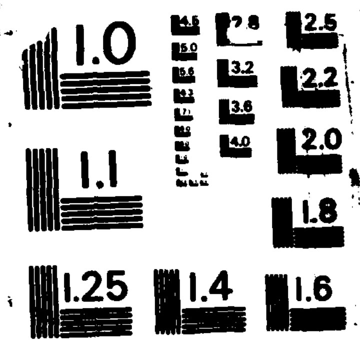
AD-A187 676 ENVIRONMENTAL IMPACT RESEARCH PROGRAM ECOLOGICAL 1/2
EFFECTS OF RUBBLE WEIR J..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS ENVIR..
UNCLASSIFIED R F VAN DOLAH ET AL. AUG 87 WES/TR/EL-84-4 F/G 8/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

US Army Corps
of Engineers

AD-A187 676

ENVIRONMENTAL IMPACT
RESEARCH PROGRAM

DTIC FILE COPY

TECHNICAL REPORT EL-84-4

ECOLOGICAL EFFECTS OF RUBBLE WEIR JETTY CONSTRUCTION AT MURRELLS INLET SOUTH CAROLINA

VOLUME III: COMMUNITY STRUCTURE AND HABITAT UTILIZATION OF FISHES AND DECAPODS ASSOCIATED WITH THE JETTIES

by

Robert F. Van Dolah, Priscilla H. Wendt, Charles A. Wenner,
Robert M. Martore, George R. Sedberry, Charles J. Moore

South Carolina Wildlife and Marine Resources Department
Marine Resources Research Institute
Charleston, South Carolina 29412

August 1987

Final Report

Approved For Public Release. Distribution Unlimited

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

Under EIRP Work Unit 31532

Monitored by Environmental Laboratory
US Army Engineer Waterways Experiment Station
PO Box 631, Vicksburg, Mississippi 39180-0631

87 6

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY 2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) Technical Report EL-84-4
6a. NAME OF PERFORMING ORGANIZATION See reverse. — 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION USAEWES Environmental Laboratory
6c. ADDRESS (City, State, and ZIP Code) Charleston, SC 29412	7b. ADDRESS (City, State, and ZIP Code) PO Box 631 Vicksburg, MS 39180-0631
8a. NAME OF FUNDING / SPONSORING ORGANIZATION US Army Corps of Engineers — 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Washington, DC 20314-1000	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification) Ecological Effects of Rubble Weir Jetty Construction at Murrells Inlet, South Carolina; Volume III: Community Structure and Habitat Utilization of Fishes and Decapods Associated with the Jetties

12. PERSONAL AUTHOR(S)
See reverse.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final report (3 vols)	FROM ______ TO ______	August 1987	164

16. SUPPLEMENTARY NOTATION
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	See reverse.

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Quarrystone jetties at Murrells Inlet, South Carolina, were studied over a 1-year period to: (a) identify changes in the distribution, relative abundance, and composition of fish and crab assemblages, (b) characterize the food habits of most fish species collected, and (c) identify seasonal patterns in recreational fishing activities around the jetties. Fishes were assessed using gill nets, traps, and rotenone collections and by diver surveys; crabs were sampled using traps. Fish food habits were determined through stomach content analyses, and interview-count surveys were used to identify recreational fishing activities.

Seventy-five species of fish representing [illegible] families were captured or observed around the jetty rocks. Distinct seasonal differences were observed in the community composition, as well as in the overall abundance of fishes collected or observed. The jetties generally attracted fish species that are normally associated with reef structures,

(Continued)

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

6a. PERFORMING ORGANIZATION (Continued).

South Carolina Wildlife and Marine Resources Department
Marine Resources Research Institute

12. PERSONAL AUTHOR(S) (Continued).

Van Dolah, Robert F.; Wendt, Priscilla H.; Wenner, Charles A.; Martore, Robert M.; Sedberry, George R.; Moore, Charles J.

18. SUBJECT TERMS (Continued).

Decapods,	Fishery resources,	Murrells Inlet, South Carolina
Fish community structure,	Habitat utilization,	Recreational fishery
Fish food habits,	Jetties,	

19. ABSTRACT (Continued).

species that are commonly found around estuarine inlets, and species that seasonally migrate along the coast. The jetties also appear to serve as nursery habitat for a variety of fish species.

Stomach content analyses of 55 species identified three major trophic groups: fish that are mostly piscivorous, fish that feed primarily on sand bottom epifauna, and fish that feed primarily on jetty biota or zooplankton. Several of the recreationally important species feed directly on the jetty fauna, or on smaller fishes which consume jetty biota.

Stone crabs were numerically dominant among the eight species of crabs captured by trap around the jetty rocks. Stone crab catches were greatest in spring and declined in all subsequent seasons. More stone crabs were captured on the exposed versus channel side of the jetty, and most were caught at night. The Murrells Inlet jetties do not appear to support more than an incidental stone crab fishery.

Considerable recreational fishing was observed around both the north and south jetties, with most fishing activity observed on weekend days. Interviewed anglers primarily sought red drum, flounder, spot, bluefish, king mackerel, and sheepshead; however, black sea bass and smooth dogfish were the species most frequently caught. The numbers of fishes and fish species caught by fishermen were greatest during the summer, and more fish were captured around the jetty structures than in nonjetty areas.

PREFACE

This report describes the results of field investigations on the ecological effects of rubble weir jetty construction at Murrells Inlet, South Carolina. The study was conducted by the Marine Resources Research Institute of the South Carolina Wildlife and Marine Resources Department. Funding was provided under Work Unit 31532 of the Environmental Impact Research Program (EIRP), which is sponsored by the Office, Chief of Engineers (OCE), US Army, and assigned to the US Army Engineer Waterways Experiment Station (WES). Technical Monitors were Dr. John Bushman and Mr. Earl Eiker of OCE and Mr. David Mathis, Water Resources Support Center. Dr. Roger T. Saucier of the WES Environmental Laboratory (EL) was the Program Manager of the EIRP.

The report was prepared by Dr. Robert F. Van Dolah, Ms. Priscilla H. Wendt, Dr. Charles A. Wenner, Mr. Robert M. Martore, Dr. George R. Sedberry, and Mr. Charles J. Moore. The authors wish to thank Randy Beatty, Bill Roumillat, and Jack McGovern for their assistance in the fieldwork; Margaret Lentz, who typed all drafts of this report; and Karen Swanson, who prepared all figures for the report. The report was edited by Ms. Jessica S. Ruff of the WES Information Products Division.

Dr. Douglas G. Clarke served as contract monitor for this study under the general supervision of Mr. Edward J. Pullen, Chief, Coastal Ecology Group; Dr. Conrad J. Kirby, Chief, Environmental Resources Division; and Dr. John Harrison, Chief, EL.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is the Technical Director.

This report should be cited as follows:

Van Dolah, R. F., et al. 1987. "Ecological Effects of Rubble Weir Jetty Construction at Murrells Inlet, South Carolina; Volume III: Community Structure and Habitat Utilization of Fishes and Decapods Associated with the Jetties," Technical Report EL-84-4, prepared by South Carolina Wildlife and Marine Resources Department, Charleston, S. C., for US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

TABLE OF CONTENTS

VII. APPENDIXES

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

In 1980, construction was completed on a rubble jetty system designed to stabilize the entrance channel at Murrells Inlet, South Carolina. The jetty rocks also provided a major new type of habitat in an area previously characterized by sandy beaches with very little hard substratum. Since the initiation of jetty construction in 1977, the US Army Engineer Waterways Experiment Station (WES) has funded three phases of a major research project designed to evaluate the ecological effects of this jetty construction. The first two phases: (1) evaluated the influence of jetty construction on nearby intertidal and subtidal macrobenthic communities, and (2) evaluated the recruitment and community development of biota associated with the jetty rocks. Results obtained from those studies have provided a comprehensive data base on the biological changes which occurred over a five-year period following jetty construction (Hales and Calder, 1979; Knott et al., 1983, 1984; Van Dolah et al., 1984). However, the primary focus of that research was directed toward an assessment of the invertebrate and algal communities present, and only limited information was obtained on the fish assemblages attracted to the jetties.

Since their completion, the Murrells Inlet jetties have attracted a large number of sport fishermen who live or vacation in the "Grand Strand" area. These jetties are particularly attractive as a recreational fishing site because both jetty structures can be easily reached with small boats, and an asphalt walkway on the south jetty makes it available to fishermen without boats. Although Murrells Inlet has always attracted sport fishermen, it is obvious that the jetties have improved sport fishing opportunities in the area.

Studies conducted in Florida and elsewhere have shown that rock jetties and other rubble structures function well as artificial reef habitat and improve angling in nearshore areas (Hastings, 1978; Hurme, 1979; Buckley, 1982; Grant et al., 1982; Bohnsack and Sutherland, 1985; Burchmore et al., 1985; Lindquist et al., 1985). However, detailed information on the fish communities associated with rubble structures and other nearshore artificial reefs in South Carolina has been lacking, and only limited information is available on how these fishes are utilizing the jetty rocks (Van Dolah et al., 1984). Additionally, no information has been available on the utilization by sport fishermen of recreationally important species at Murrells Inlet and other rubble jetties along the South Carolina coast.

This report describes the third phase of the WES study at Murrells Inlet. Specific objectives of this study phase were to:

1. analyze the species composition and relative abundance of fishes present around the Murrells Inlet jetties and document the seasonal changes which occur in those fish assemblages,
2. assess seasonal variability in the abundance of recreationally and commercially important decapods (*Menippe mercenaria* and *Callinectes sapidus*) near the jetties,
3. determine if differences exist in the community composition and abundance of fishes and decapods on the wave-exposed versus channel side of the north jetty,
4. characterize the food habits of the recreationally important fish species and the other fishes associated with the jetty rocks and
5. evaluate seasonal differences in recreational fishing, crabbing, and shrimping near the Murrells Inlet jetties.

II. DESCRIPTION OF THE STUDY AREA

Murrells Inlet is located on the northeastern coast of South Carolina within an economically important tourist area known as the Grand Strand. The inlet is relatively small and supports a coastal marsh system of approximately 721 ha. Murrells Inlet is isolated from inland water bodies and the Atlantic Intracoastal Waterway. As a result, salinities in the area are relatively high and stable. The mean tidal range at Murrells Inlet is 1.4 m (National Ocean Survey, 1986).

The beaches and nearshore sediments in the vicinity of Murrells Inlet consist primarily of medium to fine quartz sand with varying amounts of shell fragments (for additional details, see Knott et al. 1984). Shallow nearshore hard-bottom reef habitat has been identified approximately 5 km to the northeast of the jetties off Garden City (Van Dolah and Knott, 1984) and approximately 7.5 km to the southwest off Pawleys Island (Parker et al., 1979); however, no known reef habitat has been found in closer proximity to the inlet. Wave energy in the study area is moderate because waters are shallow for a considerable distance offshore.

Construction of the jetties began in October 1977, and all work was completed by May 1980. The north jetty extends approximately 1020 m into the ocean with a 411-m weir section forming the landward portion (Fig. 1). This weir is a portion of the rock jetty built to a much lower height (approximately mean low water) and designed to allow sand to pass over the weir and settle into a dredged deposition basin. The south jetty extends 1011 m seaward. This jetty has no weir and is topped with an asphalt walkway. Approximate heights of the north and south jetties range from 2.5 to 3.5 m above mean low water (MLW) except at the weir, where the height is approximately 0.7 m above MLW. Crest width of both jetties is about 6 m, and the sides slope at an angle of 45 deg (1V:1H). Granite armor stones of the jetties vary between 5.4×10^3 kg and 9.1×10^3 kg, and individual stone faces vary from horizontal to vertical. Much smaller stones of various sizes are present at the base of each jetty to prevent erosion around the armor stones.

Since completion of construction, there has been considerable shoaling around both jetties. At the present time, most of the south side of the south jetty is completely exposed at low tide, with only the rocks along the outermost portion submerged in 1 to 2 m of water (Figs. 1 and 2). The smaller base stones along the entire length of the channel side of this jetty are also often exposed during low-tide periods. The water is deeper around most of the north jetty except for a 200-m section on the channel side near the deposition basin which is exposed at low-tide periods (Fig. 1). Tidal scouring has kept the water depths along the channel side of the north jetty relatively deep near the seaward end (> 7 m), but the exposed side of this jetty has shoaled during the last five years, so that water depths now range from approximately 2 m near the outer portion of the weir to approximately 3 m near the seaward end at low tide.

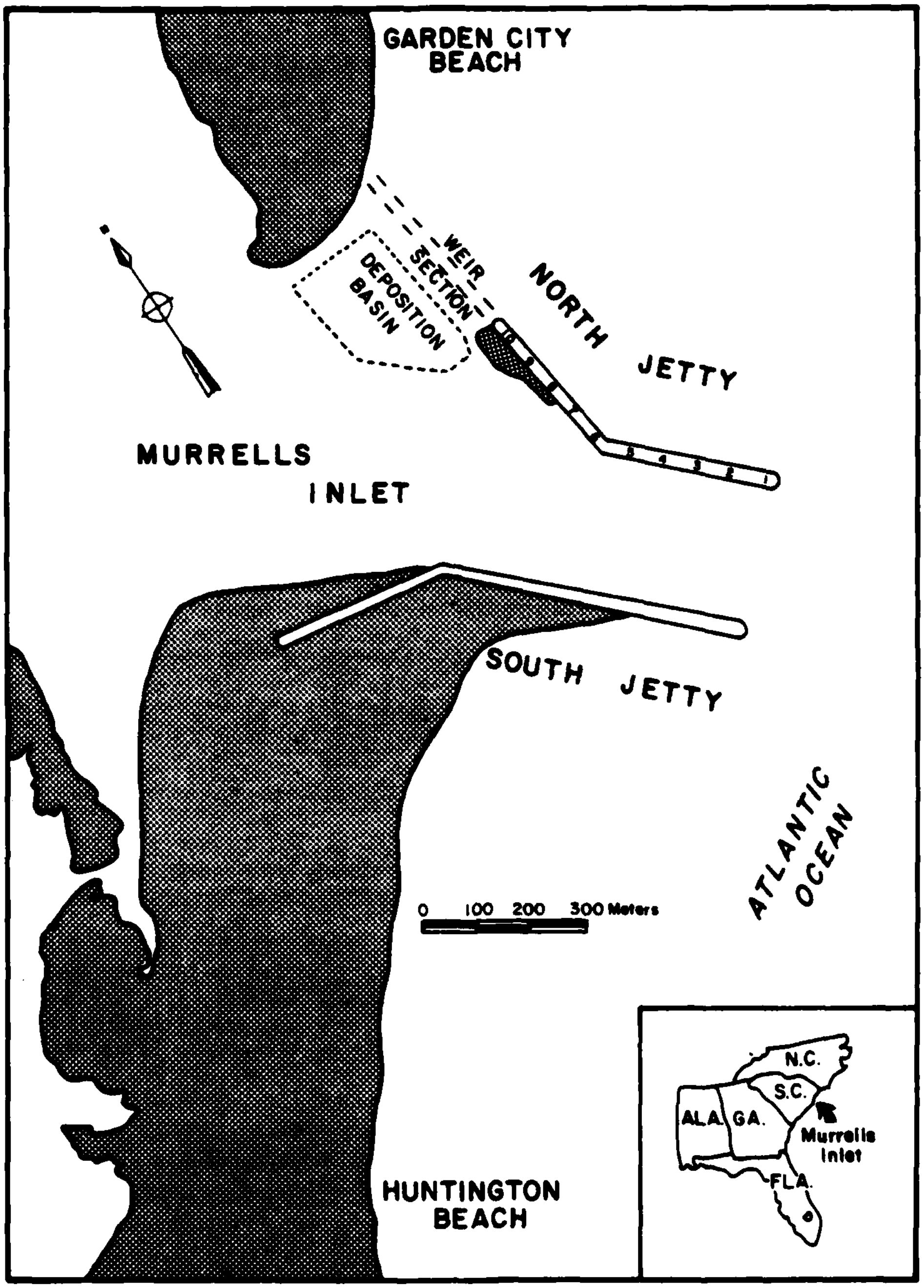


Figure 1. Map of the Murrells Inlet jetties with the locations of benchmarks (1-10) shown on the north jetty. Shaded areas represent beach exposed at low tide periods.

A

B

C

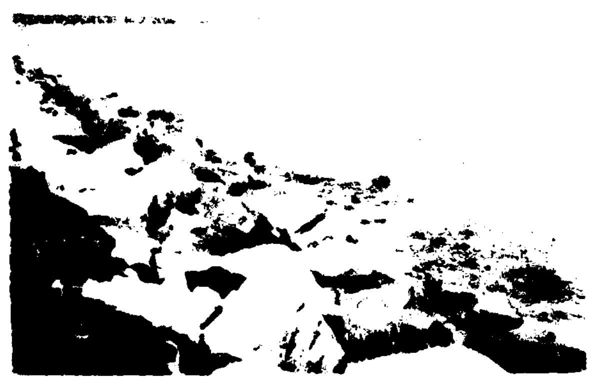


Figure 2. Photographs depicting shoals around the Murrells Inlet jetties. (A) Aerial view showing buildup of Huntington Beach. This photograph was taken near high tide. (B and C) Landward views from the end of the south jetty at low tide. Photograph (B) shows the exposed (Huntington Beach) side and photograph (C) shows the channel side. Note exposure of the smaller base rocks on both sides.

