21.50	36.94	13.94	0.02	–	–	–	–	–	–	7.30
Carangidae	–	–	–	–	0.09	0.71	2.75	0.94	16.81	1.96	1.85	–	2.56
Bothidae	3.68	1.55	3.91	2.04	1.28	1.56	2.25	2.76	2.27	3.12	4.26	9.29	2.37
Stromateidae	0.08	0.91	3.03	4.22	6.31	0.42	1.52	2.27	2.05	3.35	4.32	0.96	2.26
Cynoglossidae	6.42	3.16	4.32	8.62	0.48	0.12	0.31	0.32	1.02	1.93	0.94	6.25	2.05
Soleidae	0.12	0.16	0.45	3.65	0.92	0.52	0.59	1.33	1.78	1.59	1.41	3.53	1.18
Ariidae	–	–	–	0.08	0.32	2.26	0.43	2.26	0.92	0.53	0.03	–	0.94
Scombridae	–	–	–	–	0.05	0.58	2.23	2.24	2.56	1.06	0.40	–	1.00
TOTALS	97.91	94.21	98.08	98.26	95.38	96.51	96.70	92.51	98.27	90.91	96.81	97.64	97.54

Table 3. Total number of species in monthly samples and the number of those species representing 90% or more (by number) of the monthly samples

Month	Total number of species per month in samples	Number of species representing 90% or more of monthly samples
1974		
May	25	9
June	49	8
July	55	10
August	54	12
September	49	13
October	49	14
November	43	12
December	26	9
1975		
January	32	6
February	39	6
March	31	8
April	51	8
May	42	10
June	63	9
July	61	13
August	54	14

Table 4. Predominant species in shrimp trawler samples May to December 1974 and May to August 1975

Species	Weight (kg)	Percent
Leiostomus xanthurus	938.6	40.2
Brevoortia tyrannus	239.9	10.3
Micropogon undulatus	206.3	8.8
Stellifer lanceolatus	117.4	5.0
Menticirrhus americanus	116.0	5.0
Arius felis	80.6	3.4
Cynoscion regalis	70.9	3.0
Rhinoptera bonasus	51.0	2.2
Scomberomorus maculatus	49.1	2.1
Larimus fasciatus	44.9	1.9
TOTALS	1914.7	81.9%

Table 5. Mean total length, weight, and number of sport fishes in shrimp trawl catches sampled during this investigation (Asterisk indicates no measurements)

	Mean Length (cm)	Range (cm)	Number Measured	Mean Weight (kg)	(lb)	Number Caught
Serranidae						
Centropristis striata	*			0.07	0.15	19
Mycteroperca interstitialis	*			0.10	0.22	1
Pomatomidae						
Pomatomus saltatrix	18.6	14.0-24.0	24	0.06	0.13	584
Carangidae						
Trachinotus carolinus	*			0.11	0.24	18
Caranx hippos	*			0.20	0.44	2
Sciaenidae						
Menticirrhus americanus	15.1	6.0-28.0	270	0.04	0.09	3328
Micropogon undulatus	11.0	4.0-22.0	1624	0.02	0.04	10600
Cynoscion nebulosus	*			0.13	0.29	23
Cynoscion regalis	13.3	7.0-21.0	144	0.02	0.04	3219
Leiostomus xanthurus	13.7	4.0-25.0	4723	0.04	0.09	36356
Ephippidae						
Chaetodipterus faber	*			0.05	0.11	53
Scombridae						
Scomberomorus maculatus	17.4	11.0-28.0	51	0.05	0.11	1065
Scomberomorus cavalla	*			0.03	0.07	135
Bothidae						
Paralichthys lethostigma	*			0.15	0.33	79

