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## The Occurrence of Penaeus spp. in the Stomachs of Trawl-caught Fishes from the Northwestern Gulf of Mexico, 1981

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By

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#### ABSTRACT

During the FRS OREGON II Texas Closure operations between 4 June and 4 July 1981, samples of trawl-caught finfish were obtained. The objectives of the study were to record the number of Penaeus spp. found in trawl-caught fishes and to document shrimp predator species. The stomachs from the trawl-caught fishes were examined for the presence of brown (Penaeus aztecus), white (P. setiferus), and pink (P. duorarum) shrimp. Thirteen brown shrimp were identified from the stomachs of 7598 fish. The collected data were compiled for further examination to determine the impact of fish predation on shrimp stocks and to estimate natural mortality due to predation.

## INTRODUCTION

During the FRS OREGON II Texas Closure operations between 4 June and 4 July 1981, samples of trawl-caught finfish were obtained. The stomachs from these fish were later examined for the presence of brown (Penaeus aztecus), white (P. setiferus), and pink (P. duorarum) shrimp. The collected data were compiled for further examination to determine the impact of fish predation on shrimp stocks and to estimate natural mortality due to predation. The objectives of the study were to record the number of Penaeus spp. found in trawl-caught fishes and to document shrimp predator species.

## METHODS

### Trawling Procedures

The FRS OREGON II was used to conduct a trawl survey off the Texas coast from 5 to 35 fm based on a stratified sampling pattern of 100 randomly selected trawling sites (Fig. 1, Table 1). Stations located from 5 to 29 fm were sampled by trawling across the appropriate 1 fm depth stratum, and those of 30 fm or more were sampled by trawling across a 5 fm depth stratum to 35 fm. All stations were sampled at night with a 12.2 m (40 ft) semi-balloon shrimp trawl rigged with tickler chain and 2.4 m x 1.0 m (8 ft x 40 in) wooden doors. Trawls were pulled perpendicular to the shoreline as bottom topography permitted. Individual tows were limited to a maximum 30-minute bottom time, making a series of consecutive tows necessary to completely cover a given depth stratum on certain stations. Stations requiring 15 minutes or less of bottom time to completely cover the depth stratum were replicated immediately after the initial tow. An additional eight deep-water (i.e., 35-50 fm) stations were sampled by a 30-minute tow.

Four stations located on a transect perpendicular to the shoreline just south of San Luis Pass, Texas were visited three times during the study period by the FRS OREGON II. The stations, located in 7, 13, 20 and 24 fathoms, were visited at two-week intervals beginning in early June. At each station, simultaneous tows with port and starboard nets were made. Standard sample processing procedures were also used.

### Sampling Procedures

On board the OREGON II the total weight of fishes from each trawl-haul on each station was recorded. Depending on catch size and trawl constraints, a maximum 100 lb randomly selected sample was collected from each trawl-haul and frozen for laboratory analyses.

## Laboratory Procedures

In the laboratory, each sample was thawed and sorted according to species and size. In most cases fishes less than 150 mm standard length (SL) and all herbivorous fishes were discarded. However, in samples consisting of at least 75% carnivorous fishes less than 150 mm SL, at least 50% of these fishes were examined. All discarded fishes were identified to species, counted and numbers per species recorded.

To examine the fish, the abdominal area was cut from the anus to the isthmus and the stomach was located. Relative stomach fullness was determined as follows: (1) a collapsed stomach was considered empty and was not examined further, (2) partial distention of the stomach was considered 50% full, and (3) maximum distention was considered 75-100% full. Distended stomachs were removed and contents were identified and grouped as crabs, fish, detritus, gastropods or shrimp. Penaeus spp. found in gut contents were measured and preserved in 10% formalin solution.