III. METHODS

Sampling was conducted around the north and south jetties at three-month intervals for a period of one year. The quarterly sampling dates were:

Spring	April 13 - April 26, 1985
Summer	August 10 - August 24, 1985
Fall	October 20 - November 2, 1985
Winter	January 11 - February 4, 1986

Both jetties were surveyed prior to initial sampling to determine which sections were suitable for gear deployment. Around the north jetty, sampling was restricted to the offshore portion of the jetty, extending from the seaward end of the weir to the seaward end of the jetty. Benchmarks were painted at 50-m intervals along this section on both sides of the jetty (Fig. 1) and were used for randomly selecting specific sites to deploy the various fishing gears. Shoals precluded sampling along the weir section of the north jetty, and a large shoal also restricted trap deployment on the channel side to the area between benchmarks 1 and 7. Because of shoaling, as discussed in Section II, only the outer portion of the south jetty could be effectively sampled for fish. No benchmarks were placed on this jetty since only three sites could be fished with appropriate separation between the fishing gear. The entire outer inlet area encompassing both jetties was surveyed for recreational fishing activities.

1. Fish Community Assessment

Gill Net Collections: Three gill nets constructed of 30.5-m lengths of 2.44-m-deep, sinking monofilament with stretched mesh sizes of 6.35 cm (2.5 in), 7.62 cm (3 in), and 10.16 cm (4 in) were set on the outside of the north and south jetties. The relative positions of the three nets were randomly selected. Each net was deployed for three 3-hr set periods during every season. The nets were spaced approximately 100 m apart to minimize competition between them. All nets were set using 40.6-cm tuna floats attached to each end of the headline and 6.8-kg mushroom anchors tied to the ends of the leadline. One end of each net was set among the submerged rocks. The boat was then backed away from the jetty at an acute angle so that the distance of the outer end of the net was approximately 23 m from the rocks.

Nets were checked about every 45 min, and fishes were removed, placed in coolers, and covered with crushed ice. At the dock, fishes were sorted to species, counted, and measured for total length (TL), standard length (SL), fork length (FL), or disc width (DW-for skates and rays). Each fish was weighed to the nearest gram, and stomachs were removed and preserved in 10 % formalin-seawater.

Trap Collections: Commercial blue crab traps were covered with 6.35-mm hex mesh netting and baited with cut herring (*Alosa* sp.). The netting retained small fishes that would have passed through the regular trap wire. Six traps were randomly placed at the base of the jetty rocks on both the inside and outside of the north and south jetties. The traps were fished for three hours. The contents of each trap were identified to species, counted, weighed to the nearest gram, and measured to the nearest millimeter (TL and SL).

Rotenone Collections: Since nets and traps failed to collect small, cryptic species such as blennies and gobies that were closely associated with the rocks, a small area on the inside of the north jetty was sampled with rotenone (benchmarks 7 and 8, Fig. 1). A single qualitative collection was made each season during low tide by placing rotenone in the small pools formed by the jetty rocks. This was mixed by the surge which flowed through the spaces between rocks. Stressed fishes which surfaced in these pools were collected by dipnets. Other fishes washed out of the rocks by the surge were caught in seine hauls along the edge of the jetty base. Fishes were immediately preserved in 10 % formalin-seawater. In the laboratory, the fishes were washed in tap water, sorted to species, counted, measured, weighed, and stored in 50 % isopropyl alcohol.

Diver Surveys: An underwater visual survey of the fish assemblages present along both sides of the north jetty was conducted by SCUBA divers using the following census technique. Four sampling areas extending from benchmarks 1 through 5 and 6 through 10 on the exposed and channel sides, respectively, were selected for the visual survey (Fig. 1). The starting point of the survey within each area was determined by swimming a random number of kicks from one end of the area. The divers then laid a survey line, marked in 1-m intervals, from the exposed rocks at the high-tide level to the bottom of the jetty. One diver then began a 5-min count, recording all fish observed along a 2-m path bisected by the line. A total of 4 min was spent looking for cryptic and demersal species among the rocks (2 min lower zone, 2 min upper zone) and 1 min looking for pelagic species in the water column (30 sec at the bottom, 30 sec at the surface). Estimates of the minimum, maximum, and average length of each species were also noted during the 5-min count, along with a notation of the observed location of each species relative to depth. Schools of fish were roughly estimated by 10's, 20's, 100's, etc. The divers then swam to the next location using a random number of kicks to conduct a second 5-min count and continued this process until 10 counts had been completed. During each count, the censusing diver's partner kept time. The number of kicks made between stops was predetermined using a random numbers table, but swimming distances were sufficient to ensure that approximately 100 m of jetty length was assessed in each of the four areas. All diver surveys using this technique were conducted at or near high tide. The choice of ten 5-min counts in each area was based on diver bottom-time constraints.

Additional dives were conducted to: (1) make qualitative behavioral observations on the different fish species, (2) capture additional fishes for food habits analysis, (3) place traps and other fishing devices in appropriate locations, and (4) make qualitative observations on the invertebrate and algal assemblages present for comparison with previous study findings (Van Dolah et al., 1984).

2. Fish Food Habits Assessment

Most fishes examined for food habits were collected from gill nets or traps or by hook-and-line fishing. Some cryptic species were taken from rotenone collections, and a few fish were captured by divers. Attempts were made to collect at least 25 specimens of each species present. Stomachs from all fish collected in the field were individually labeled, wrapped in cheesecloth, and preserved in a 10 % formalin-seawater solution. Small fishes were preserved whole.

In the laboratory, stomach contents were identified to the lowest taxon possible and counted. For sheepshead (Archosargus probatocephalus) and black drum (Pogonias cromis), which have no clearly defined stomach, the contents of the anterior fourth of the digestive tract were examined. Colonial forms and fragments of animals were counted as one organism unless abundance could be estimated by counting pairs of eyes (crustaceans), otoliths (fishes), or other parts. The volume displacement of most prey taxa was measured using a graduated cylinder or estimated using a 0.5-cm^2 grid (Windell, 1971).

Since methods of food habits quantification are variously biased (Hynes, 1950; Pinkas et al., 1971; Windell, 1971), the relative contribution of different food items to the total diet was determined using three methods: percent frequency of occurrence (F), percent numerical abundance (N), and percent volume displacement (V).

3. Crab Assessment

Large crab species present around the jetties were sampled by deploying six sets of five standard blue crab traps (62 x 62 x 62 cm) among the rocks along each side of the north jetty. Specific fishing locations used during each set were randomly selected from among the benchmark locations on the jetty. All traps were placed near the base of the jetty. The traps were buoyed at the surface and retrieved after 12-hr soak periods. Diel differences in trap catches were evaluated by deploying the traps in three replicate sets during daylight hours and three replicate sets during night hours. Captured crabs were weighed, measured for carapace width, and tagged with a Floy tag prior to being released. Crabs captured during the spring were not tagged but were marked on the back to identify recaptures.

4. Survey of Recreational Fishing Activities

An interview-count survey was conducted to evaluate fishing activities and species harvested by sport fishermen in the vicinity of the Murrells Inlet jetties. Individuals harvesting crabs and shrimp recreationally were also surveyed. Surveys were conducted on four weekend days and four weekdays during each quarterly sampling period. Counts of recreational fishermen utilizing various parts of the jetties and the surrounding area were made four times per day (8 am, 11 am, 2 pm, 5 pm) in order to map areas of heavy fishing pressure during different tidal stages. Zones surveyed in the vicinity of the jetties are depicted in Fig. 3. Surveyors approximated the location of fishermen (stationed on boats, the beach, or the jetties), who were actively engaged in recreational fishing, crabbing, or shrimping within any of these zones.

During the remainder of each day, surveyors interviewed fishermen within the sampling area. Information gathered from anglers included their residence (county and state), number of hours fished, fishing methods, fish species sought, and the number and species of fish caught. The number of crabs and/or pounds of shrimp harvested was also recorded. With the angler's permission, fish caught were identified and measured for total length.

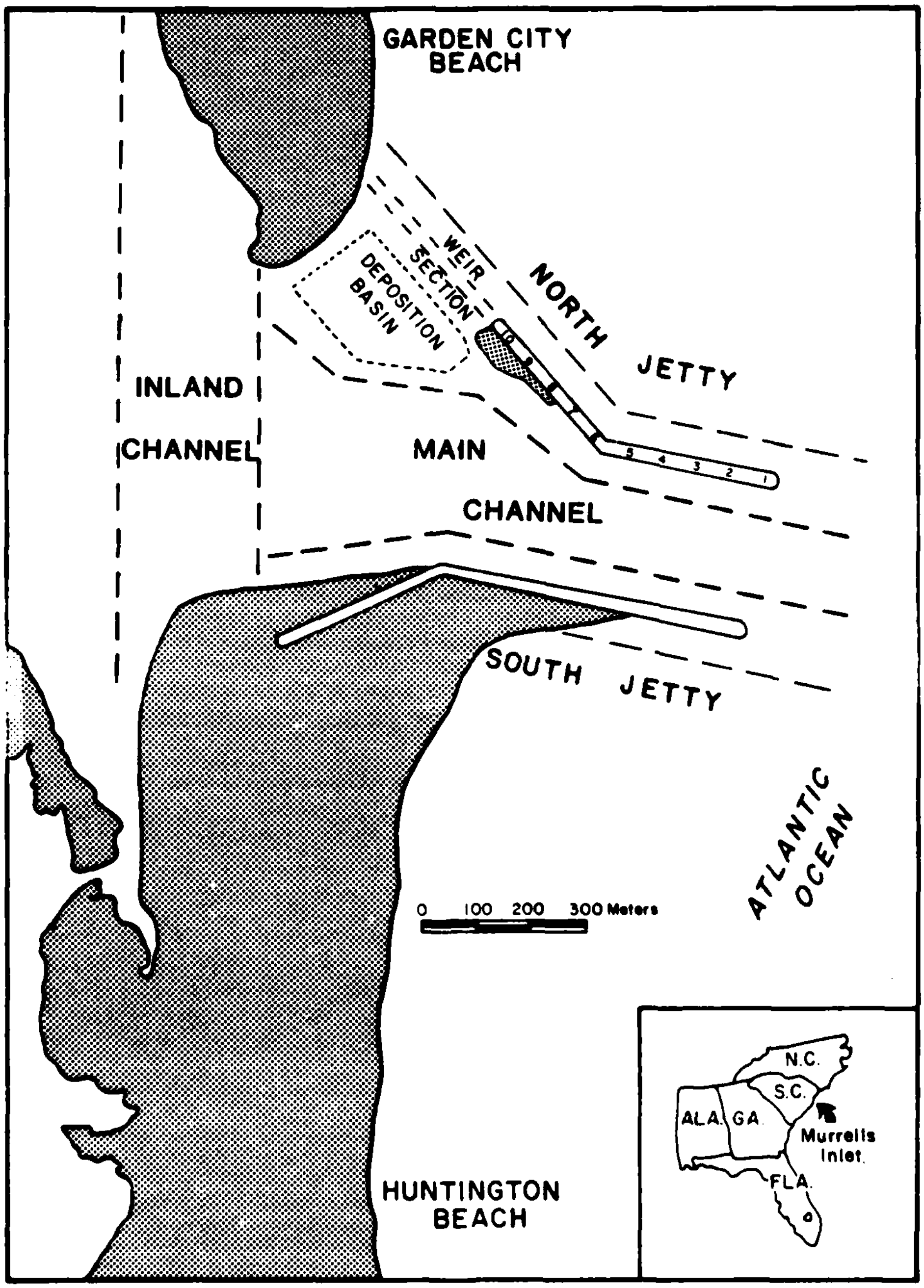


Figure 3. Map showing areas around the Murrells Inlet jetties which were surveyed for fishing activities.

5. Data Analyses

The Bray-Curtis similarity index (Bray and Curtis, 1957) and the flexible sorting algorithm, with a cluster intensity coefficient (β) of -0.025 (Lance and Williams, 1967) were used to compare 1) gill net collections, 2) diver observations and 3) food habits of fishes. Prior to calculating the similarity values, log-transformed abundances from all three gill net collections and untransformed abundances from diver observations were pooled by site and season. Only those species that occurred in two or more pooled gill net collections were included in the cluster analysis. For the food habits analysis, the Bray-Curtis index was applied to untransformed percent volume displacement data for each predator (for each season separately, and for all seasons combined). Cluster analysis was subsequently performed on the pooled volumetric data for those predators represented by at least five specimens each. Rotenone collections were compared between seasons using a percent similarity index developed by Whittaker and Fairbanks (1958). Stone crab catches were compared with respect to location on the jetty, time of set and sex ratio using one-way analyses of variance based on crab abundances subjected to a log (x + 1) transformation.

IV. RESULTS AND DISCUSSION

1. Fish Community

Gill Net Collections: The 72 gill net sets made during this study collected 1,662 fishes representing 48 species and 23 families, with a total weight of 843.5 kg (Table 1). This resulted in an overall average of 23 fishes/set with a weight of 11.7 kg. The highest catch/set values were in spring outside the south jetty for each of the three net sizes (Figs. 4-6, Table 2). These nine collections accounted for 47.7 % of the total number and 66.1 % of the total weight of fishes taken during the entire study. The most abundant species during this season were smooth dogfish (Mustelus canis), bluefish (Pomatomus saltatrix), and clearnose skate (Raja eglanteria) (Table 1). Summer gill net catches were dominated by Spanish mackerel (Scomberomorus maculatus), bluefish (P. saltatrix), Atlantic menhaden (Brevoortia tyrannus), and spot (Leiostomus xanthurus); whereas only spot were abundant during the fall. The lowest catch rates and diversity occurred during winter when all three net types caught only 15 individuals representing six species, with a weight of 13.7 kg.

Normal cluster analysis of the pooled data (collections of all three nets for a given site and season) gave three station groups (Figure 7). The main division in the dendrogram separated the winter gill net collections on both the north and south jetties from all other collections. This separation demonstrated the dissimilarity in the species composition of the winter samples (Group 3) and those from the other seasons. Group 1 contained spring catches from both jetties, and Group 2 contained those from summer and fall.

Inverse analysis (species cluster) gave five groups containing from three to nine species each (Table 3). Group A included eight species that were rare in winter and common in collections from other seasons. Groups C and D included fishes that were primarily summer and fall species, whereas those in E were most abundant in winter. Taxa in Group B were rare in spring, summer, and fall and were absent in winter.

Trap Collections: The modified commercial blue crab traps caught 573 individuals representing ten species and ten families, with a total weight of 29.7 kg. Atlantic silverside, Menidia menidia, was the numerically dominant species, however, it was taken only during the spring (Table 4). Black sea bass, Centropristis striata, contributed the greatest proportion by weight and was caught during all seasons except winter (Table 4).

There was a significant difference between seasons in the frequency of occurrence of fishes in traps ($G = 27.861$, $df = 3$, $p < 0.01$). Only three of the 24 traps fished during the winter sampling period caught fishes. Of the 24 traps in spring, 21 had fishes, whereas 19 and 13 contained fishes in summer and fall, respectively. Mean catch per trap was an order of magnitude higher in spring than in either summer or fall, and two orders of magnitude higher than in winter (Table 5). Spring samples also had a greater average weight per trap and more species. Lowest catch rates and diversity were observed during winter.

Although absent in the winter traps set, black sea bass was the most frequently collected species during other seasons, being present in 40 of the

Table 1. Seasonal species composition, numbers, and weights of fishes collected in 3-hr gill net sets outside the north and south jetties at Murrells Inlet, South Carolina. Weight units are kilograms; asterisks denote trace weights.