DISCUSSION

Weight Ratio Estimates

Shrimp trawl catches along the North and South Carolina coasts are characterized by extremely variable fish/shrimp ratios. In North Carolina, Wolff (1972) sampled 39 shrimp trawls (18 day and 21 night) and reported an average fish/whole shrimp ratio of 5.4:1; however, he did not indicate the variation among the individual ratios. Wolff's individual ratios for day trawls ranged from 0.6:1 to 185.9:1 and in general were larger than those found in this study. By excluding only the largest ratio and log transforming the data, I calculated a mean ratio of 6.3:1 from Wolff's data with a 95% confidence interval of 0.4:1 to 91.2:1. Both the mean ratio and the confidence interval from the North Carolina study were larger than that found for South Carolina. No published fish/shrimp ratio data have been found for Georgia, but studies by Anderson, 1968; Anderson and Gehringer, 1965; Knowlton, 1972, describe species composition and catch-per h data. Seibenaler (1952) reported a 6:1 fish/shrimp ratio as an average for the east coast of Florida. Juhl (1974) reported that in the Gulf of Mexico, fish/heads-on shrimp ratios ranged from 4.1:1 to 20.0:1. He used an average ratio of 10.0:1 to estimate annual incidental fish catches on shrimping

grounds. Chittenden and McEachran (1975a) calculated a ratio of 11.35 volumes of discard (approximately 90% fish) to 1 volume of shrimp (heads-off) from 60 shrimp trawl catches; 95% confidence limits were 9.7:1 and 13.0:1. The overall fish/shrimp (heads-off) ratio was approximately 10.0:1. This corresponds to a fish/shrimp (heads-on) ratio of approximately 6.2:1.

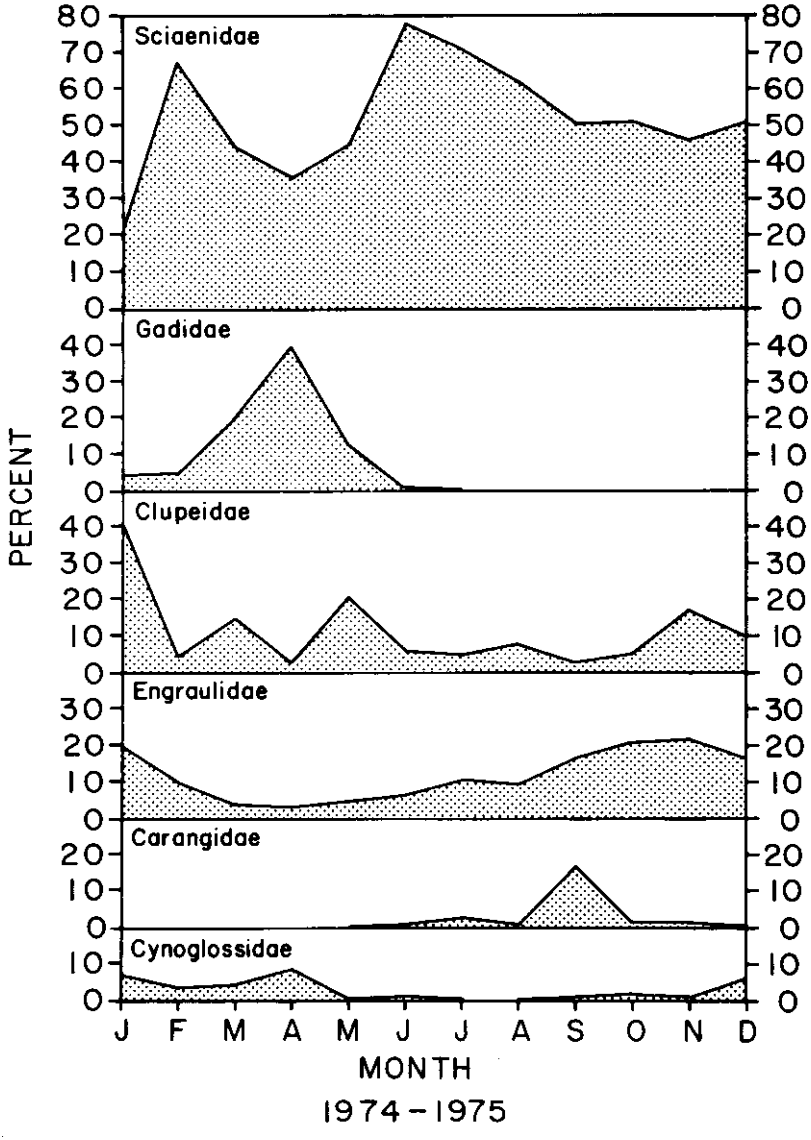

Fig. 6. Percent contribution of six families of fishes to monthly incidental catch samples (May to August values calculated from a composite of 1974 and 1975 samples).