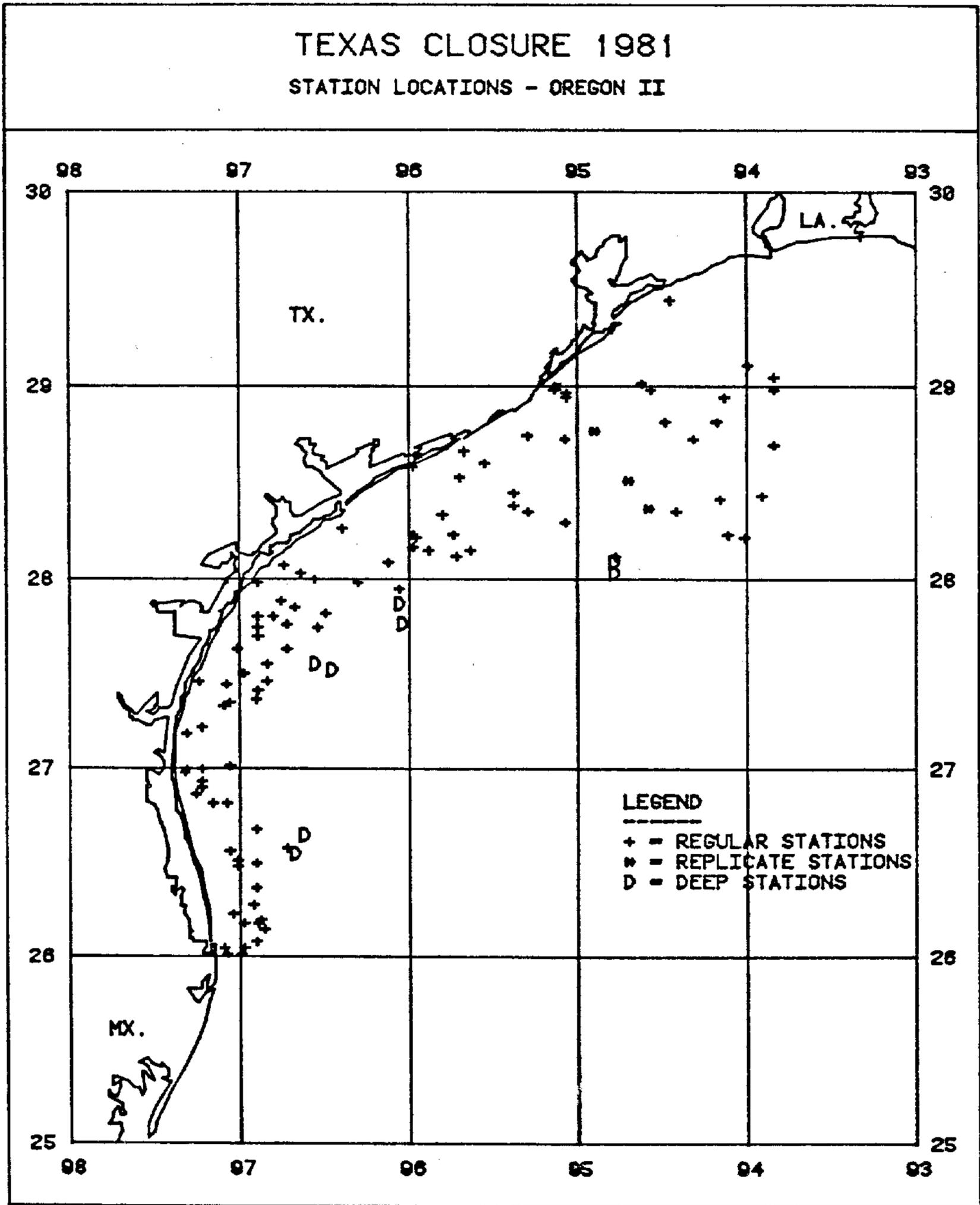


Figure 1. Chart of Texas Gulf Coast with FRS OREGON II station locations.

TABLE 1. Station locations and depth strata (fathoms) for the OREGON II Texas Closure survey. Asterisks (\*) indicate bottom obstructions in the vicinity of the station 1 per obstruction.