Family	Species	Spring No.	Spring Weight	Summer No.	Summer Weight	Fall No.	Fall Weight	Winter No.	Winter Weight
Carcharhinidae	Mustelus canis	467	408.7	1	0.3	---	-----	---	-----
	Rhizoprionodon terraenovae	1	0.9	---	-----	---	-----	---	-----
Sphyrnidae	Sphyrna tibure	1	0.7	3	8.0	---	-----	---	-----
Rajidae	Raja eglanteria	81	53.9	---	-----	---	-----	---	-----
Dasyatidae	Dasyatis sabina	2	2.1	---	-----	---	-----	---	-----
	Dasyatis sayi	---	-----	1	1.2	---	-----	---	-----
	Gymnura micrura	3	1.4	2	1.2	---	-----	---	-----
Myliobatidae	Myliobatis freminvillei	8	5.1	---	-----	---	-----	---	-----
	Rhinoptera bonasus	---	-----	---	-----	1	1.5	---	-----
Elopidae	Elops saurus	---	-----	1	0.2	4	0.8	---	-----
Clupeidae	Alosa aestivalis	5	0.9	---	-----	---	-----	---	-----
	Alosa mediocris	3	1.8	---	-----	---	-----	3	1.7
	Alosa sapidissima	5	7.5	---	-----	---	-----	5	10.6
	Brevoortia smithi	---	-----	---	-----	2	1.1	---	-----
	Brevoortia tyrannus	1	0.4	36	5.3	4	0.8	1	0.4
	Dorosoma cepedianum	3	1.6	---	-----	---	-----	---	-----
	Opisthonema oglinum	---	-----	12	1.4	---	-----	---	-----
Engraulidae	Anchoa hepsetus	1	*	1	*	---	-----	---	-----
Ariidae	Arius felis	---	-----	3	0.9	---	-----	---	-----
Serranidae	Centropristis striata	---	-----	---	-----	3	0.7	---	-----
Pomatomidae	Pomatomus saltatrix	189	76.6	67	24.5	18	8.2	---	-----
Carangidae	Caranx hippos	---	-----	7	0.6	---	-----	---	-----
	Chloroscombrus chrysurus	1	0.1	1	0.1	---	-----	---	-----
	Selene setipinnis	---	-----	---	-----	2	0.2	---	-----
	Selene vomer	---	-----	3	0.4	12	2.8	---	-----
	Trachinotus carolinus	---	-----	8	1.1	---	-----	---	-----
Haemulidae	Orthopristis chrysoptera	---	-----	1	0.5	---	-----	---	-----
Sparidae	Archosargus probatocephalus	---	-----	1	0.4	7	10.0	---	-----
	Diplodus holbrooki	---	-----	---	-----	2	0.2	---	-----
	Lagodon rhomboides	---	-----	7	0.8	2	0.2	---	-----
Sciaenidae	Cynoscion nebulosus	---	-----	18	7.7	4	2.0	---	-----
	Cynoscion regalis	7	4.3	3	1.5	4	1.9	---	-----
	Leiostomus xanthurus	4	0.4	27	4.2	306	57.3	3	0.5
	Menticirrhus americanus	1	0.8	1	0.4	3	0.8	---	-----
	Menticirrhus littoralis	25	10.2	6	1.9	16	7.2	---	-----
	Micropogonias undulatus	---	-----	5	0.8	---	-----	---	-----
	Pogonias cromis	3	7.7	2	2.6	4	3.2	---	-----
	Sciaenops ocellatus	---	-----	2	0.6	7	4.5	---	-----
Ephippidae	Chaetodipterus faber	---	-----	6	2.7	2	1.2	---	-----
Labridae	Tautoga onites	2	0.5	6	5.0	4	2.6	---	-----
Mugilidae	Mugil cephalus	---	-----	10	3.1	1	0.8	---	-----
Uranoscopidae	Astroscopus y-graecum	---	-----	1	0.2	---	-----	---	-----
Scombridae	Scomberomorus cavalla	---	-----	1	0.1	---	-----	---	-----
	Scomberomorus maculatus	1	1.6	136	40.4	10	4.6	---	-----
Stomateidae	Peprilus alepidotus	22	3.1	1	0.1	2	0.1	---	-----
Bothidae	Paralichthys lethostigma	2	1.8	2	1.9	3	4.5	1	0.2
	Scophthalmus aquosus	---	-----	---	-----	1	0.1	2	0.3
Soleidae	Trinectes maculatus	1	0.1	1	0.1	---	-----	---	-----
TOTAL		840	592.3	383	119.9	424	117.6	15	13.7
	Recreational Species	232	103.4	276	90.8	387	106.1	4	0.7
	Percent of Total	27.6	17.5	72.1	75.7	91.1	90.2	26.7	5.1

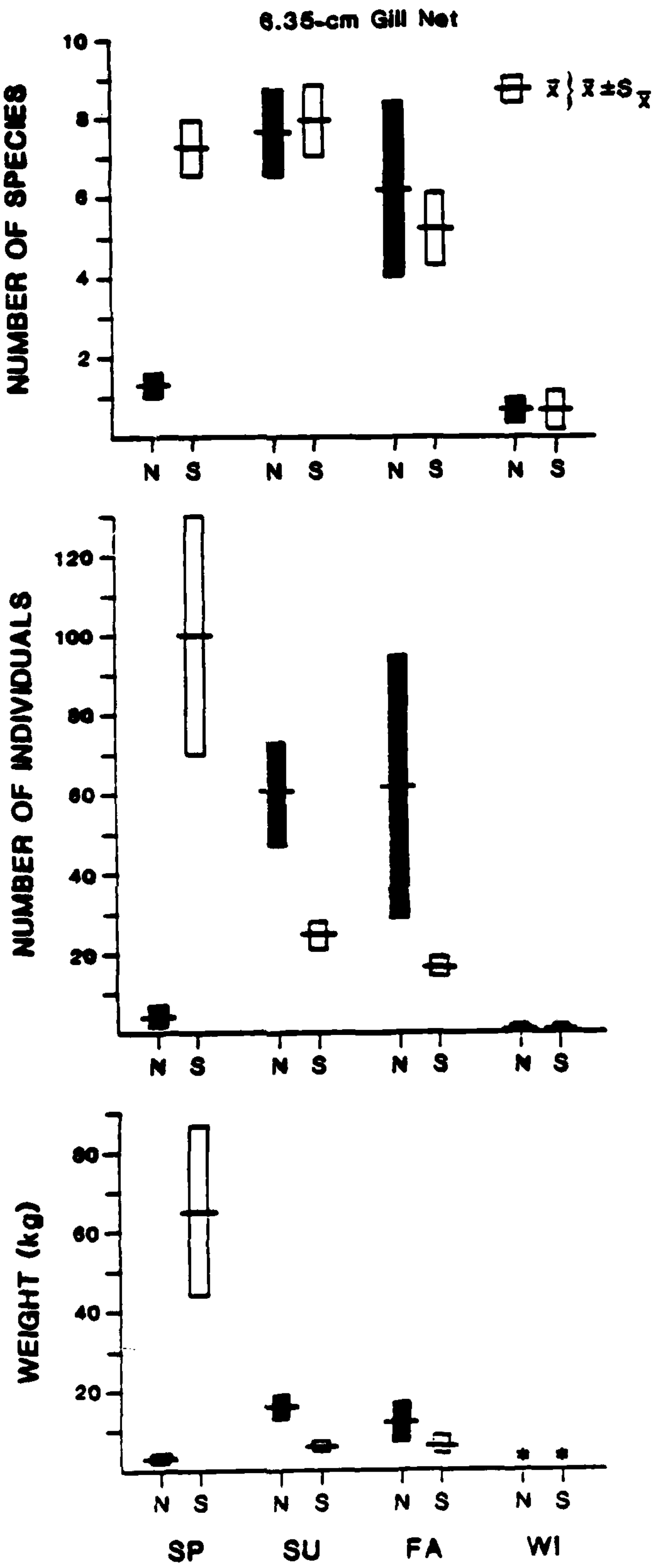


Figure 4. Number of species, individuals, and weight of fishes collected in 6.35-cm (2.5-in.) gill nets set on the outside of the north (N) and south (S) jetties at Murrells Inlet by season (SP = spring, SU = summer, FA = fall, WI = winter); * = trace weight.

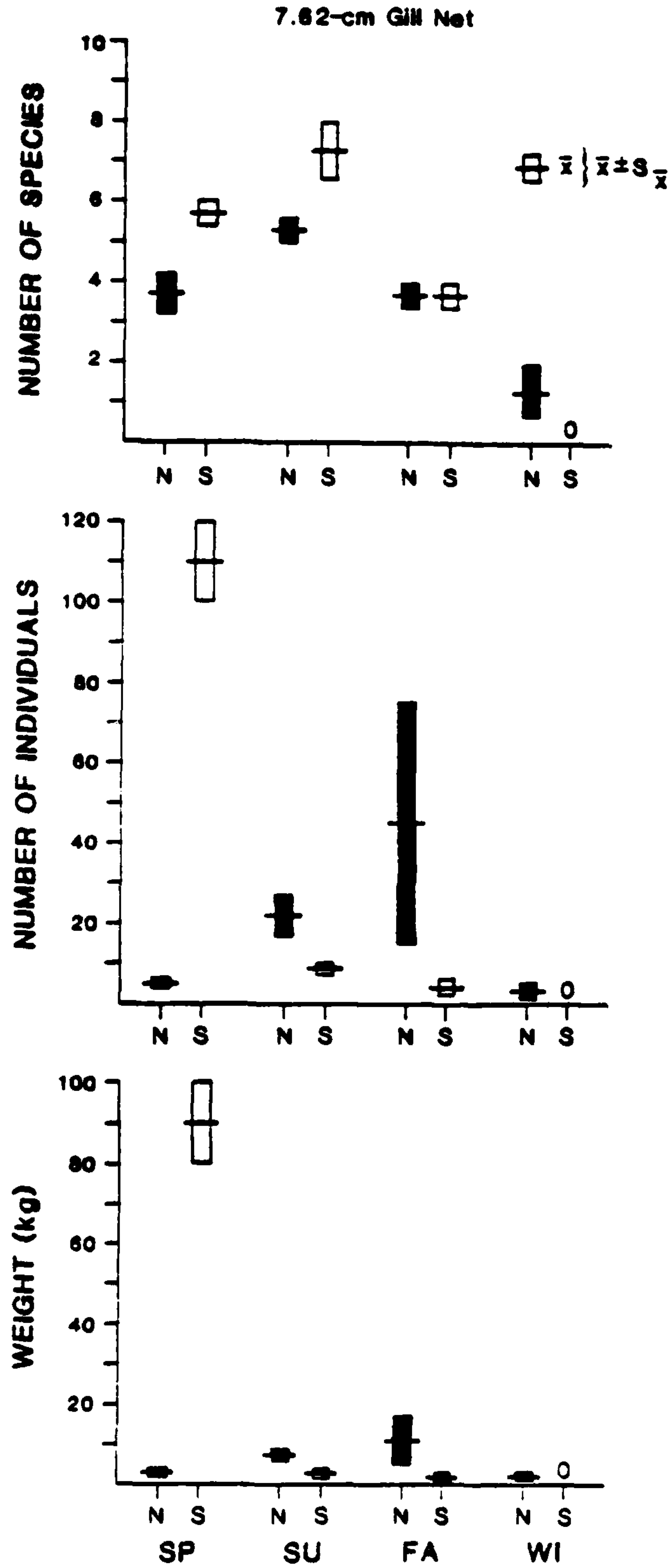


Figure 5. Number of species, individuals, and weight of fishes collected in 7.62-cm (3-in.) gill nets set on the outside of the north (N) and south (S) jetties at Murrells Inlet by season (SP = spring, SU = summer, FA = fall, WI = winter).

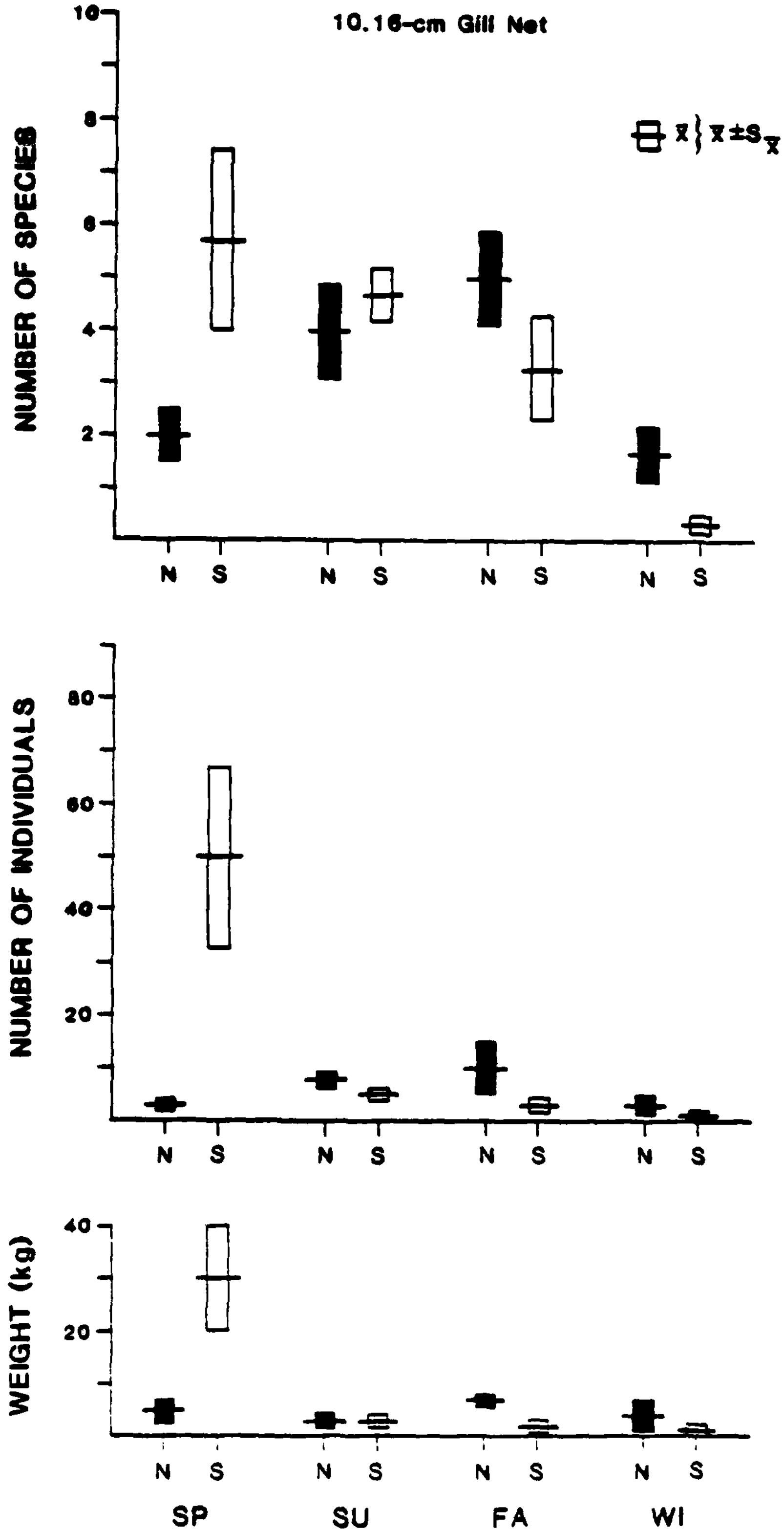


Figure 6. Number of species, individuals, and weight of fishes collected in 10.16-cm (4-in.) gill nets set on the outside of the north (N) and south (S) jetties at Murrells Inlet by season (SP = spring, SU = summer, FA = fall, WI = winter).

Table 2. Summary of seasonal catches of fishes from gill nets set for 3 hrs on the ocean side of the north and south jetties at Murrells Inlet. (CPUE = catch per unit effort = mean catch for three sets; weight units are kilograms.)

Mesh Size	Variable	Spring North	Spring South	Summer North	Summer South	Fall North	Fall South	Winter North	Winter South
6.35 cm	total number	24	299	182	74	186	52	2	2
	total weight	9.2	199.4	49.0	18.4	36.5	17.2	0.5	0.5
	total species	2	13	12	14	13	8	2	2
	CPUE - number	8	99.7	60.7	24.7	62	17.3	0.7	0.7
	CPUE - weight	3.1	66.5	16.3	6.1	12.2	5.7	0.2	0.2
	CPUE - species	0.7	7.3	7.7	8	6.3	5.3	0.7	0.7
7.62 cm	total number	15	347	66	27	134	13	9	0
	total weight	9.4	267.5	24.0	9.8	32.4	4.9	4.4	0
	total species	7	11	10	17	9	6	3	0
	CPUE - number	5	115.7	22	9	44.7	4.3	3	0
	CPUE - weight	3.1	89.2	8.0	3.3	10.8	1.3	1.5	0
	CPUE - species	3.7	5.7	5.3	7.3	3.7	3.7	1.3	0
10.16 cm	total number	10	147	20	14	29	10	9	2
	total weight	13.7	90.6	8.3	8.7	21.0	4.9	12.3	0.2
	total species	3	11	9	12	10	9	4	1
	CPUE - number	3.3	49	6.7	4.7	9.7	3.3	3	0.7
	CPUE - weight	4.6	30.2	2.8	2.9	7.0	1.6	4.1	0.1
	CPUE - species	2	5.7	4	4.7	5	3.3	1.7	0.3

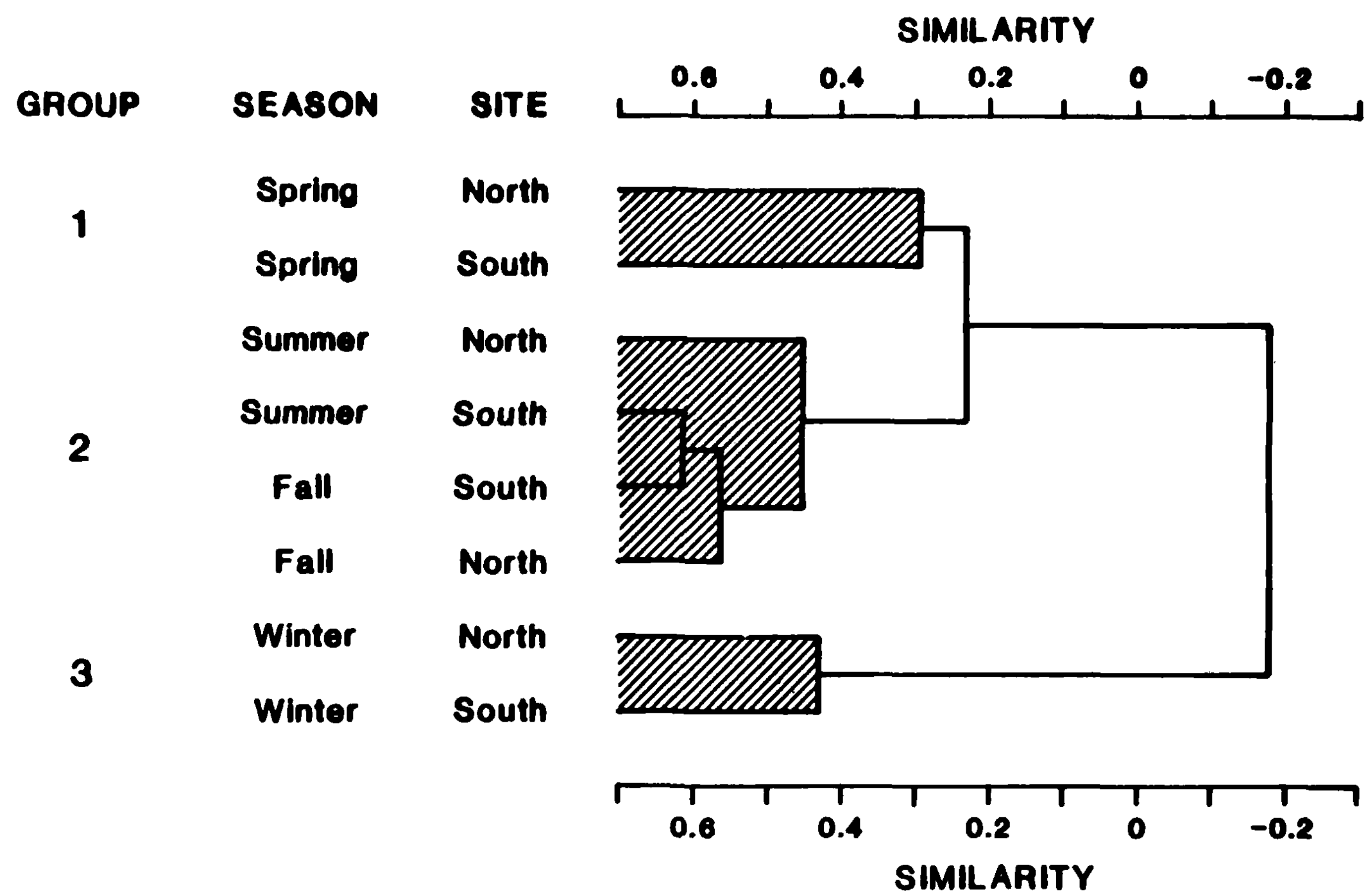


Figure 7. Dendrogram derived from normal cluster analysis of gill net collections made seasonally outside the jetties at Murrells Inlet.