Shrimping activities along the southeastern coast of the United States differ from those of the Gulf of Mexico. Commercial fishing for brown and white shrimp in North and South Carolina is generally restricted to within 6 miles of shore in waters < 60 m deep (Eldridge and Goldstein, 1975). In the Gulf of Mexico, however, the white and brown shrimp grounds are distinct, the white shrimp grounds in shallow water (1.1 to 6.7 m; 3.6 to 22 ft) and brown shrimp grounds further offshore in waters of 8.9 and 27.8 m (29 to 91 ft). Chittenden and McEachran (1975b) found that fish fauna of white shrimp grounds were primarily estuarine-dependent, whereas those of brown shrimp grounds were essentially estuarine-independent. Discard ratios on offshore brown shrimp grounds were 2 to 5 times higher than those on white shrimp grounds (Chittenden and McEachran, 1975c).

The wide confidence interval associated with ratio estimates limits their usefulness in making resource utilization decisions. In an attempt to obtain information of more value in assessing resource potential, I calculated the median of the untransformed ratio distribution as well as the 25th and 75th percentiles. Confidence limits of the median were defined as those percentiles encompassing 50% of the individual ratios. The median ratio of 1.94:1 was comparable to the mean ratio of 1.98:1 determined from $\log_{10}$ transformed data. The 25th and 75th percentiles were 0.98:1 and 4.43:1, respectively. Examination of monthly mean ratios (Table 1) suggests that the above ratio estimate can be refined by calculating separate ratios for the periods May to August and September to December. The median ratio for May to August (both years combined) was 2.58:1 with confidence limits of 1.24:1 to 5.43:1 while the median for September to December was 1.20:1 with confidence limits of 0.56:1 to 2.66:1. Applying these seasonal ratio estimates to the shrimp landing statistics (South Carolina Landings, 1974, 1975), I estimate that between 3.65 and 16.59 million kg (8.0 to 36.5 million lb) of fish were caught incidental to shrimping in 1974 and between 3.4 and 15.2 million kg (7.3 and 33.4 million lb) in 1975.

Not all fish caught by shrimp trawlers are discarded. South Carolina Landing statistics (Ken Harris, NMFS, personal communication) reveal that in 1974, 82,636 kg (181,800 lb) of Atlantic croaker, flounders, kingfishes, mackerel, and spot were landed. The quantity of three major groups – selected sciaenids (Atlantic croaker, spot, kingfish, and spotted sea trout), scombrids (Spanish and king mackerel), and commercial flounders (*Paralichthys* spp) caught monthly – was estimated by multiplying the percentage contribution of each group to the monthly samples times estimated monthly fish catches (Table 6). These estimates were compared to monthly landings from central and southern districts in order to compute the percentage of fish marketed to those caught. The northern district (Horry and Georgetown counties) landings were excluded because they include fish caught in haul seines as well as in shrimp trawls. Northern district landings from shrimp trawlers account for less than 20% of the shrimp landed in the state, and exclusion of these fish landings should not significantly affect estimates of incidental fish landings.

The percentage of sciaenids and scombrids caught, that were marketed, differed greatly from that of flounders. Approximately 74% of estimated flounder catches were marketed compared to less than 2% of the sciaenids and

Table 6. A comparison between estimated catches and estimated landings of selected sciaenids, scombrids, and bothids caught incidental to shrimp trawling in South Carolina from May, 1974 to December, 1974 and from May, 1975 to mid-August, 1975 (Source: Shrimp Landings: South Carolina Landings)