STATION	LAT.	LONG.	DEPTH STRATA (fm)
1	29°08'	93°52'20"	10-11
2	28°57'	93°52'	12-13
3	28°40'	93°52'30"	15-16
4	28°24'	93°56'30"	28-29
5	29°05'	94°01'30"	10-11
6	28°11'	94°02'10"	35-36
7	28°55'	94°09'10"	11-12 *
8	28°47'	94°12'30"	14-15
9	28°23'	94°11'	26-27 *
10	28°13'	94°11'	30-35 ***
11	29°25'	94°28'	6-7 *
12	28°59'	94°37'50"	9-10
13	28°57'	94°35'10"	10-11
14	28°47'	94°30'20"	13-14
15	28°42'	94°19'40"	16-17
16	28°22'	94°27'	25-26
17	28°56'10"	95°05'	9-10
18	28°56'20"	95°05'	9-10
19	28°44'20"	94°55'	13-14
20	28°29'	94°42'50"	20-21
21	28°20'	94°35'40"	24-25
22	28°58'	95°09'30"	7-8
23	28°54'40"	95°10'	8-9
24	28°42'10"	95°06'30"	13-14
25	28°05'40"	94°48'20"	30-35
26	28°43'	95°20'	9-10
27	28°16'30"	95°05'30"	23-24*
28	28°38'30"	95°43'	7-8
29	28°33'20"	95°35'	10-11
30	28°33'30"	95°25'	16-17*
31	28°19'20"	95°25'	18-19
32	28°19'20"	95°20'	19-20
33	28°30'40"	95°45'	11-12
34	28°06'40"	95°40'30"	23-24
35	28°18'30"	95°50'	14-15
36	28°11'50"	95°45'	18-19
37	28°04'40"	95°45'	23-24
38	28°07'	95°55'	20-21
39	28°34'	96°00'	5-6
40	28°13'	96°00'	15-16
41	28°12'	96°00'	15-16
42	28°08'	96°00'	18-19
43	28°13'50"	96°25'	10-11
44	28°03'	96°10'	19-20
45	28°02'	96°25'	8-9
46	28°00'20"	96°40'	11-12
47	27°58'20"	96°35'	14-15
48	27°57'	96°20'	21-22
49	27°55'	96°05'	29-30
50	27°57'20"	96°55'	6-7

STATION	LAT.	LONG.	DEPTH STRATA (fm)
51	27°50'30"	96°45'30"	13-14
52	27°48'30"	96°40'	17-18
53	27°46'40"	96°30'	25-26
54	27°46'	96°50'	13-14
55	27°44'10"	96°45'	17-18
56	27°43'10"	96°35'	24-25
57	27°44'10"	96°55'	11-12*
58	27°43'40"	96°55'	12-13*
59	27°39'40"	96°55'	14-15
60	27°35'30"	96°45'	22-23
61	27°35'20"	97°02'30"	12-13
62	27°31'10"	96°52'30"	19-20
63	27°28'30"	97°00'	16-17
64	27°28'10"	97°00'	16-17
65	27°25'40"	96°52'30"	22-23
66	27°26'20"	97°16'	6-7
67	27°24'50"	97°06'30"	13-14
68	27°22'50"	96°55'	21-22
69	27°17'40"	97°07'	15-16
70	27°18'30"	97°05'	16-17
71	27°20'	96°56'15"	21-22*
72	27°10'10"	97°20'	7-8
73	27°10'50"	97°15'	11-12*
74	26°57'	97°21'30"	5-6
75	26°58'10"	97°20'	8-9
76	26°58'30"	97°15'	12-13
77	26°59'20"	97°05'	19-20***
78	26°50'	97°17'30"	9-10
79	26°53'20"	97°15'	12-13
80	26°52'	97°15'	12-13
81	26°47'30"	97°11'30"	14-15
82	26°46'50"	97°06'30"	17-18
83	26°39'10"	96°56'30"	22-23
84	26°29'50"	97°05'	14-15
85	26°29'30"	97°02'30"	17-18
86	26°28'	97°02'30"	15-16
87	26°27'40"	96°56'30"	20-21
88	26°33'20"	96°45'	27-28*
89	26°12'40"	97°04'30"	10-11
90	26°14'40"	96°57'	16-17
91	26°19'40"	96°56'30"	18-19
92	26°09'10"	97°00'	14-15
93	26°10'30"	96°55'	19-20
94	26°08'20"	96°55'	18-19
95	26°06'50"	96°53'30"	20-21
96	26°01'20"	97°07'	7-8
97	26°01'10"	97°00'	15-16
98	26°02'30"	96°55'	17-18
99	25°58'50"	97°06'	8-9
100	25°59'30"	97°01'30"	13-14

Deep Water  
STATIONS

D-1	28°03'	94°48'	35
D-2	28°00'	94°48'	45
D-3	27°50'	96°05'30"	35
D-4	27°44'	96°04'	45
D-5	27°31'	96°35'	35
D-6	27°28'	96°29'	45
D-7	26°30'30"	96°41'	35
D-8	26°37'30"	96°37'	45

## RESULTS

A total of 68,983 fish were collected of which 61,385 were discarded, a representation of 98 species. The species discarded in the laboratory are recorded in Table 2. Syacium gunteri was discarded most frequently (10,725 individuals, 18% of total discards). Other fish frequently discarded included Stenotomus caprinus, Micropogonias undulatus, Chloroscombrus chrysurus, Prionotus rubio, and Diplectrum bivittatum.