Table 3. Numerical abundance of fishes in the five species groups in each of the three site groups as defined by cluster analysis.

Species Group	Species	Site Group 1	2	3
A	P. saltatrix	189	85	---
	M. littoralis	25	22	---
	L. xanthurus	4	333	3
	P. lethostigma	4	5	1
	P. alepidotus	22	3	---
	G. micrura	3	2	---
	M. canis	468	1	---
B	C. chrysurus	1	1	---
	T. maculatus	1	1	---
	A. hepsetus	1	1	---
	S. tiburo	1	3	---
C	O. oglinum	---	12	---
	T. carolinus	---	8	---
	A. felis	---	3	---
	B. tyrannus	1	40	1
	S. maculatus	1	146	---
	L. rhomboides	---	9	---
	C. nebulosus	---	22	---
	C. faber	---	8	---
D	E. saurus	---	5	---
	S. ocellatus	---	9	---
	M. cephalus	---	11	---
	P. cromis	3	6	---
	T. onites	2	10	---
	C. regalis	7	7	---
	S. vomer	---	15	---
	A. probatocephalus	---	8	---
	M. americanus	1	4	---
E	S. aquosus	---	1	3
	A. mediocris	3	3	10
	A. sapidissima	5	---	5

Table 4. Ranking of species by numerical abundance in modified commercial blue crab traps fished at the base of the jetties at Murrells Inlet, South Carolina. Twenty-four traps were set for a 3-hr duration during each season. (Weight units are kilograms.)

Family	Species	Spring		Summer		Fall		Winter		Total	
		No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
Atherinidae	*Menidia menidia*	269	1.290	---	------	---	------	---	------	269	1.290
Serranidae	*Centropristis striata*	162	8.007	47	1.970	34	2.413	---	------	243	12.390
Batrachoididae	*Opsanus tau*	5	1.813	13	6.327	1	0.284	---	------	19	8.424
Sciaenidae	*Leiostomus xanthurus*	13	0.006	---	------	---	------	---	------	13	0.006
Sparidae	*Lagodon rhomboides*	8	0.244	2	0.096	---	------	2	0.016	12	0.356
Congridae	*Conger oceanicus*	8	6.100	2	1.014	---	------	---	------	10	7.114
Haemulidae	*Orthopristis chrysoptera*	---	------	4	0.057	---	------	---	------	4	0.057
Gobiesocidae	*Gobiesox strumosus*	---	------	---	------	---	------	1	0.001	1	0.001
Blenniidae	*Hypleurochilus geminatus*	---	------	---	------	1	0.006	---	------	1	0.006
Bothidae	*Paralichthys lethostigma*	1	0.064	---	------	---	------	---	------	1	0.064
	TOTAL	466	17.524	68	9.464	36	2.703	3	0.017	573	29.708

Table 5. Catch rates for modified commercial blue crab traps fished at the base of the Murrells Inlet jetties by season. Twenty-four traps were fished during each period. (* = trace.)

	Catch Per Trap			
	Number		Weight	
Season	Mean	SE	Mean	SE
Spring	19.4	6.9	0.730	0.279
Summer	2.8	0.6	0.394	0.083
Fall	1.5	0.4	0.113	0.040
Winter	0.1	*	0.001	*

remaining 72 trap sets (55.6 %). This species was most commonly collected during spring when overall catch rates were highest. In spring, black sea bass ranged in size from 5 to 16 cm SL ($\bar{x}$ = 10.6 cm) (Fig. 8). Summer black sea bass averaged 10.2 cm SL (range = 5 to 17 cm), and fall samples were slightly larger ($\bar{x}$ = 12.1 cm, range = 6 to 18 cm). All black sea bass were probably young of the year or one year old (Wenner et al., 1986).

The unmodified blue crab traps, which were set around the north jetty to assess the decapod assemblages, also captured 347 fish representing nine species (Appendix 1). During the spring, the eel *Conger oceanicus* dominated the catch numerically as well as in total biomass. This eel also was the most abundant species during the winter and was commonly collected during the summer and fall. All but one of the 80 *C. oceanicus* were captured in night sets.

The most abundant fishes captured in the crab traps during the summer were black sea bass, *Centropristis striata*; pinfish, *Lagodon rhomboides*; spottail pinfish, *Diplodus holbrooki*; and oyster toadfish, *Opsanus tau* (Appendix 1). Other fish species captured in the crab traps were represented by only one specimen. In addition, four specimens of *Octopus vulgaris* were captured in the fall. Differences in the composition of the catch collected by the modified sea bass traps and the blue crab traps were primarily due to differences in the trap mesh size, as well as time of deployment and duration of set.

Rotenone Collections: Rotenone poisoning resulted in the collection of 804 fishes representing 24 identifiable species and 20 families (Table 6). The four species that occurred in all seasons (*Gobiosoma ginsburgi*, *Gobiesox strumosus*, *Hypleurochilus geminatus*, and *Hypsoblennius hentzi*) accounted for 82.6 % of the total number of fishes (Appendix 2). Seaboard goby, *G. ginsburgi*, was most abundant (36.7 %), followed by skilletfish, *G. stromosus* (17.7 %); crested blenny, *H. geminatus* (15.0 %); and feather blenny, *H. hentzi* (13.2 %).

The total catch of fishes collected by rotenone poisoning during winter was approximately half that of the other seasons (which were relatively consistent), and the total number of species collected was also slightly lower during this season (Table 6). The species assemblages in rotenone collections were relatively similar among seasons (Table 6) and consisted mostly of cryptic resident species (blennies, gobies, clingfish, pipefish, and Carolina hake), transients (silversides, anchovies, gerreids, young of year spot), and species that were probably residents but only rarely collected (toadfish, sparids, haemulids).

Visual Census: Over 4400 fishes, representing at least 32 species and many temperate and tropical teleost families, were observed during the visual swimming transects along the north jetty (Table 7). The Atlantic silverside, *Menidia menidia*, was the most abundant species observed, and large schools were found near the surface adjacent to the upper rocks on the jetty face. Atlantic silversides were never observed at the base of the jetty and were infrequent at mid-depth zones. Most *M. menidia* were observed in the spring, and a few were seen in the fall. None were noted in visual surveys conducted during the summer and winter (Tables 7-11). In spring, when *M. menidia* were most abundant, they were found on both sides of the jetty and appeared to

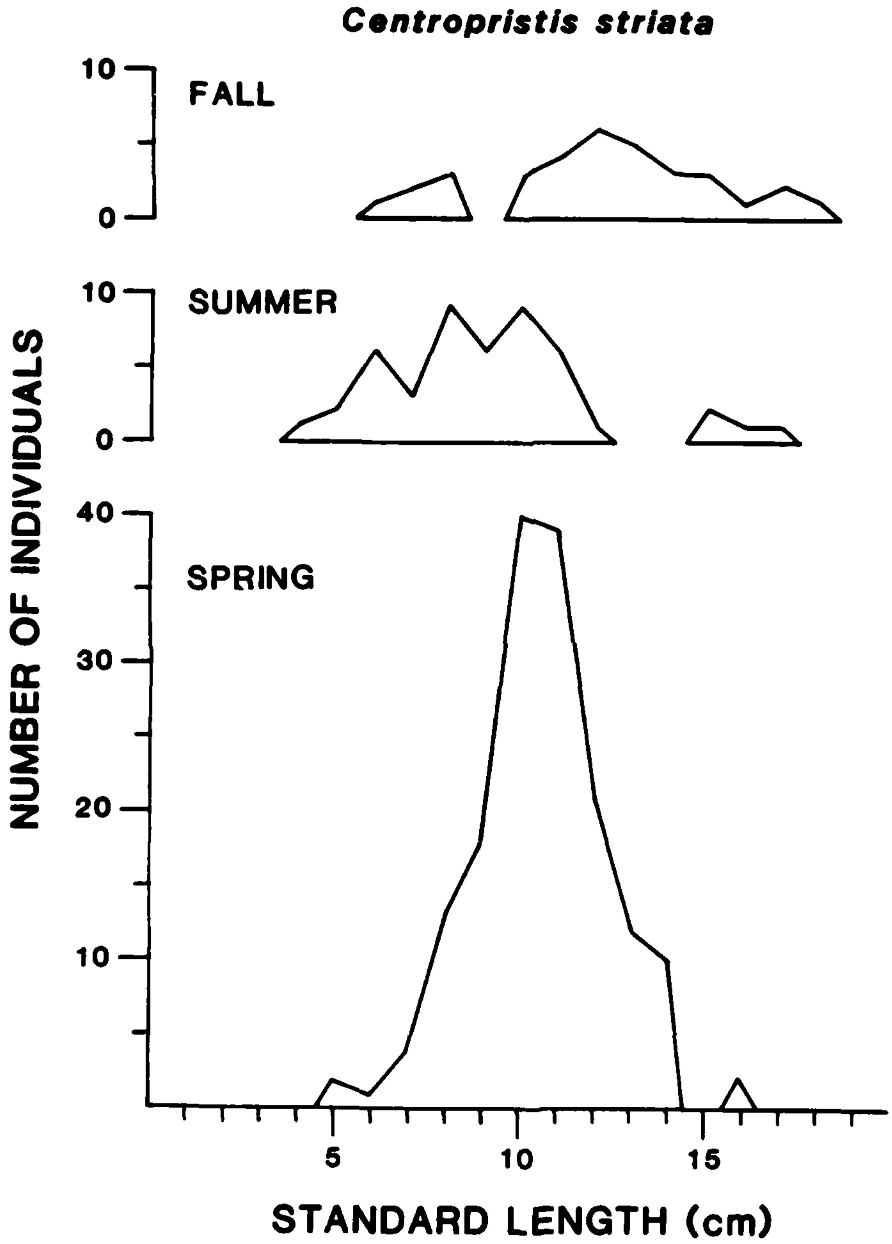


Figure 8. Sizes of black sea bass, Centropristis striata, collected in modified traps fished at the base of the Murrells Inlet jetties.

Table 6. Seasonal species composition and relative abundance of fishes (a) and percent similarity values between seasons (b) for rotenone samples collected on the channel side of the north jetty.

(a)

Family	Species	Spring	Summer	Fall	Winter
Engraulide	<u>Anchoa cubana</u>	-	1	-	-
	<u>Anchoa hepsetus</u>	2	-	-	-
Batrachoididae	<u>Opsanus tau</u>	-	1	-	-
Gobiesocidae	<u>Gobiesox strumosus</u>	82	24	24	12
Gadidae	<u>Urophycis earlli</u>	4	2	1	-
Exocoetidae	<u>Hyporhamphus unifasciatus</u>	-	-	1	-
Cyprinodontidae	<u>Fundulus majalis</u>	6	-	-	-
Atherinidae	<u>Membras martinica</u>	-	-	2	-
	<u>Menidia menidia</u>	5	-	-	-
Syngnthidae	<u>Syngnathus fuscus</u>	3	-	1	1
Serranidae	<u>Centropristis striata</u>	1	-	-	-
Carangidae	<u>Caranx bartholomaei</u>	-	-	1	-
Gerreidae	Gerreidae	-	25	3	-
Haemulidae	<u>Orthopristis chrysoptera</u>	-	2	-	-
Sparidae	<u>Archosargus probatocephalus</u>	2	-	-	-
	<u>Diplodus holbrooki</u>	-	1	-	-
	<u>Lagodon rhomboides</u>	-	-	-	4
Sciaenidae	<u>Leiostomus xanthurus</u>	41	-	-	20
Pomacentridae	<u>Pomacentrus dorsopunicans</u>	-	-	1	-
Mugilidae	<u>Mugil cephalus</u>	-	-	-	1
Blenniidae	<u>Hypleurochilus geminatus</u>	18	55	32	16
	<u>Hypsoblennius hentzi</u>	10	9	85	2
Gobiidae	<u>Gobiosoma ginsburgi</u>	61	84	110	40
Cynoglossidae	<u>Symphurus plagiusa</u>	1	-	-	1
Balistidae	<u>Monacanthus hispidus</u>	-	1	1	-
	number of species	13	11	12	9
	number of fishes	236	205	262	97

(b)

Season	Spring	Summer	Fall
Spring	x		
Summer	50.3	x	
Fall	48.7	68.7	x
Winter	66.7	71.3	65.1

Table 7. Abundance of fishes observed during diver transects on the north jetty at Murrells Inlet, by season.

Species	Number of Individuals Spring	Summer	Fall	Winter	Total
Clupeidae					
Brevoortia tyrannus		195			195
Batrachoididae					
Opsanus tau	1	1	3	1	6
Gadidae					
Urophycis earlli	3				3
Gobiesocidae					
Gobiesox strumosus		1			1
Atherinidae					
Menidia menidia	2090		50		2140
Serranidae					
Centropristis striata	123	208	680		1011
Mycteroperca microlepis		1			1
Grammistidae					
Rypticus maculatus			1		1
Carangidae					
Chloroscombrus chrysurus			1		1
Lutjanidae					
Lutjanus griseus			8		8
Haemulidae					
Orthopristis chrysoptera		22			22
Sparidae					
Archosargus probatocephalus	4	15	22		41
Diplodus holbrooki		112	470		582
Lagodon rhomboides	83	5	3		91
Stenotomus aculeatus			1		1
Sciaenidae					
Bairdiella chrysoura		1			1
Leiostomus xanthurus	107	2	3		112
Pogonias cromis		2			2
Sciaenops ocellatus		1	2		3

(Continued)

Table 7. (Concluded)

Species	Spring	Summer	Fall	Winter	Total
	Number of Individuals				
Ephippidae					
Chaetodipterus faber		7	1		8
Chaetodontidae					
Chaetodon aya			1		1
Chaetodon ocellatus		2			2
Chaetodon sedentarius		1			1
Pomacentridae					
Abudefduf saxatilis		2	1		3
Pomacentrus variabilis		3	1		4
Labridae					
Tautoga onitis			2		2
Mugilidae					
Mugil cephalus		28	71		99
Blenniidae					
Blenniidae undetermined	2	7	52		61
Chasmodes bosquianus	2				2
Hypleurochilus geminatus	11	7	1		19
Hypsoblennius hentzi		4			4
Hypsoblennius sp.	6				6
Bothidae					
Paralichthys sp.		2	2		4
Balistidae					
Monacanthus hispidus		4	1		5
Total	2432	633	1377	1	4443

Table 8. Abundance of fishes observed during diver transects on the north jetty at Murrells Inlet during spring, by location.

Species	Number of Individuals Exposed Offshore	Exposed Inshore	Channel Offshore	Channel Inshore	Total
Batrachoididae					
Opsanus tau	1				1
Gadidae					
Urophycis earlli	3				3
Atherinidae					
Menidia menidia	905	600	50	535	2090
Serranidae					
Centropristis striata	10	19	80	14	123
Sparidae					
Archosargus probatocephalus			4		4
Lagodon rhomboides		25		58	83
Sciaenidae					
Leiostomus xanthurus		75		32	107
Blenniidae					
Blenniidae undetermined	1			1	2
Chasmodes bosquianus		1	1		2
Hypleurochilus geminatus	4	4	3		11
Hypsoblennius sp.		6			6
Total	924	730	138	640	2432

Table 9. Abundance of fishes observed during diver transects on the north jetty at Murrells Inlet during summer, by location.