				Sciaenids				Scombrids				Bothids			
				Croaker, Spot, Kingfishes, Spotted Trout				Spanish and King Mackerel				Summer and Southern Flounders			
Month	Shrimp Landings 1000's of lbs	Fish Heads-on Shrimp Ratios	Total Estimated Fish Catch 1000's of lbs	Percent in Sample	Estimated Catch 1000's of lbs	Actual Landings 1000's of lbs	Percent of Estimated Landings	Percent in Sample	Estimated Catch 1000's of lbs	Actual Landings 1000's of lbs	Percent of Estimated Landings	Percent in Sample	Estimated Catch 1000's of lbs	Actual Landings 1000's of lbs	Percent of Estimated Landings
1974															
May	796	6.37:1	5070.5	66.09	3351.1	9.8	0.29	--	--	--	--	--	--	3.6	--
June	372	2.28:1	848.2	53.69	455.4	4.6	1.01	0.94	8.0	0.2	2.50	0.37	3.1	1.7	54.84
July	1554	2.06:1	3201.2	53.80	1722.2	24.6	1.40	3.13	100.2	0.1	0.10	0.19	6.1	4.5	74.00
August	950	2.21:1	2099.5	41.39	869.0	24.6	2.83	2.30	48.3	0.4	0.83	0.13	2.7	6.2	--
September	1566	1.08:1	1691.3	18.14	306.8	26.1	8.50	2.56	43.3	0.4	0.90	0.29	4.9	7.9	--
October	920	1.56:1	1435.2	10.37	148.8	18.4	12.40	1.06	15.2	0.2	1.30	0.34	4.9	9.6	--
November	647	1.78:1	1151.7	18.65	214.8	9.4	4.38	0.40	4.6	--	--	0.26	3.0	4.2	--
December	424	0.23:1	97.5	21.80	21.2	4.2	19.80	--	--	--	--	0.64	0.6	0.3	50.00
1975															
May	489	8.40:1	4107.6	24.00	985.8	14.9	1.51	0.06	2.5	0.6	24.00	0.29	11.9	9.5	79.75
June	1164	2.39:1	2782.0	70.37	1957.7	8.8	0.40	0.48	13.4	1.8	13.40	0.69	19.2	5.4	28.10
July	1192	3.36:1	4005.1	49.29	1972.9	20.3	1.03	1.54	61.7	1.5	2.43	0.42	16.8	5.9	35.07
August	763	2.16:1	28137.7	40.98	675.4	10.2	1.50	2.16	35.6	0.6	1.70	0.60	9.9	2.9	29.30
					12681.1	175.9			332.8	5.8			83.1	61.7	
				OVERALL		1.48%				1.74%				74.25%	

scombrids (Table 6). Several reasons exist for these marked differences. Sciaenids on the whole are of very small size and only a fraction of the sciaenid catch is large enough to be marketed locally as food fish (Raymond Rhodes, personal communication). According to Juhl's (1974) length-frequency criterion, all croaker sampled during this investigation would be classified as industrial. Scombrids, on the other hand, are generally of edible size, but there appears to be little demand for these species. During our sampling program, some shrimpers saved every mackerel, while others discarded all of them. In comparison, all shrimpers saved large flounders. Shrimpers generally catch only a few commercial flounder, but those caught are usually of edible size. Flounders are also easily distinguished from the other fish in the catch. The discrepancy between estimated flounder catches and estimated landings in several months (Table 6) results from a lack of precision associated with the small percentage of flounder in the monthly samples. These discrepancies are actually larger than indicated since shrimpers often save flounder for home consumption.

The above discussion shows that shrimpers apparently save fish that can be marketed at a good price and that can be easily culled from the catch. At the present time, no markets exist in South Carolina for the majority of species discarded by shrimpers.

CONCLUSIONS

1. Data acquired during this study indicate that between 3.4 and 15.2 million kg of fish were caught incidental to shrimping in 1975. Only a small number of incidental fish are landed in South Carolina, the majority being discarded at sea. Fish landings consist exclusively of fish, such as flounder, Atlantic croaker, spot, that can be marketed as food fish. Spanish and king mackerel reach commercial size, but at the present there is a low market acceptance for these species. The majority of discarded fish are small and suitable only for processing into pet food or other industrial fish products. Utilization of the bulk of incidental fish catches would require processing facilities that do not exist in South Carolina at the present time.

2. There is doubt that incidental catches can be economically utilized. A fishing fleet, distinct from the shrimping fleet, provides the bulk of the incidental fish catches for processing plants in the Gulf of Mexico (Gutherz et al., 1975) as the amount paid to shrimpers for incidental species failed to provide them with sufficient incentive to land a dependable supply of fish. Apparently a similar situation existed in North Carolina where the industrial fish processing plants were also served by their own fleet (Wolff, 1972). Bullis and Carpenter (1968) suggested that the only practical way to utilize incidental fish discards would be to place highly automated reduction or partial processing facilities aboard trawlers.

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