Stomachs from 81 species of fish were examined for the presence of Penaeus spp. Stomachs from a total of 7598 fish were examined (10% of total fish collected). A summary of size range, weight, the number of shrimp and number of Penaeus spp. found for the species-examined appears in Table 3. Micropogonias undulatus (95-163 mm SL) was the species with the greatest number of individuals examined. Other species examined in numbers greater than 300 include Synodus foetens (48-333 mm SL), Cynoscion nothus (76-219 mm SL), Centropristis philadelphica (85-224 mm SL), Lepophidium graellsii (95-140 mm SL), and Leiostomus xanthurus (87-164 mm SL). The column in Table 3 labeled "Total Shrimp" represents all species of shrimp found in the stomachs including Penaeus spp. Of the non-Penaeus species, Trachypenaeus spp. occurred most frequently and in greatest abundance, followed by Mysids and Sicyonia spp. Of the six fish species in which Penaeus spp. were found, more than 100 individuals were examined, except Lutjanus synagris, where 65 individuals were examined.

Thirteen Penaeus spp. were found and identified as Penaeus aztecus, brown shrimp. The greatest number of P. aztecus (5) were found in the stomachs of Synodus foetens and 4 P. aztecus were found in Cynoscion arenarius stomachs. A list of length, weight and stomach fullness of species in which P. aztecus shrimp were found, along with the tail length of the brown shrimp appears in

Table 4. The P. aztecus found ranged in size from 20 to 62 mm tail length and the fish species in which these shrimp were found ranged in size from 119 to 244 mm (SL).

A correlation between shrimp size and fish size of the fish found to contain P. aztecus is illustrated in Figure 2. According to the data obtained from this study (See Equation 1), there is a direct correlation between fish size and size of consumed P. aztecus, 99% of the time (Fig. 2).

Equation:  $y = -14.43 + 0.32x$   
x = Shrimp (Tail length), y = Fish SL  
r = 0.79, p = 0.01

Table 2. Number and species of fish discarded.

SPECIES	NUMBER
<i>Syacium gunteri</i>	10756
<i>Stenotomus caprinus</i>	8563
<i>Micropogonias undulatus</i>	6787
<i>Chloroscombrus chrysurus</i>	4352
<i>Prionotus rubio</i>	2895
<i>Diplectrum bivittatum</i>	2699
<i>Peprilus burti</i>	2631
<i>Cynoscion nothus</i>	2206
<i>Sphoeroides parvus</i>	1662
<i>Citharichthys spilopterus</i>	1621
<i>Halieutichthys aculeatus</i>	1315
<i>Porichthys plectrodon</i>	1307
<i>Lutjanus synagris</i>	1161
<i>Serranus atrobranchus</i>	1123
<i>Etropus crossotus</i>	1106
<i>Saurida brasiliensis</i>	1088
<i>Centropristis philadelphica</i>	993
<i>Lutjanus campechanus</i>	739
<i>Prionotus paralatus</i>	665
<i>Prionotus tribulus</i>	629
<i>Prionotus salmonicolor</i>	595
<i>Trachurus lathami</i>	587
<i>Cyclopsetta chittendeni</i>	570
<i>Stellifer lanceolatus</i>	531
<i>Larimus fasciata</i>	458
<i>Mullus auratus</i>	446
<i>Bollmannia communis</i>	422
<i>Lepophidium graellsii</i>	362
<i>Scorpaena calcarata</i>	357
<i>Polydactylus octonemus</i>	328
<i>Prionotus stearnsi</i>	319
<i>Leiostomus xanthurus</i>	318
<i>Cynoscion arenarius</i>	291
<i>Ogcocephalus radiatus</i>	266
<i>Lagocephalus laevigatus</i>	209
<i>Synodus poeyi</i>	203
<i>Prionotus roseus</i>	187
<i>Opisthonema oglinum</i>	183
<i>Symphurus plagiusa</i>	156
<i>Monacanthus hispidus</i>	128
<i>Hoplunnis macrurus</i>	111
<i>Lagodon rhomboides</i>	108
<i>Harengula jaguana</i>	106
<i>Gymnachirus texae</i>	98
<i>Anchoa hepsetus</i>	96
<i>Orthopristis chrysoptera</i>	89
<i>Urophycis cirratus</i>	80
<i>Bellator militaris</i>	76
<i>Ancylopsetta quadrocellata</i>	67