Species	Number of Individuals Exposed Offshore	Exposed Inshore	Channel Offshore	Channel Inshore	Total
Clupeidae					
Brevoortia tyrannus	195				195
Batrachoididae					
Opsanus tau				1	1
Gobiesocidae					
Gobiesox strumosus		1			1
Serranidae					
Centropristis striata	24	63	82	39	208
Mycteroperca microlepis		1			1
Haemulidae					
Orthopristis chrysoptera	2	7	1	12	22
Sparidae					
Archosargus probatocephalus	2	2	1	10	15
Diplodus holbrooki	29	37	19	27	112
Lagodon rhomboides		1		4	5
Sciaenidae					
Bairdiella chrysoura				1	1
Leiostomus xanthurus				2	2
Pogonias cromis				2	2
Sciaenops ocellatus		1			1
Ephippidae					
Chaetodipterus faber	4	2	1		7
Chaetodontidae					
Chaetodon ocellatus			2		2
Chaetodon sedentarius		1			1
Pomacentridae					
Abudefduf saxatilis			2		2
Pomacentrus variabilis		2		1	3
Mugilidae					
Mugil cephalus	3	21	3	1	28

(Continued)

Table 9. (Concluded)

Species	Number of Individuals				Total
	Outside		Channel		
	Offshore	Inshore	Offshore	Inshore	
Blenniidae					
Blenniidae undetermined	1	6			7
Hypleurochilus geminatus	4	2	1		7
Hypsoblennius hentzi		3		1	4
Bothidae					
Paralichthys sp.	1		1		2
Balistidae					
Monacanthus hispidus		2		2	4
Total	265	152	113	103	633

Table 10. Abundance of fishes observed during diver transects on the north jetty at Murrells Inlet during fall, by location.

Species	Number of Individuals Exposed Offshore	Exposed Inshore	Channel Offshore	Channel Inshore	Total
Batrachoididae					
Opsanus tau			2	1	3
Atherinidae					
Menidia menidia		50			50
Serranidae					
Centropristis striata	212	175	291	2	680
Grammistidae					
Rypticus maculatus			1		1
Carangidae					
Chloroscombrus chrysurus			1		1
Lutjanidae					
Lutjanus griseus	4		4		8
Sparidae					
Archosargus probatocephalus	9	3	2	8	22
Diplodus holbrooki	135	331	2	2	470
Lagodon rhomboides			2	1	3
Stenotomus aculeatus				1	1
Sciaenidae					
Leiostomus xanthurus			1	2	3
Sciaenops ocellatus				2	2
Ephippidae					
Chaetodipterus faber			1		1
Chaetodontidae					
Chaetodon aya			1		1
Pomacentridae					
Abudefduf saxatilis		1			1
Pomacentrus variabilis			1		1
Labridae					
Tautoga onitis		2			2

(Continued)

Table 10. (Concluded)

Species	Number of Individuals				Total
	Exposed		Channel		
	Offshore	Inshore	Offshore	Inshore	
Mugilidae					
Mugil cephalus	51		20		71
Blenniidae					
Blenniidae undetermined	8	22	20	2	52
Hypleurochilus geminatus				1	1
Bothidae					
Paralichthys sp.			1	1	2
Balistidae					
Monacanthus hispidus				1	1
Total	419	584	351	23	1377

Table 11. Abundance of fishes observed during diver transects on the north jetty at Murrells Inlet during winter, by location.

Species	Number of Individuals				Total
	Exposed		Channel		
	Offshore	Inshore	Offshore	Inshore	
Batrachoididae					
Opsanus tau		1			1
Total		1			1

school along the entire length. More were seen on the exposed side than in the channel.

Black sea bass, Centropristis striata, was the second most abundant species seen during the visual census of the jetty (Table 7). Black sea bass were common during all seasons except winter, and they were most abundant in fall, when many small juveniles were recruited to the rocks of the jetty. Unlike Atlantic silversides, most black sea bass were confined to the base of the jetty, with a few individuals noted in crevices at middle depths on the rock face. Black sea bass occurred along both the inshore (benchmarks 6-10) and offshore (benchmarks 1-5) segments of both sides of the jetty during those seasons they were present. Centropristis striata showed no clear preference for inshore or offshore depths on either side, but fish in deeper waters were generally larger.

Spottail pinfish, Diplodus holbrooki, was the third most abundant species counted on visual transects and, like M. menidia, was very seasonal in its occurrence. Spottail pinfish occurred only in the warmer months, summer and fall (Table 7) and was more abundant along the inshore portion of the jetty than along the outer portion (Tables 9-11). Spottail pinfish schooled around mid-depths and in the upper regions of the jetty face. They were common on both sides of the jetty in summer, but were abundant only on the exposed face in the fall.

Atlantic menhaden, Brevoortia tyrannus, was the fourth most abundant species observed; however, this species was only observed on one occasion, and may not be closely associated with the jetty structure. All specimens of Atlantic menhaden were observed in small schools from the base to the top of the offshore exposed jetty face in summer (Table 9).

Small juvenile spot, Leiostomus xanthurus, were also frequently observed on the jetty, especially in spring (Tables 7-8). All but one specimen were observed on the inshore portion of both sides of the jetty, where they hovered above the sand at the base of the jetty rocks.

Several other species of commercial and recreational importance were sighted around the jetty rocks. Schools of striped mullet (Mugil cephalus) were seen during the warmer months (Table 7), swimming along the length of the jetty adjacent to the upper rocks. A single juvenile gag (Mycteroperca microlepis) was observed on the exposed face during summer (Table 9), and several juvenile gray snapper (Lutjanus griseus) were observed along offshore portions of the jetty in the fall (Table 10). Small individuals of sheepshead (Archosargus probatocephalus) were seen during all seasons but winter, and most were present along the inshore portion of the jetties. Inshore specimens were generally smaller than offshore specimens. Small individuals of black drum (Pogonias cromis) and red drum (Sciaenops ocellatus) were seen infrequently on the sandy bottom next to the base of the rocks. Juvenile spadefish (Chaetodipterus faber) and tautog (Tautoga onitis) were also infrequently seen (Table 7). Juvenile pinfish (Lagodon rhomboides) were abundant in spring on the sandy bottom adjacent to the rocks on inshore portions of the jetty (Table 8).

Several other cryptic or rare species were occasionally noted (Table 7). Tropical and subtropical reef fishes such as grammistids, chaetodontids, and pomacentrids were occasionally seen during the warmer months. The only species observed during all seasons, Opsanus tau, was only occasionally seen and its courtship and territorial calls were often heard by divers. This toadfish, like the several species of blennies that were seen (Table 7), is probably very abundant, but was only occasionally sighted because of its cryptic coloration and habits.

Abundance of all fishes was highest in spring because of the high abundance of the surface schooling species, M. menidia. Fish abundance was also high in the fall; however C. striata and D. holbrooki, two species that were more abundant on the lower half of the rock face, were the dominant species. Centropristis striata and D. holbrooki were also the dominant species in summer. A single oyster toadfish was the only fish observed on the transects completed in winter (Table 11).

Normal cluster analysis of replicate transects pooled by habitat and season resulted in groupings that indicated the seasonal nature of the fish fauna on the jetty (Fig. 9). Some exceptional transects (i.e., channel/offshore/spring and channel/inshore/fall) grouped with other seasons because of the unusually small number of fishes seen in those habitats and seasons. Inverse cluster analysis resulted in groupings of species that had similar habitat/seasonal occurrences and/or abundance patterns (Table 12). Group A consisted of species that were very rare and occurred only in the fall, whereas Group D consisted of more common species that also occurred mainly in the fall (Table 7). Groups B and E consisted of rare species that were more abundant or only observed in the warmer months, summer and fall. Group B fishes occurred mostly on inshore sites, while Group E consisted of fishes that were primarily offshore in distribution. Group C consisted of moderately abundant species with no clear habitat affinity. Hypleurochilus geminatus occurred mainly on the exposed side during the spring, and C. faber was most abundant on the exposed side in summer. Archosargus probatocephalus was most abundant in the fall and occurred in all four habitats, whereas O. chrysoptera was found only in the summer in inshore waters. Groups F and G consisted of common to abundant species. Species in Group F were very abundant, especially in summer and fall, and were found at inshore and offshore areas on both sides of the jetties. Species in Group G were also abundant, but were found almost exclusively in spring. Species in Group H included the most abundant species (M. menidia) and some of the rarest species; however, most of these species were seen primarily in spring. The exception was B. tyrannus, which was included in this group because of its similar affinity to the exposed side of the jetty. Groups I and J consisted of rare species that were almost exclusively seen in summer. Species in Group I were each represented by one specimen observed on the inshore end of the exposed side of the jetty; Group J consisted of species found at the inshore end of both sides of the jetty.

Diversity values varied but were generally low (Table 13). Highest H' diversity occurred in fall at the channel inshore area and was due to a high evenness value and a moderate number of species being present. High H' values also occurred in summer, when more species generally were observed at all sites. With the exception of winter, lowest diversity values were found in spring, when the large numbers of M. menidia that were present contributed to low evenness values.

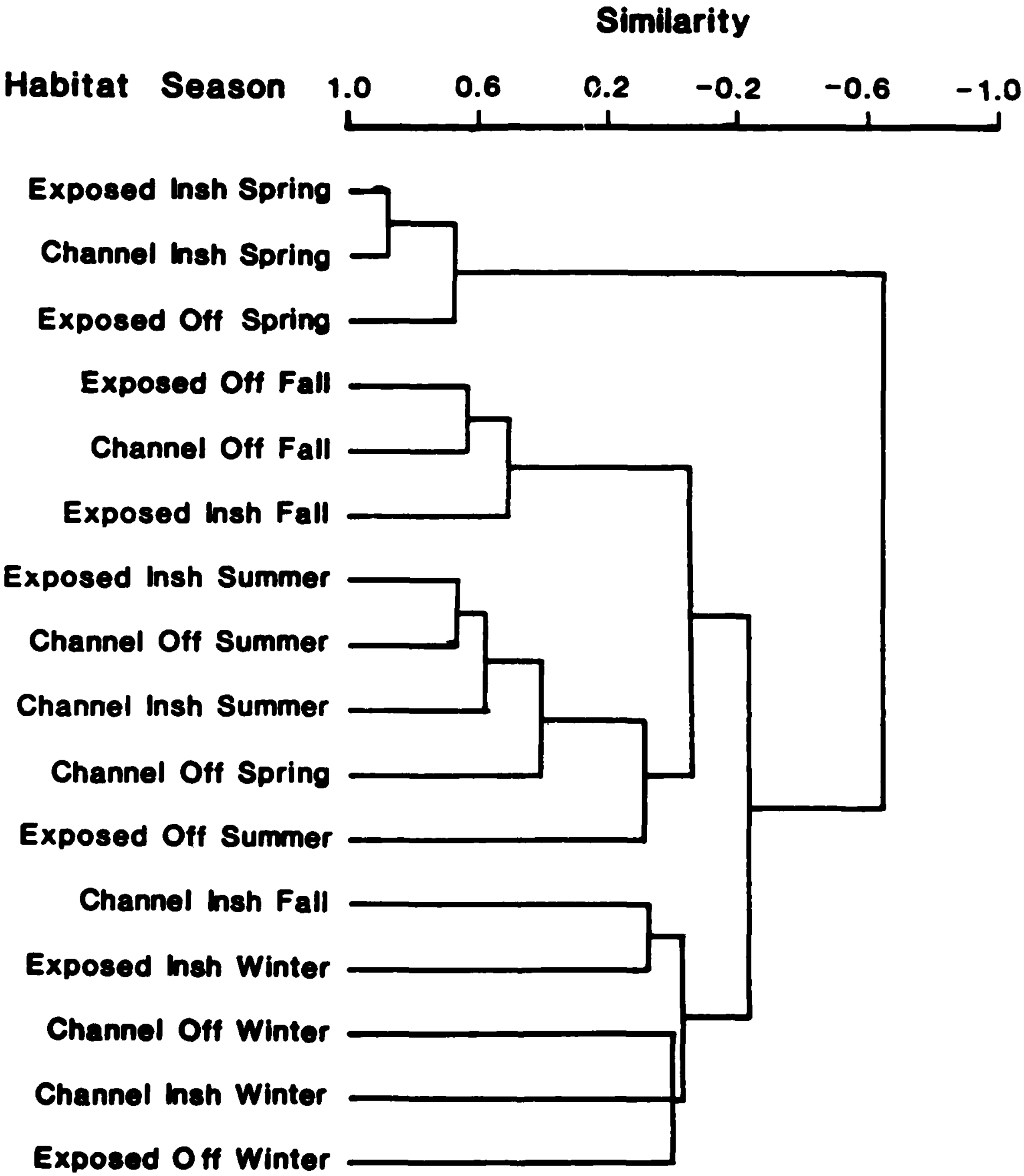


Figure 9 Normal cluster analysis of visual survey transects conducted by divers (Insh = inshore, Off = offshore).

Table 12. Species associations elucidated through inverse cluster analysis of visual fish counts.

Group A
- *Chaetodon aya*
- *Chloroscombrus chrysurus*
- *Rypticus maculatus*

Group B
- *Sciaenops ocellatus*
- *Stenotomus aculeatus*
- *Opsanus tau*
- *Paralichthys* sp.

Group C
- *Hypleurochilus geminatus*
- *Chaetodipterus faber*
- *Archosargus probatocephalus*
- *Orthopristis chrysoptera*

Group D
- Blenniidae undetermined
- *Mugil cephalus*
- *Lutjanus griseus*

Group E
- *Abudefduf saxatilis*
- *Chaetodon ocellatus*
- *Tautoga onitis*

Group F
- *Centropristis striata*
- *Diplodus holbrooki*

Group G
- *Leiostomus xanthurus*
- *Lagodon rhomboides*

Group H
- *Hypsoblennius* sp.
- *Chasmodes bosquianus*
- *Menidia menidia*
- *Urophycis earlli*
- *Brevoortia tyrannus*

Group I
- *Mycteroperca microlepis*
- *Gobiesox strumosus*
- *Chaetodon sedentarius*

Group J
- *Pogonias chromis*
- *Bairdiella chrysoura*
- *Pomacentrus variabilis*
- *Monacanthus hispidus*
- *Hypsoblennius hentzi*

Table 13. Community structure values for replicate visual transects pooled by habitat and season.

Habitat/Season	Number of Individuals	Number of Species	H-Prime Diversity	J-Prime Evenness
Exp/Off/Sp	924	6	0.18	0.07
Exp/Insh/Sp	730	7	0.98	0.35
Chan/Off/Sp	138	5	1.30	0.56
Chan/Insh/Sp	640	5	0.88	0.38
Exp/Off/Su	265	10	1.41	0.42
Exp/Insh/Su	152	16	2.57	0.64
Chan/Off/Su	113	10	1.41	0.43
Chan/Insh/Su	103	13	2.56	0.69
Exp/Off/Fa	419	6	1.69	0.65
Exp/Insh/Fa	584	7	1.55	0.55
Chan/Off/Fa	351	16	1.13	0.28
Chan/Insh/Fa	23	11	3.04	0.88
Exp/Insh/Wi	1	1	0.00	0.00

The visual transects appeared to be an adequate method of assessing non-cryptic fishes associated with the jetties. An *a posteriori* test of cumulative species observed versus number of counts indicated that few species were added to the list after five counts were completed. Since ten counts were made in each area, the number of counts chosen was adequate to determine species composition.

Visibility, however, may have limited the effectiveness of the technique for counting some species, especially cryptics and transitory pelagic species such as jacks and bluefish. Cryptic species abundance was probably underestimated because they could not be easily seen in dark crevices. Although visual transects were conducted when tide and sea conditions were expected to produce maximum visibility, the visibility was consistently fair to poor. Fishes could be accurately identified and counted for a distance of about 1.5 m from the observer and, therefore, many fishes may have been missed during diver counts. In spite of these limitations, diver observations provided useful information to supplement that provided by other techniques.

General Discussion: Both traps and gill nets showed the seasonal nature of the ichthyofauna near the jetties. When water temperatures reached minimum values in winter, fishes that occurred in moderate numbers during other seasons were either absent or extremely rare. Trap catches showed black sea bass to be relatively abundant in all seasons except winter when they were absent. Also during winter, gill nets caught an order of magnitude fewer species, individuals, and total weight than during any other season.

Seasonal changes in the ichthyofauna taken in rotenone collections were not as dramatic. Although the samples from January had fewer species and individuals, there was little difference in the species composition of the samples in comparison to that of other seasons. Most species taken with rotenone were fishes that, because of their small body size and cryptic habits, do not move offshore or south to avoid cold water temperatures.

Species composition and abundance of the ichthyofauna noted on diver transects differed considerably from those of collections taken by most forms of removal sampling. The most notable differences between diver observations and gill net samples were: 1) the complete absence of elasmobranch fishes, and 2) the rarity of many pelagic fishes in diver observations. Whereas gill net sets were dominated by smooth dogfish, bluefish, and clearnose skates in spring, these species were not observed on the north jetty. This was probably due to the fact that much of the gill net length was fished over a sand bottom away from the jetty, whereas diver observations were confined to the areas immediately adjacent to the rocks. Similarly, the Spanish mackerel and bluefish that dominated gill net catches in summer were not observed by divers, and although spot dominated net catches in fall, few were seen by divers. Gill net catches and diver observations both indicated a paucity of fishes in the area in winter. In addition, although the faunas sampled by the two techniques differed considerably, cluster analysis of net catches showed seasonal groupings similar to those suggested by observations in diver transects.

Modified trap catches were more similar to diver observations than gill net collections in some ways. In spring, for example, *M. menidia* was the dominant species observed by divers and collected in modified traps, although some M. menidia were observed by divers in fall but not collected in traps at that time. Modified traps also caught a number of other species (e.g., Opsanus tau, Lagodon rhomboides, Orthopristis chrysoptera, etc.) that were often observed by divers but rarely caught in gill nets. These larger species (as compared to M. menidia) were also caught in the unmodified blue crab traps. The closer similarity in diver observations and traps (versus diver observations and gill nets) is probably due to the proximity of the trap sets to the jetty rocks. A notable difference between trap collections and diver observations was that traps caught larger black sea bass in fall than in other seasons, whereas divers noted a decrease in average size of black sea bass in fall. This is probably due to size selectivity of fish traps (Lagler, 1971).