Table 2. continued

SPECIES	NUMBER
<i>Ancylopsetta dilecta</i>	65
<i>Priacanthus arenarius</i>	53
<i>Brotula barbata</i>	50
<i>Centropristis ocyura</i>	48
<i>Antennarius radiosus</i>	44
<i>Brevoortia patronus</i>	43
<i>Scomber japonicus</i>	42
<i>Vomer setapinnis</i>	40
<i>Prionotus carolinus</i>	35
<i>Upeneus parvus</i>	31
<i>Urophycis floridana</i>	31
<i>Menticirrhus americanus</i>	28
<i>Prionotus ophryas</i>	28
<i>Prionotus scitulus</i>	26
<i>Etropus microstomus</i>	19
<i>Synodus foetens</i>	19
<i>Equetus umbrosus</i>	18
<i>Caulolatilus intermedius</i>	16
<i>Decapterus punctatus</i>	15
<i>Peprilus paru</i>	15
<i>Hoplunnis tenuis</i>	14
<i>Sardinella anchoa</i>	14
<i>Neomerinthe hemingwayi</i>	13
<i>Paralichthys squamilentos</i>	11
<i>Serraniculus pumilio</i>	11
<i>Syacium papillosum</i>	11
<i>Balistes capriscus</i>	10
<i>Histrion histrio</i>	9
<i>Raja texana</i>	9
<i>Trichiurus lepturus</i>	9
<i>Anchoa mitchilli</i>	8
<i>Congrina flava</i>	8
<i>Engyophrys senta</i>	7
<i>Brevoortia gunteri</i>	5
<i>Etrumeus teres</i>	5
<i>Cyclopsetta fimbriata</i>	4
<i>Eucinostomus gula</i>	4
<i>Aluterus schoepfi</i>	3
<i>Bairdiella chrysoura</i>	3
<i>Paralichthys lethostigma</i>	3
<i>Serranus subligarius</i>	3
<i>Calamus nodosus</i>	2
<i>Sphoeroides dorsalis</i>	2
<i>Acanthostracion quadricornis</i>	1
<i>Epinephelus flavolimbatus</i>	1
<i>Kathelostoma albigutta</i>	1
<i>Myrophus punctatus</i>	1
<i>Antennarius scaber</i>	1
<i>Scomberomorus maculatus</i>	1
TOTAL	61385

Table 3. All species examined with size range, weight, number of "shrimp" and # Penaeus spp.

SPECIES	NUMBER	SIZE (SL) RANGE (MM)	MEAN LENGTH (mm)	MEAN WEIGHT (g)	TOTAL SHRIMP	#PENAEUS spp. SHRIMP
<i>Micropogonias undulatus</i>	2949	95-163	127.10	48.04	176	1
<i>Synodus foetens</i>	944	48-444	192.04	72.34	42	5
<i>Cynoscion nothus</i>	881	76-219	134.93	49.07	439	1
<i>Centropristis philadelphica</i>	459	85-224	120.15	46.83	110	1
<i>Lepophidium graellsii</i>	318	95-240	182.83	29.14	44	0
<i>Leiostomus xanthurus</i>	315	86-164	134.31	79.63	0	0
<i>Menticirrhus americanus</i>	257	112-282	174.33	128.82	45	0
<i>Diplectrum bivittatum</i>	134	87-115	101.00	26.01	41	0
<i>Urophycis floridana</i>	134	114-277	145.37	41.51	111	0
<i>Lutjanus campechanus</i>	118	65-200	107.31	45.73	20	0
<i>Cynoscion arenarius</i>	108	134-239	177.00	99.82	42	4
<i>Larimus fasciatus</i>	92	78-135	116.32	47.69	15	0
<i>Prionotus rubio</i>	70	72-163	124.53	44.48	12	0
<i>Lutjanus synagris</i>	65	82-190	114.14	52.90	10	1
<i>Scomber japonicus</i>	54	130-326	158.94	59.86	0	0
<i>Arius felis</i>	45	132-293	191.76	139.46	8	0
<i>Polydactylus octonemus</i>	42	72-130	110.10	32.48	49	0
<i>Prionotus salmonicolor</i>	34	98-155	129.94	47.37	4	0
<i>Chloroscombrus chrysurus</i>	32	99-172	125.50	39.88	0	0
<i>Stellifer lanceolatus</i>	30	72-112	86.30	18.54	7	0
<i>Saurida brasiliensis</i>	28	78-125	99.36	11.39	3	0
<i>Centropristis ocyura</i>	27	92-175	125.26	65.60	0	0
<i>Lagodon rhomboides</i>	24	91-147	119.54	54.27	0	0
<i>Prionotus tribulus</i>	24	100-145	121.75	38.19	8	0
<i>Stenotomus caprinus</i>	23	54-122	69.17	17.12	0	0
<i>Decapterus punctatus</i>	20	133-170	151.35	52.38	0	0
<i>Orthopristis chrysoptera</i>	20	112-176	135.85	67.64	0	0
<i>Priacanthus arenatus</i>	20	150-205	183.00	167.38	10	0
<i>Cyclopsetta chittendeni</i>	19	100-224	178.95	100.16	0	0
<i>Ophidion welshi</i>	19	174-236	200.42	49.25	0	0
<i>Porichthys plectrodon</i>	17	109-161	134.53	38.59	0	0
<i>Calamus nodosus</i>	16	121-162	137.56	109.61	0	0
<i>Ophidion holbrooki</i>	16	173-235	204.19	51.94	0	0
<i>Paralichthys lethostigma</i>	14	138-265	216.57	252.01	0	0
<i>Serranus atrobranchus</i>	13	71-88	80.38	17.12	1	0
<i>Gymnothorax nigromarginatus</i>	12	240-463	373.67	79.37	0	0
<i>Prionotus paralatus</i>	12	113-133	120.92	33.79	0	0
<i>Brotula barbata</i>	11	120-270	149.27	29.92	3	0
<i>Trichiurus lepturus</i>	11	372-560	446.55	50.27	1	0
<i>Citharichthys spilopterus</i>	10	70-119	91.40	19.20	0	0
<i>Cyclopsetta fimbriata</i>	10	118-227	184.30	114.73	0	0
<i>Mullus auratus</i>	10	92-146	115.60	39.44	10	0
<i>Chaetodipterus faber</i>	9	118-140	128.11	152.37	0	0
<i>Equetus umbrosus</i>	8	114-134	123.88	41.34	0	0
<i>Trachurus lathami</i>	8	142-156	150.00	59.49	0	0
<i>Prionotus roscus</i>	7	112-144	121.70	40.86	4	0
<i>Raja texana</i>	7	260-527	348.29	441.14	6	0

Table 3. continued

SPECIES	NUMBER	SIZE (SL) RANGE (mm)	MEAN LENGTH (mm)	MEAN WEIGHT (g)	TOTAL SHRIMP	#PENAEUS spp. SHRIMP
Rhizoprionodon terraenovae	7	140-600	267.57	369.86	0	0
Sardinella anchovia	7	173-186	177.43	91.46	0	0
Scorpaena calcarata	7	48-111	61.57	12.03	0	0
Sphyrna tiburo	7	343-662	470.57	788.61	5	0
Peprilus burti	6	72-136	89.33	33.47	1	0
Urophycis cirratus	6	111-140	125.17	17.37	6	0
Odontoscion dentex	5	105-117	109.20	31.46	4	0
Ancylosetta quadrocellata	4	123-197	176.50	137.53	0	0
Balistes capriscus	4	189-210	197.00	302.85	0	0
Mustelus canis	4	342-375	359.25	370.55	1	0
Opisthonema oglinum	4	162-166	164.25	107.25	0	0
Sphyraena guachancho	4	220-224	229.50	106.55	0	0
Trachinocephalus myops	4	118-130	123.75	25.40	0	0
Bairdiella chrysoura	3	109-119	114.00	32.93	0	0
Echeneis naucrates	3	189-655	467.33	650.55	0	0
Haemulon aurolineatum	3	136-140	138.00	73.37	0	0
Congrina flava	2	175-300	237.50	20.25	0	0
Conodon nobilis	2	128-152	140.00	77.40	0	0
Diplectrum formosum	2	163-166	164.50	103.75	0	0
Prionotus scitulus	2	100-115	107.50	24.25	2	0
Ancylosetta dilecta	1	174	174.00	146.30	0	0
Archosargus probatocephalus	1	191	191.00	269.00	0	0
Brevoortia gunteri	1	160	160.00	103.60	0	0
Carcharhinus limbatus	1	133	133.00	129.70	0	0
Carcharhinus porosus	1	330	330.00	581.00	0	0
Caulolatilus microps	1	190	190.00	131.20	0	0
Chilomycterus schoepfi	1	141	141.00	178.20	0	0
Dasyatis sabina	1	245	245.00	412.00	0	0
Lagocephalus laevigatus	1	103	103.00	31.10	0	0
Myrophus punctatus	1	400	400.00	54.30	0	0
Rypticus maculatus	1	116	116.00	41.60	0	0
Scomberomorus maculatus	1	345	345.00	420.50	0	0
Syacium papillosum	1	206	206.00	154.10	1	0
Symphurus plagiusa	1	114	114.00	16.50	0	0
TOTAL	7598					

Table 4. Fish species in which penaeid shrimp were found, standard length, weight and stomach fullness, along with shrimp tail length.