Rotenone collections captured numerous specimens of cryptic species including blennies, skilletfish and gobies that were not easily quantifiable by divers.

The species composition of fishes that were closely associated with the jetties was similar to that noted in previous investigations of artificial and natural reefs in the South Atlantic Bight (Parker et al., 1979; Sedberry and Van Dolah, 1984; South Carolina Wildlife and Marine Resources Department (SCWMRD), 1984; Van Dolah et al., 1984). For example, Van Dolah et al. (1984) collected or observed 33 fish taxa on the Murrells Inlet jetties in a more limited sampling effort, and of these, 23 were also taken or observed in this study. Faunal studies of artificial reefs offshore from Murrells Inlet listed 60 taxa (Parker et al., 1979), of which 21 were collected in the current study. Of the 117 taxa taken or observed in this study and in the two studies cited above, only 15 were present in all surveys (Table 14). The differences can be attributed to location (inshore versus offshore) and collecting techniques.

The jetties at Murrells Inlet appear to attract fishes in three main ways. First, fishes that are normally associated with structure, either offshore hardbottom reefs (e.g., black sea bass, sheepshead) or inshore high salinity oyster reef habitat (e.g., blennies, gobies, clingfish, oyster toadfish) are attracted to the hard substratum of the jetties both for food and as a refuge from predators. The numerous interstitial spaces between the rocks provide abundant hiding places for fishes, and the hard substratum allows for the attachment of dense epifloral and epifaunal communities (Van Dolah et al., 1984).

Secondly, the jetties are adjacent to the inlet through which abundant food (zooplankton, etc.) is exported from the estuary by tidal currents. Several forage species such as Menidia menidia, Brevoortia tyrannus, and Opisthonema oglinum appear to capitalize on this estuarine export (see Fish Food Habits section). These, in turn, are preyed upon by various piscivorous species such as bluefish during spring and summer, and Spanish mackerel in summer.

Thirdly, the jetties appear to attract fishes during their northerly migrations in spring and southerly movements in fall. For example, the smooth dogfish, Mustelus canis, is an abundant shark in shallow waters off the Middle Atlantic coast and southern New England during late spring,

Table 14 . Fishes in faunal surveys of the Murrells Inlet jetties (Van Dolah et al., 1984; present study) and artifical reef habitat near Murrells Inlet (Parker et al., 1979). Species in the list for the present study with an * were collected during preliminary gear trials during April 1984.

Family	Species	Parker et al.	Van Dolah et al.	Present Study
Carcharhinidae	*Mustelus canis*			+
	Rhizoprionodon terraenovae		+	+
Sphyrnidae	*Sphyrna tiburo*			+
	Sphyrna lewini			+
Rajidae	*Raja eglanteria*	+		+
Dasyatidae	Dasyatidae		+	
	Dasyatis sp.	+		
	Dasyatis americana			+
	Dasyatis sabina			+
	Dasyatis sayi			+
	Gymnura micrura			+
Myliobatidae	*Myliobatis freminvillei*			+
	Rhinoptera bonasus		+	+
Elopidae	*Elops saurus*			+
Congridae	*Conger oceanicus*			+
Clupeidae	*Alosa aestivalis*			+
	Alosa mediocris			+
	Alosa sapidissima			+
	Brevoortia smithi			+
	Brevoortia tyrannus		+	+
	Dorosoma cepedianum			+
	Dorosoma petenense		+	
	Opisthonema oglinum	+	+	+
Engraulidae	*Anchoa cubana*			+
	Anchoa hepsetus		+	+
Synodontidae	*Synodus foetens*	+		
Ariidae	*Arius felis*			+
	Bagre marinus			+
Batrachoididae	*Opsanus tau*	+	+	+
Gobiesocidae	*Gobiesox strumosus*			+
Antennariidae	Antennariidae	+		
Gadidae	*Urophycis earlli*	+		+
	Urophycis floridana	+		
Exocoetidae	*Hyporhamphus unifasciatus*			+
Cyprinodontidae	*Fundulus majalis*			+
Atherinidae	*Membras martinica*			+
	Menidia menidia			+
Syngnathidae	*Hippocampus* sp.	+		
	Syngnathus fuscus			+

(Continued)

Table 14 . Continued:

Family	Species	Parker et al.	Van Dolah et al.	Present Study
Serranidae	Centropristis philadelphica	+		
	Centropristis striata	+	+	+
	Diplectrum formosum	+		
	Mycteroperca microlepis	+		+
	Serranus subligarius	+		
Grammistidae	Rypticus sp.	+		
	Rypticus maculatus			+
Pomatomidae	Pomatomus saltatrix	+	+	+
Rachycentridae	Rachycentron canadum	+		
Echeneidae	Remora remora	+		
Carangidae	Caranx bartholomaei			+
	Caranx crysos	+		
	Caranx hippos			+
	Caranx ruber	+		
	Chloroscombrus chrysurus	+	+	+
	Decapterus sp.	+		
	Selene setapinnis			+
	Selene vomer	+	+	+
	Seriola dumerili	+		
	Seriola zonata	+		
	Trachinotus carolinus		+	+
Lutjanidae	Lutjanus campechanus	+		
	Lutjamus griseus			+
	Lutjanus synagris	+		
Gerreidae	Gerreidae			+
Haemulidae	Anisotremus virginicus	+		
	Haemulon aurolineatum	+		
	Haemulon sp.	+		
	Haemulon sciurus		+	
	Orthopristis chrysoptera	+	+	+
Sparidae	Archosargus probatocephalus	+	+	+
	Calamus sp.			+
	Calamus arctifrons	+		
	Diplodus holbrooki	+		+
	Lagodon rhomboides	+	+	+
	Stenotomus sp.	+		
	Stenotomus aculeatus			+
Sciaenidae	Bairdiella chrysoura			+
	Cynoscion nebulosus	+	+	+
	Cynoscion regalis			+
	Equetus lanceolatus	+		
	Equetus umbrosus	+		
	Leiostomus xanthurus	+	+	+
	Menticirrhus americanus			+

(continued)

Table 14 . (Concluded)

Family	Species	Parker et al.	Van Dolah et al.	Present Study
Sciaenidae	*Menticirrhus littoralis*	+		+
(con't)	*Micropogonias undulatus*			+
	Pogonias cromis	+		+
	Sciaenops ocellatus			+
Mullidae	*Pseudupeneus maculatus*	+		
Ephippidae	*Chaetodipterus faber*	+	+	+
Chaetodontidae	*Chaetodon* sp.		+	
	Chaetodon aya			+
	Chaetodon ocellatus	+		+
	Chaetodon sedentarius			+
Pomacentridae	*Abudefduf saxatilis*			+
	Pomacentrus sp.		+	
	Pomacentrus dorsopunicans			+
	Pomacentrus variabilis			+
Labridae	*Halichoeres bivittatus*	+		
	Tautoga onitis	+	+	+
Mugilidae	*Mugil cephalus*			+
	Mugil sp.		+	
Sphyraenidae	*Sphyraena* sp.	+		
Uranoscopidae	*Astroscopus y-graecum*		+	+
Blenniidae	*Chasmodes bosquianus*			+
	Hypleurochilus geminatus		+	+
	Hypsoblennius hentzi			+
	Hypsoblennius sp.			+
	Blenniidae	+		+
Gobiidae	Gobiidae	+		
	Gobiosoma ginsburgi			+
Acanthuridae	*Acanthurus* sp.	+		
	Acanthurus chirurgus		+	
Trichiuridae	*Trichiurus lepturus*		+	
Scombridae	*Scomberomorus cavalla*	+	+	+
	Scomberomorus maculatus	+	+	+
Stromateidae	*Peprilus alepidotus*			+
Scorpaenidae	Scorpaenidae	+		
Triglidae	*Prionotus carolinus*	+		
Bothidae	*Paralichthys dentatus*	+		
	Paralichthys lethostigma		+	+
	Scophthalmus aquosus			+
Soleidae	*Trinectes maculatus*			+
Cynoglossidae	*Symphurus plagiusa*			+
Balistidae	*Balistis capriscus*	+		
	Monacanthus hispidus	+		+
Ostraciidae	*Lactophrys* sp.	+		
Tetraodontidae	*Sphoeroides maculatus*	+	+	
Diodontidae	*Chilomycterus schoepfi*		+	
	# of taxa	60	33	83

summer, and early fall. As the more northerly waters cool late in the year, the species moves south of the Virginia capes (Bigelow and Schroeder, 1948). Apparently, a substantial portion of the population moves south of the North Carolina capes, and enters the coastal waters of the South Atlantic Bight. During spring, there is a northerly movement as the water warms. Our sampling showed that most of the smooth dogfish were taken in spring, and of these 468 individuals, 466 were collected in gill nets fished outside the south jetty. It appears that, during spring, this species moves north in shallow coastal waters, and when it encounters the south jetty it moves slightly offshore and north again. This route would significantly reduce the probability of catching this shark in nets fished on the north jetty.

Finally, it should be noted that although the jetty fauna is similar to offshore reef faunas, there are differences. A major difference between the jetties and offshore reefs is the much lower diversity found on the jetties than on natural reefs (Sedberry and Van Dolah, 1984). Lindquist et al. (1985) also noted a similar low number of species in visual counts on jetties off North Carolina. Lindquist et al. (1985) reported a marked decrease in number of species in colder months (they found no fishes present in December), a finding similar to that in the present study. The increase in diversity in warmer months in both studies is a result of the presence of seasonal visitors and tropical strays (chaetodontids, pomacentrids) in summer.

A second major difference between the jetties and offshore reefs is the smaller size of many species on the jetty (Buchanan, 1973; SCWMRD, 1984; Wenner et al., 1986; Sedberry, in prep.). Black sea bass, sheepshead, spadefish, and gag observed on the jetties consisted mainly of small juveniles, the adults of which occur in deeper waters, considerably farther offshore. Although many of these smaller fishes are of little value to recreational fishermen on the jetties (and some, such as black sea bass are usually of sublegal size), the jetties obviously serve as nursery areas for these fishes, where they can feed and seek shelter from predators. The near absence of economically important fishes on the jetty in winter indicates seasonal migration, probably in late fall, to offshore reefs where the water is warmer. Thus, the jetties may be important in providing recruits to offshore fishing grounds. A tagging study of an abundant and economically important species on the jetties (e.g., black sea bass) would be a valuable contribution to our understanding of juvenile migrations and recruitment of these economically important species, and would help to further evaluate the contribution of the jetties to stocks of important fishery species.

2. Fish Food Habits

Description of Species Diets: The stomach contents of 55 species of fish were examined (Appendix 3). The number of specimens varied between predators and among seasons due to differences in abundance, susceptibility to capture, and stomach fullness. Twenty-four of the 55 species were represented by fewer than five specimens each. This precluded a definitive analysis of some species' diets. Nevertheless, it is apparent from this study that many fish feed extensively on the jetty biota while others feed primarily in adjacent sand bottom habitats. Several other species are largely piscivorous, and a few feed principally on zooplankton.

The food habits of all species examined are summarized below. Food habits are compared among size classes for those species represented by at least three specimens in each of three or more size intervals. The chosen interval varied with the ultimate size of the species.

Mustelus canis - Twenty-five specimens of the smooth dogfish were analyzed from spring collections. These ranged in size from 590 to 980 mm (TL) with all except five individuals falling in the 600- to 700-mm range. Decapods were the most frequently encountered prey items, and were also dominant in number and volume (Table 15). They included several species of brachyuran and anomuran crabs, as well as some penaeid shrimps (Appendix 3.1). Stomatopods and fish ranked second and third, respectively, in percent frequency and total volume. Relatively small contributions to the diet were made by polychaetes, bivalves, and squid. One small dogfish (460 mm), collected in summer, contained only decapods and polychaete fragments in its stomach. These findings are consistent with those reported by Hildebrand and Schroeder (1928) who noted that the smooth dogfish fed mostly on larger crustaceans.

Rhizoprionodon terraenovae - Menhaden (Brevoortia tyrannus) composed the entire stomach contents of the only sharpnose shark (595 mm TL) collected during the course of this study (Table 15; Appendix 3.2). The food of this shark is known to consist mostly of fish and crustaceans (Hildebrand and Schroeder, 1928).

Sphyrna lewini - A single specimen (755 mm TL) of the scalloped hammerhead shark collected in spring contained only anchovies (Anchoa hepsetus) and spot (Leiostomus xanthurus) in its stomach (Table 15; Appendix 3.3).

Sphyrna tiburo - Six bonnethead sharks (545-924 mm TL) were analyzed from spring and summer collections (Appendix 3.4). Stomatopods constituted > 80 % of the total prey volume from spring specimens; however, fish were numerically dominant (Table 15). In summer specimens, decapods dominated the diet of S. tiburo both numerically and volumetrically (Table 16). Hildebrand and Schroeder (1928) reported the presence of fish, crabs, shrimp, and other crustaceans in specimens of the bonnethead shark.

Raja eglanteria - Twenty-five clearnose skates (248-615 mm DW) were analyzed from spring collections (Appendix 3.5). Decapods and fish (especially spot) were consumed most frequently (72 and 60 % frequency of occurrence, respectively), and these taxa constituted 94 % of the total food volume among all skates examined (Table 15). Mysids were the most numerous prey items. Crustaceans and fish have been cited by others as the primary food items of clearnose skate (Hildebrand and Schroeder, 1928) and two congeneric species, as well (McEachran et al., 1976). In the smallest size class (200-300 mm DW), decapods made up the greatest share of total prey volume, but fish were also important (Fig. 10). In the four larger size classes (400-700 mm DW), fish (particularly juvenile spot) accounted for most of the food volume, indicating a trend toward an increasingly piscivorous habit as skates increase in size.

Dasyatis americana - Only three specimens of the southern stingray (325-585 mm DW) were collected. The diet of this species was dominated numerically by haustoriid amphipods and glycerid polychaetes; however, two

Table 15. Percent volume displacement of major prey taxa consumed by predators in spring.

Predator \ Prey taxa	Algae	Hydrozoa	Polychaeta	Gastropoda	Pelecypoda	Cephalopoda	Copepoda	Ostracoda	Cirripedia	Isopoda	Amphipoda	Mysidacea	Stomatopoda	Decapoda	Sipuncula	Bryozoa	Echinoidea	Ophiuroidea	Pisces
Mustelus canis			1		<1	<1							21	61					16
Rhizoprionodon terraenova																			100
Sphyrna lewini																			100
Sphyrna tiburo													81	4					15
Raja eglanteria												1	5	17					77
Dasyatis americana			16								6	1		3					74
Dasyatis sabina			77											23					
Gymnura micrura														23					77
Myliobatis freminvillei				54										46					
Anchoa hepsetus					7			2			48	17		25					
Bagre marinus																			100
Opsanus tau	<1	<1			<1				<1		<1			52		<1	2		45
Gobiesox strumosus	<1	<1		19	<1		<1	<1	6	19	51					3			
Urophycis earlli											1			39					60
Menidia menidia			3		<1		6		<1		81	<1		2					8
Syngnathus fuscus							28				69					3			
Centropristis striata	1	<1	8	<1	<1		<1			<1	12	2		38	<1	<1		6	33
Pomatomus saltatrix																			100
Selene setapinnis						97													3
Archosargus probatocephalus	4	5			80					<1	7			3					
Diplodus holbrooki	58										24				18				
Lagodon rhomboides	1	3					<1				4			4					88
Cynoscion nebulosus																			100
Cynoscion regalis																			100
Leiostomus xanthurus			3				31				53	7		5					
Menticirrhus americanus														100					
Menticirrhus littoralis				<1	<1						1	<1		99					
Pogonias cromis	1	<1	<1	<1	78						<1			21					
Tautoga onitis	<1		1	<1	66						10			22		1			
Hypleurochilus geminatus	2	7	4		2				1		81					1			
Hypsoblennius hentzi			12		1			1	31	7	48					1			
Peprilus alepidotus				17															83
Paralichthys dentatus												67		33					
Gobiosoma ginsburgi			2		7						89					2			

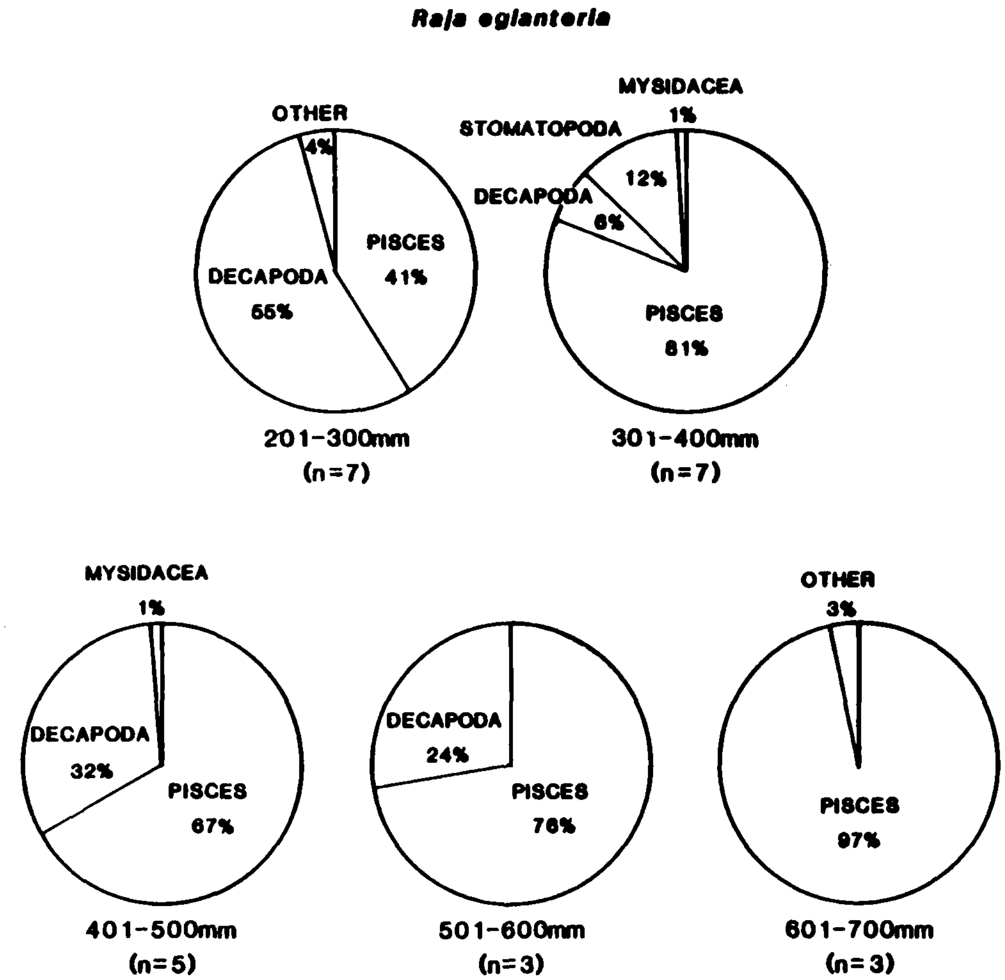


Figure 10. Percent volume displacement of major prey taxa consumed by clearnose skates (Raja eglanteria) of different size classes (n = number of fish in each size class, all seasons combined).

Atlantic silversides (Menidia menidia) composed > 75 % of the total prey volume (Appendix 3.6; Table 15). The food of stingrays, in general, has been reported to consist primarily of benthic invertebrates (Darnell, 1958).

Dasyatis sabina - A single Atlantic stingray (304 mm DW) was collected in spring. Its diet was dominated numerically and volumetrically by glycerid polychaetes (Appendix 3.7; Table 15). The anomuran mud shrimp Callianassa atlantica also made up a substantial proportion of total prey volume. Hildebrand and Schroeder (1928) reported that specimens of this stingray contained fragments of crustaceans in their stomachs.

Dasyatis sayi - One individual (315 mm DW) of the bluntnose stingray was collected in summer. Its stomach contained mostly decapods, but also a few mysids (Appendix 3.8; Table 16).

Gymnura micrura - Spot accounted for > 76 % of the total prey volume in the two smooth butterfly rays (335-415 mm DW) with food in their stomachs. The caridean shrimp Ogyrides alphaerostris (Appendix 3.9) was the only other prey item encountered. Hildebrand and Schroeder (1928) noted that little is known of the food of this species, except that it does feed on crabs and, presumably, on other crustaceans as well.

Myliobatis freminvillei - The stomach contents of 11 bullnose rays (307-480 mm DW) consisted almost entirely of pagurid crabs and gastropod shell fragments (Table 15; Appendix 3.10). Conceivably, many of these gastropod shells harbored the hermit crabs prior to their being ingested, although the literature suggests that molluscs themselves constitute an important food source for this species (Hildebrand and Schroeder, 1928).

Elops saurus - The single ladyfish examined (205 mm SL) contained one fish in its stomach, the rough silverside Membras martinica (Appendix 3.11). A variety of fishes and penaeid shrimp have been cited as principal food items for adult ladyfish (Darnell, 1958; Diener et al., 1974; Sekavec, 1974). Copepods and crab zoea are reputedly more important in the diet of younger ladyfish (Odum and Heald, 1972).

Conger oceanicus - All of the conger eels collected in this study were taken from crab traps baited with menhaden or herring, and most of their stomachs contained only bait. However, two specimens collected in summer also contained other prey items (Table 16; Appendix 3.12). These included the red cleaning shrimp (Lysmata wurdemanni) and the skilletfish (Gobiesox strumosus) both of which are commonly found on stone jetties (Hildebrand and Schroeder, 1928; Williams, 1984). Hildebrand and Schroeder (1928) noted that conger eels feed chiefly on fish, but also eat other prey.

Opisthonema oglinum - The food of the three thread herrings analyzed from summer collections (156-168 mm FL) consisted primarily of nereid worms (Table 16; Appendix 3.13). Other food items included pelagic copepods, one decapod, and some larval blennies. Since the food of this species is known to consist largely of zooplankton (Hildebrand and Schroeder, 1928; Carr and Adams, 1973), it is likely that the nereid worms, which are typically benthic in habit as adults, were swarming in the water column when they were consumed.

Table 16. Percent volume displacement of major prey taxa consumed by predators in summer.

Predator \ Prey taxa	Algae	Foraminifera	Porifera	Hydrozoa	Anthozoa	Polychaeta	Gastropoda	Pelecypoda	Cephalopoda	Pycnogonida	Copepoda	Ostracoda	Cumacea	Cirripedia	Isopoda	Amphipoda	Mysidacea	Stomatopoda	Decapoda	Bryozoa	Ophiuroidea	Ascidiacea	Pisces
Mustelus canis						<1													100				
Sphyrna tiburo																		5	95				
Dasyatis sayi																	<1		100				
Gymnura micrura																							100
Conger oceanicus																			49				51
Opisthonema oglinum						96					<1								<1				3
Anchoa hepsetus																			100				
Arius felis									73					<1				9	4				13
Opsanus tau	<1			<1		<1		<1											5	<1			94
Gobiesox strumosus								25			<1				25	1			43				6
Hyporhamphus unifasciatus	13			<1		1		2			26			12	2	33		<1	12				
Strongylura marina						<1			3														97
Membras martinica											70			20					10				
Centropristis striata	<1			<1	6	<1	<1	<1							<1	<1	<1		21	<1	3		70
Pomatomus saltatrix						8												<1	6				86
Chloroscombrus chrysura						33					17					17			33				
Selene vomer																	1						99
Trachinotus carolinus																			100				
Orthopristis chrysoptera	<1					85	2	4							<1	<1			8				
Archosargus probatocephalus	22			1				<1								<1			11		1	65	
Diplodus holbrooki	26	<1		1			2	37						<1	4	3			27	2			
Lagodon rhomboides	31			3				2						2	<1	11	<1		21	<1		6	25
Cynoscion nebulosus									11										15				74
Cynoscion regalis																							100
Leiostomus xanthurus						3	2	52			<1		<1	3	<1	7	15		16				
Menticirrhus americanus																		37	62				
Menticirrhus littoralis								8								<1	2		90				
Micropogonias undulatus																	<1		100				
Pogonias cromis							<1	76						<1	1		<1		22				<1
Sciaenops ocellatus																			33				67
Chaetodipterus faber	7		70	2	15					<1					<1	2			<1	1	<1	2	
Tautoga onitis	<1			<1		2		29						38	<1	<1			18	11			
Astroscopus y-graecum																			89				10
Hypleurochilus geminatus				43		1		8							7	<1				11		24	
Hypsoblennius hentzi				6		53								37	2	1							
Scomberomorus cavalla																							100
Scomberomorus maculatus																							100
Sphoeroides maculatus																			100				
Gobiosoma ginsburgi		1				16		15			23	3		1	7	25			6				

Anchoa hepsetus - Three specimens of the striped anchovy were analyzed (47-108 mm FL). In two specimens from spring collections, epifaunal amphipods were the most numerous prey items and also constituted the greatest proportion of food volume (Appendix 3.14). Mysids and decapods were equally abundant, but decapods contributed a greater share of the total prey volume (Table 15). The one striped anchovy from summer collections contained an unidentified majid crab as the only prey item. Hildebrand and Schroeder (1928) noted that the food of this anchovy consists almost entirely of small crustaceans.

Arius felis - Three specimens of the hardhead catfish were taken in summer collections (227-288 mm SL). Decapods and fish were found in all stomachs, but made up a relatively small portion of the total prey volume in comparison to the squid *Lolliguncula brevis*, which accounted for about 73 % of the total food volume (Table 16; Appendix 3.15). Decapods were the most numerous prey items, while the gooseneck barnacle *Lepas pectinata* ranked second in abundance. These results support other evidence that *A. felis* is primarily a bottom feeder, but also feeds on fish, squid, and other pelagic prey items (Darnell, 1958; Diener et al., 1974; Odum and Heald, 1972).

Bagre marinus - The one specimen of the gafftopsail catfish collected (329 mm FL) contained a single unidentifiable fish in its stomach (Appendix 3.16). Darnell (1958) reported that this fish feeds primarily on blue crabs and penaeid shrimp, although fishes and other invertebrates may also be eaten. Similar findings were reported by Odum and Heald (1972).

Opsanus tau - The stomach contents of 23 oyster toadfish (150-280 mm TL) consisted mostly of decapods, fish, barnacles, and mussels (Tables 15-17; Appendix 3.17). Rock crabs (*Cancer irroratus*) were particularly important in the diet of spring specimens, but were not found in specimens taken in summer or fall. This is consistent with the ecology of the rock crab which is known to move offshore in summer after it has molted (Williams, 1984). A number of other brachyuran and anomuran crabs, as well as penaeid and caridean shrimps, were also present in toadfish stomachs. Fish composed a large portion of the total food volume in spring and summer, but not in fall, when toadfish fed mostly on mussels and barnacles. The Atlantic silverside (*Menidia menidia*) was the most important prey item in spring specimens, while menhaden (*Brevoortia tyrannus*) and black sea bass (*Centropristis striata*) constituted most of the food volume in summer specimens. Although there were no consistent trends in food preference with increasing predator size, it should be noted that decapods, particularly small mud crabs (*Panopeus herbstii*), made up most of the prey volume among toadfish in the smallest size class, while fish were the dominant prey items in the larger size classes (Fig. 11). Rock crabs replaced mud crabs as the dominant decapod species consumed by the largest size class of toadfish. Larger toadfish also ate fewer mussels and barnacles than did smaller fish. These results support previous observations that toadfish are omnivorous bottom-feeders (Hildebrand and Schroeder, 1928).

Gobiesox strumosus - Several skilletfish (15-74 mm TL) were collected during all four seasons; their stomach contents consisted primarily of jetty biota (Appendix 3.18). Amphipods dominated the diet with respect to frequency, number, and volume in spring specimens and were also numerically dominant in winter (Tables 15-18). Isopods, particularly *Paradella quadripunctata*, were

Table 17. Percent volume displacement of major prey taxa consumed by predators in fall.

Predator \ Prey taxa	Algae	Foraminifera	Porifera	Hydrozoa	Anthozoa	Polychaeta	Gastropoda	Pelecypoda	Pycnogonida	Copepoda	Ostracoda	Cumacea	Cirripedia	Isopoda	Amphipoda	Mysidacea	Decapoda	Insecta	Sipuncula	Bryozoa	Ophiuroida	Ascidiacea	Pisces
Elops saurus																							100
Opsanus tau				2				40					40				18						
Gobiesox strumosus				2				4				2	4	54	36								
Urophycis earlli								10						<1			88						2
Hyporhamphus unifasciatus	8												1	<1	1		66	24					
Strongylura marina																	<1						100
Centropristis striata	<1			1		<1	<1	<1						<1	5		29				3	6	54
Pomatomus saltatrix																							100
Selene vomer																	64						35
Archosargus probatocephalus	47			8			<1	35	<1				10		2					<1			
Diplodus holbrooki													3	4	93								
Lagodon rhomboides	2	<1	1	3		3		14						<1	65		12			<1	<1		
Cynoscion nebulosus																							100
Cynoscion regalis																							100
Leiostomus xanthurus	<1			<1		<1	2	41						5	47	<1	4		<1	<1		<1	
Menticirrhus americanus	5							<1									69						26
Menticirrhus littoralis															<1		100						
Pogonias cromis	<1					<1	<1	95					<1	<1			2					2	
Sciaenops ocellatus																	57						43
Chaetodipterus faber	24			5	16										53							2	
Tautoga onitis	4			<1			<1	7	<1					1	79		6			1		2	
Hypleurochilus geminatus				49		6	<1	12	2			<1	7	9	12					1		2	
Hypsoblennius hentzi		<1		6		<1		2					36	10	40		<1			2		2	
Scomberomorus maculatus																							100
Paralichthys lethostigma																							100
Monacanthus hispidus							1	3						1	68							27	
Sphoeroides maculatus								97					<1				3						
Gobiosoma ginsburgi						4		36		4	8		1	10	38								

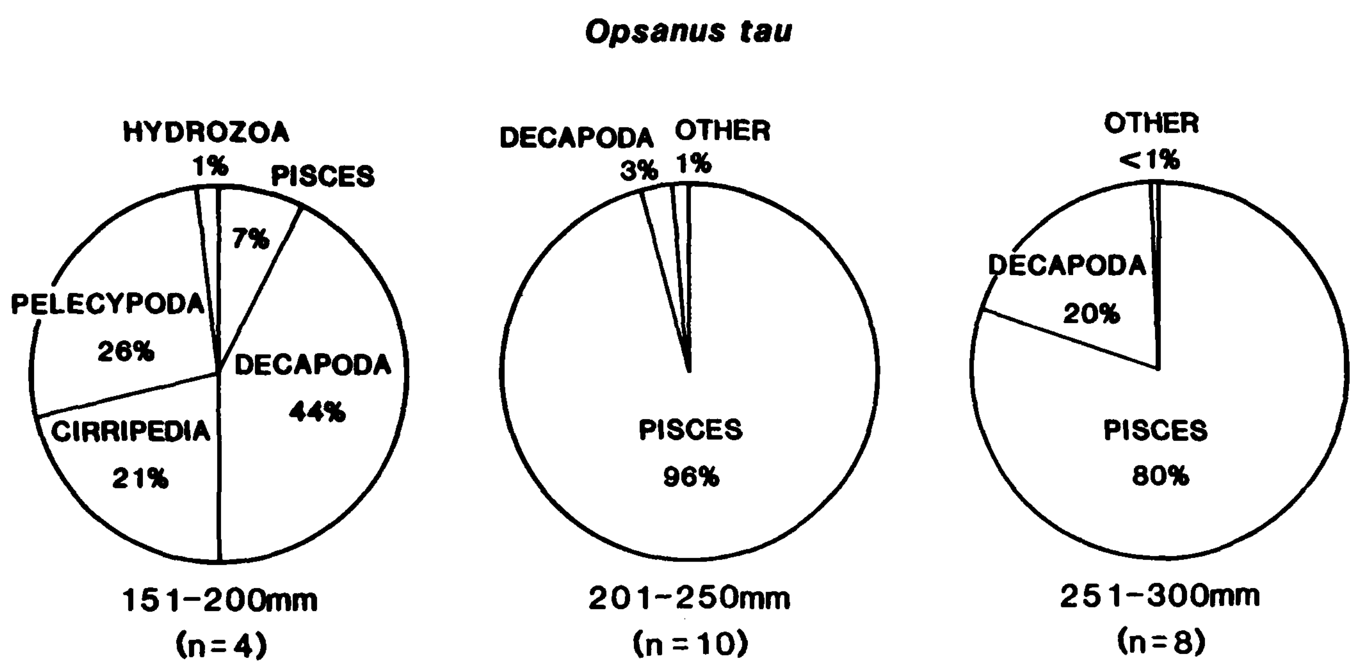


Figure 11. Percent volume displacement of major prey taxa consumed by oyster toadfish (Opsanus tau) of different size classes (n = number of fish in each size class, all seasons combined).

Table 18. Percent volume displacement of major prey taxa consumed by predators in winter.

Predator \ Prey taxa	Foraminifera	Hydrozoa	Polychaeta	Gastropoda	Pelecypoda	Copepoda	Ostracoda	Cumacea	Cirripedia	Isopoda	Amphipoda	Decapoda	Bryozoa	Echinoidea	Ascidiacea
Gobiesox strumosus		2			4			2	4	54	36				
Archosargus probatocephalus			25	6						25	44				
Lagodon rhomboides			38								54	8			
Leiostomus xanthurus					7	<1				9	83			<1	
Hypleurochilus geminatus	1	45	4		5	2	<1		3	13	5	1	9		9
Hypsoblennius hentzi		10	10							80					
Gobiosoma ginsburgi		1	19		8	7				20	50				

the most abundant prey items in summer and fall (Tables 16-17), and ranked second numerically in spring and winter. Isopods and amphipods have been cited as the major prey items of skilletfish by other researchers as well (Hildebrand and Schroeder, 1928; Odum and Heald, 1972). The shrimp Lysmata wurdemanni accounted for the greatest proportion of total prey volume in summer, but this species only occurred in one skilletfish stomach, while the mussel Brachidontes exustus and the isopod Paradella quadripunctata ranked second and third, respectively, in percent of total prey volume and occurred with much greater frequency. Other prey items included algae, hydroids, gastropods, ostracods, copepods, barnacles, and fish. With increasing predator size, isopods accounted for successively less of the total prey volume, while amphipods decreased slightly and then increased dramatically in percent of total prey volume (Figure 12). Molluscs, particularly pelecypods, constituted a greater proportion of the total diet in the two large size classes.

Urophycis earlli - Two of the four (160-255 mm SL) Carolina hake that were collected contained food. Xanthid and pinnixid crabs, skilletfish, and amphipods dominated the diet of this species (Tables 15, 17; Appendix 3.19). There appear to be no other published accounts of the Carolina hake's diet.