Species	STANDARD LENGTH (mm)	WEIGHT (g)	% STOMACH FULLNESS	SPECIES OF PENAEID	TAIL LENGTH (mm)
<u>Synodus foetens</u>	244	152.7	50	Brown	53
	204	91.7	75	Brown	44
	174	47.6	50	Brown	24
	165	39.3	50	Brown	46
	178	57.2	50	Brown	53
<u>Centropristis philadelphica</u>	119	43.5	50	Brown	20
<u>Lutjanus synagris</u>	190	234.0	75	Brown	43
<u>Cynoscion arenarius</u>	203	84.2	50	Brown	60
	227	189.6	50	Brown	62
	229	216.2	50	Brown	62
	210	168.5	75	Brown	51
<u>Cynoscion nothus</u>	190	113.1	50	Brown	45
<u>Micropogonias undulatus</u>	149	71.4	75	Brown	no length taken

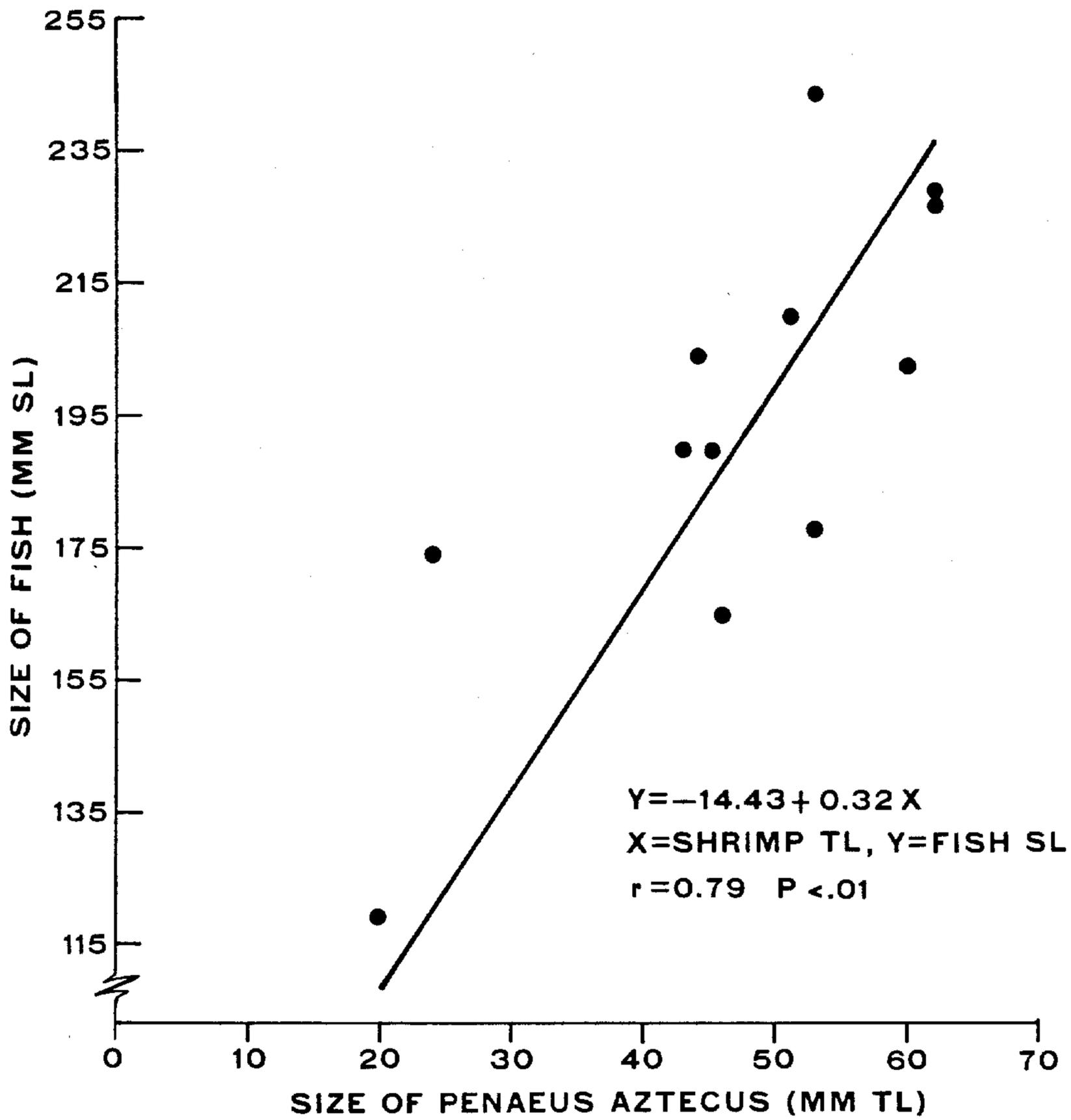


Figure 2. Correlation between fish size and size of consumed Penaeus aztecus.

## DISCUSSION

In a recent digestion study utilizing Arius felis and Micropogonias undulatus<sup>1</sup>, it was determined that it takes 4 to 5 hours for these fish to digest Penaeus aztecus to an unrecognizable state. The shrimp removed from the stomachs examined in the present study apparently were preyed upon within 3 to 4 hours of capture. All Penaeus spp. removed from the fish stomachs were identified as brown shrimp (P. aztecus). All identified brown shrimp had intact grooved rostrums, some had tail grooves present.

Aside from the P. aztecus found, a total of 9230 shrimps were found in the examined fish stomachs. These shrimps consisted mainly of Trachypenaeus similis, as large as 45 mm tail length. Mysid shrimp and Sicyonia spp. also occurred but in lower numbers.

In this study, fishes preying upon P. aztecus were from 119 to 244 mm SL (Table 4). Penaeus spp. shrimp were found in low numbers in the stomachs of suspect species, i.e., croaker (M. undulatus), trout (Cynoscion spp.), flounder (Bothidae), catfish (A. felis), seabasses (Serranidae) and lizard fish (Synodus foetens).

Although the results from this study indicate that during the summer month of June Penaeus spp. were not found as dominant food source in the carnivorous fish captured, this does not necessarily mean that these fishes do not feed on Penaeus spp. during later developmental stages. Richard Christian, Biologist, LGL Associates (personal communication), while tagging white shrimp near West Hackberry site in Louisiana, examined hardhead catfish (A. felis) and Atlantic Sharpnose shark (Rhizoprionodon terraenovae) 450-600 mm (SL) and found several white shrimp in stomachs of each species.

<sup>1</sup>"Digestion rates on Penaeid shrimp", Divita et. al, 1981

According to Landry and Armstrong (1981), the following trophic analysis was made for the more dominant species occurring in the Gulf of Mexico. P. aztecus and P. setiferus were found in sea catfish stomachs, but were not considered a major food source during the summer. Sand seatrout taken during the fall continued to subsist on sergestid shrimp and fishes, particularly anchovies, but exhibited a preference (50%) for penaeid shrimp (P. aztecus and P. setiferus). The sand sea trout did not show preference for penaeids during summer. Silver seatrout stomachs yielded penaeid and sergestid shrimp, especially Acetes americanus, and engraulid fishes as dominant food items during summer. There was no mention of Penaeus spp. in stomachs from the Atlantic croaker. A small percent of penaeids were taken from the star drum (Stellifer lanceolatus) stomachs in the spring (1978-1979) samples.

The absence of Penaeus spp. shrimp in the fish stomachs examined in this study could possibly be attributed to the size and development stage of the fishes. Dr. Andre Landry, Texas A&M at Galveston Department of Marine Biology (personal communication), stated that in taking trawl specimens during spring (May-July) the majority of the catch would be smaller fishes, 50-200 mm SL. At this size, swimming speed and behavior could limit their ability to prey on large P. aztecus, and these small fish were more likely to prey on smaller finfish. In this study, there was a direct correlation between fish size and size of consumed P. aztecus, 99% of the time (Fig. 2).

Future studies using mid-water trawls and gill nets might be more successful at collecting larger fish. Gut analyses of larger fish stomachs might show an increased utilization of Penaeus spp. as a food source.

### Literature Cited

Landry, A. M. and H. W. Armstrong, 1981. Demersal fishes and Macrocrustaceans, NOAA Tech. Mem. NMFS-SEFC-28.