Hyporhamphus unifasciatus - Thirty-six halfbeaks (133-215 mm SL) were collected in summer and fall. The diet of summer specimens consisted primarily of copepods and caprellid amphipods, while that of fall specimens was composed mostly of pinnixid crabs and caprellid amphipods (Tables 16, 17; Appendix 3.20). Alga was found in stomachs from both seasons, while hydroids, polychaetes, and mussels were encountered in summer specimens only. There were no obvious changes in food habits with increasing predator size within the range of specimens analyzed. Hildebrand and Schroeder (1928) reported that the food of eight adult specimens consisted of small crustaceans, molluscs, and vegetable matter.

Strongylura marina - Twenty-six of the 55 specimens examined contained food. These ranged in size from 284-460 mm (SL). The food of Atlantic needlefish consisted principally of fish (Tables 16, 17; Appendix 3.21). Thread herring (Opisthonema oglinum) dominated the diet of summer specimens, and rough silversides (Membras martinica) were dominant in fall. Other prey items of lesser importance included anchovies, squid, polychaetes and pinnixid crabs. Other researchers have also observed that this species is almost exclusively piscivorous, particularly as an adult (Carr and Adams, 1973; Darnell, 1958; Hildebrand and Schroeder, 1928).

Membras martinica - Stomach contents of the only rough silverside containing food (58 mm SL) consisted entirely of zooplankton (Table 16; Appendix 3.22). Calanoid copepods were the most abundant prey items and also composed most of the food volume. Cypris larvae and crab zoea were also present.

Menidia menidia - Twenty-five Atlantic silversides (74-90 mm SL) were examined from spring collections and all contained food. Caprellids and other epifaunal amphipods constituted most of the stomach contents, both numerically and volumetrically (Table 15; Appendix 3.23). Calanoid copepods were also abundant but contributed relatively little to the total food volume. Other prey items included juvenile spot, crab zoea, polychaetes, and bivalves. These findings support other evidence that Atlantic silversides

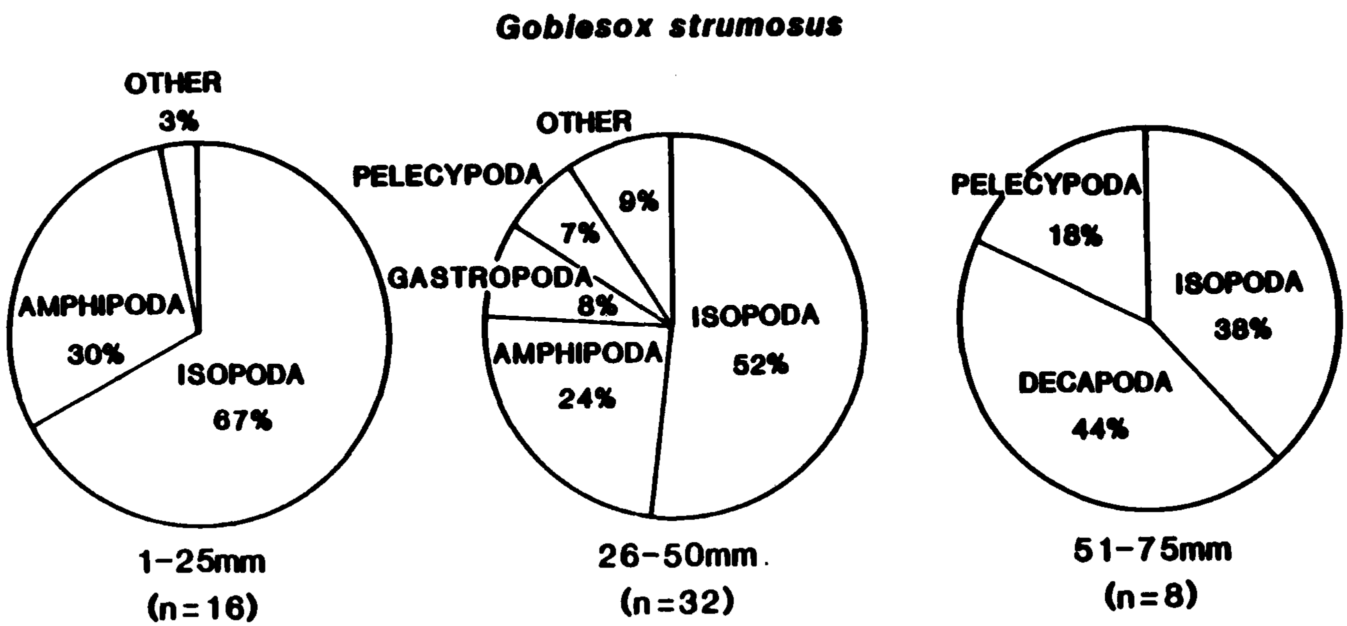


Figure 12. Percent volume displacement of major prey taxa consumed by skilletfish (*Gobiesox strumosus*) of different size classes (n = number of fish in each size class, all seasons combined.

feed principally on small crustaceans, both in the benthos and in the plankton (Adams, 1976; Bengtson, 1984; Hildebrand and Schroeder, 1928). There were no detectable changes in food habits with increasing predator size within the range of specimens examined.

Syngnathus fuscus - The northern pipefish was represented by 26 specimens taken in spring collections. Eight of these, ranging in size from 107-140 mm (TL), contained food. Calanoid copepods and epifaunal amphipods, particularly Caprella penantis, constituted most of the prey volume (Table 15; Appendix 3.24). Bryozoans, the only other prey items consumed, accounted for a very small portion of the diet. Copepods and amphipods have been cited as the principal prey taxa for pipefish by other researchers, as well (Adams, 1976; Hildebrand and Schroeder, 1928).

Centropristis striata - The food habits of 75 black sea bass (71-218 mm SL) collected during spring, summer, and fall were analyzed. These fish consumed a wide variety of prey species, consisting largely of jetty biota and fish (Appendix 3.25). Some infaunal and soft-bottom epifaunal species were also consumed. These findings support Steimle and Ogren's (1982) observation that black sea bass are "opportunistic benthic omnivores." Amphipods, especially caprellids, were the most abundant prey items in spring and fall, but accounted for relatively little of the total prey volume (Tables 15 and 17). Decapods were numerically dominant in summer (Table 16) and also made up the largest share of prey volume in spring. Fish contributed almost as much as decapods to the total food volume in spring, and accounted for most of the food volume in summer and fall. The high proportion of fish in the fall diet is partially suspect, however, since many of the black sea bass were collected in traps baited with menhaden (Brevoortia tyrannus), the species which composed most of the stomach contents. Even discounting this species, however, fish accounted for about one-third of the total prey volume in all seasons. Other prey items included algae, hydroids, anemones, polychaetes, gastropods, bivalves, mysids, copepods, isopods, sipunculans, bryozoans, ophiuroids, and ascidians. In a previous study of the food habits of black sea bass collected near the Murrells Inlet jetty (Van Dolah et al., 1984), decapods and fish were also the dominant prey items (by volume); however, amphipods were much less important numerically than they were in this study.

Fish were the dominant prey items in all size classes, but were increasingly important in the diet of black sea bass with increasing predator size (Fig. 13). Decapods consistently ranked second in importance, accounting for roughly one-fifth to one-third of the total prey volume in all size classes. These results differ from those reported for black sea bass collected offshore in hard-bottom habitats (SCWMRD, 1984). In that study, amphipods composed most of the prey volume in the smallest size class (50-100 mm), and decapods were dominant in the 101- to 150-mm and the 151- to 200-mm size classes. Fish were volumetrically dominant only in black sea bass > 200 mm.

Pomatomus saltatrix - Seventy-two bluefish (182-383 mm FL) were examined from spring, summer, and fall collections. These fish were almost exclusively piscivorous, regardless of season or size class (Figure 14). The Atlantic silverside, Menidia menidia, ranked first numerically and volumetrically in the diet of spring specimens, and second in the diet of fall specimens

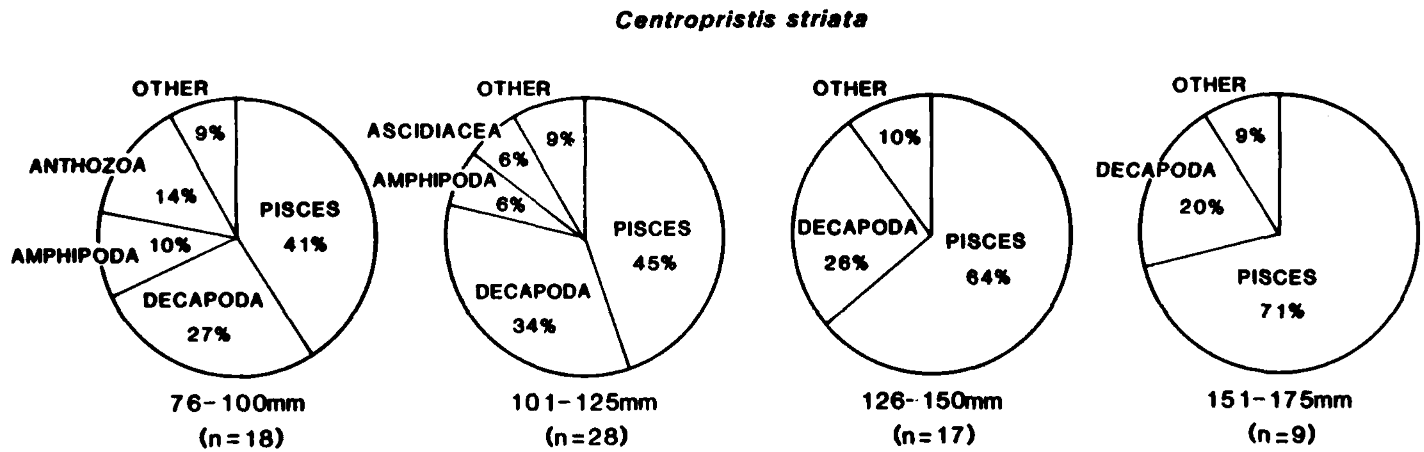


Figure 13. Percent volume displacement of major prey taxa consumed by black sea bass (Centropristis striata) of different size classes (n = number of fish in each size class, all seasons combined).

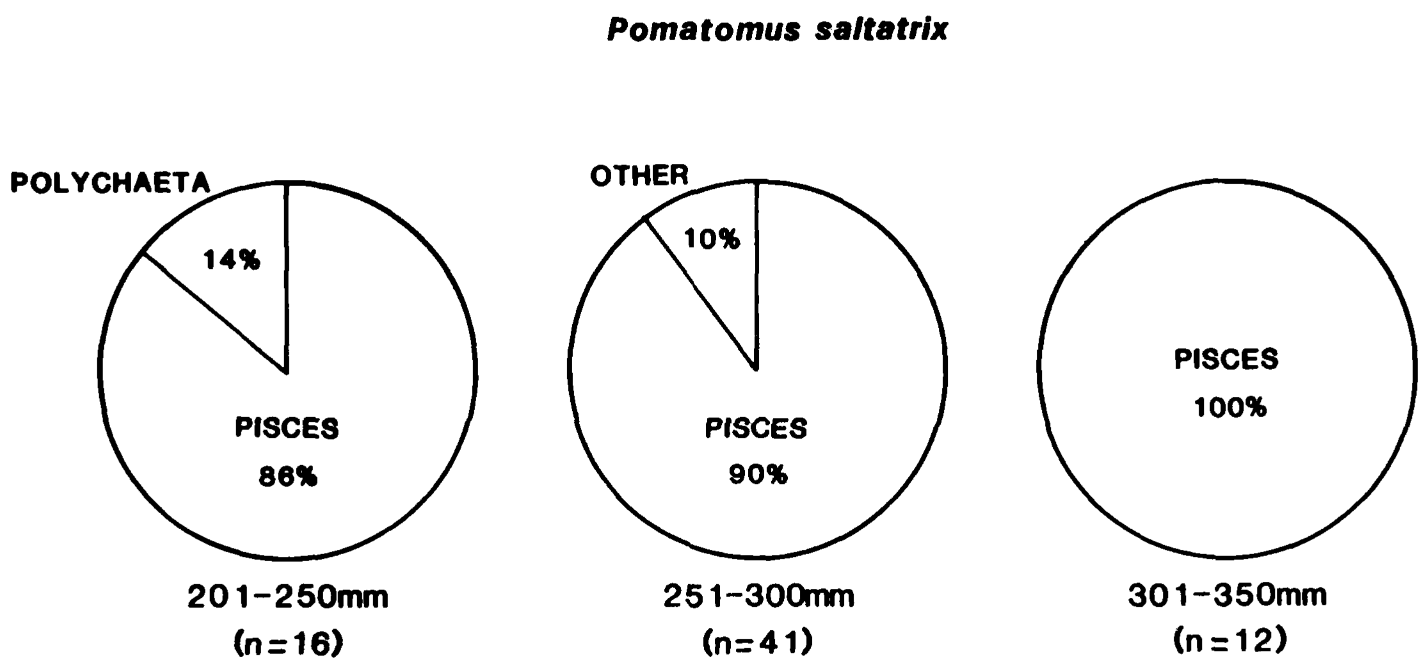


Figure 14. Percent volume displacement of major prey taxa consumed by bluefish (Pomatomus saltatrix) of different size classes (n = number of fish in each size class, all seasons combined).

(Appendix 3.26). Menhaden (Brevoortia tyrannus) made up most of the prey volume in summer and fall, and ranked second by volume in spring specimens. Silversides and menhaden have been cited by other researchers as the principal prey species of bluefish (Grant, 1962; Hildebrand and Schroeder, 1928). Bluefish also consumed at least 10 other species of fish, including other bluefish, supporting the observation made by Hildebrand and Schroeder (1928) that "the bluefish is a voracious feeder, being highly predatory on other fishes." Nereid worms were abundant in the diet of summer specimens but accounted for relatively little of the total prey volume. Negligible contributions to the diet of summer specimens were made by the stomatopod Squilla sp. and the speckled crab Arenaeus cribrarius. Although invertebrates were relatively unimportant in the diets of bluefish examined in this study, Gallaway et al. (1981) found rock shrimp and penaeid shrimp to be important in the diets of larger (450-500 mm FL) bluefish collected in the Gulf of Mexico, and Richards (1976) noted that squid were the most frequently consumed prey of bluefish collected from Long Island Sound.

Chloroscombrus chrysurus - Only two specimens of the Atlantic bumper (66 and 160 mm SL) contained food in their stomachs. None of the prey items could be identified to the species level, but the remains of polychaetes, copepods, amphipods, and decapods were recognized (Table 16; Appendix 3.27). No other published accounts of this species' food habits could be found.

Trachinotus carolinus - A single Florida pompano (166 mm FL) contained one hermit crab (Pagurus longicarpus) in its stomach (Appendix 3.28). Hildebrand and Schroeder (1928) reported the presence of molluscs, crustaceans, fish, and ova of unknown origin in the stomachs of pompano.

Selene setapinnis - The only specimen (162 mm FL) of the moonfish that contained food had consumed primarily squid (Table 15; Appendix 3.29). Menhaden composed a much smaller portion of the diet. The moonfish is reported to be carnivorous, feeding principally on fish (Hildebrand and Schroeder, 1928).

Selene vomer - Six specimens (107-218 mm FL) of the lookdown contained food. Striped anchovies (Anchoa hepsetus) dominated the diet of this fish in summer, accounting for 95 % of the total prey volume (Appendix 3.30). The stomach contents of specimens collected in fall were dominated by the caridean shrimp, Ogyrides sp. These results are consistent with those reported by Hildebrand and Schroeder (1928) who found small crustaceans and fish in the stomachs of their six specimens.

Orthopristis chrysoptera - Pigfish were captured only in summer and their diet consisted primarily of infaunal polychaetes (Table 16; Appendix 3.31). The burrowing polychaete, Arabella iricolor, alone composed 82 % of the total prey volume in the seven specimens (56-246 mm TL) examined. Other prey items included gastropods, bivalves, isopods, amphipods, and decapods. Pigfish have been described as omnivores or carnivores feeding principally on benthic invertebrates (Adams, 1976; Carr and Adams, 1973; Darcy, 1983; Hildebrand and Schroeder, 1928).

Archosargus probatocephalus - Nine of the 12 sheepshead stomachs examined contained food, consisting mostly of jetty biota. Specimens from which the stomachs were taken ranged in size from 100 to 430 mm (SL). The scorched mussel (Brachidontes exustus) was the most abundant prey item and constituted most of the food volume in the only specimen collected in spring (Appendix 3.32). The seasonally variable abundance of mussels in the sheepshead diet has also been observed by Odum and Heald (1972). Epifaunal amphipods ranked second numerically, but accounted for relatively little of the prey volume in spring. In each of the other three seasons, amphipods were numerically dominant and, in winter, they comprised the largest percentage of total prey volume (Table 18). The ascidian Eudistoma carolinense accounted for most of the prey volume in the only summer specimen collected, while algae dominated the diet, by volume, in fall. Other prey species included hydroids, polychaetes, gastropods, bivalves, pycnogonids, barnacles, isopods, decapods, bryozoans, and echinoderms. By contrast, Van Dolah et al. (1984) found that the diet of four sheepshead collected at Murrells Inlet from 1979 through 1982 consisted almost entirely of mussels or algae. The importance of sessile biota (particularly algae and mussels) in the diet of sheepshead has been documented by other researchers as well (Gallaway et al. 1981; Hildebrand and Schroeder, 1928; Lindquist et al. 1985; Overstreet and Heard, 1982; Sedberry, in prep.; Steimle and Ogren, 1982).

Little can be deduced about size-related changes in food habits, since six of the nine specimens analyzed fell within the 200- to 250-mm size range. Other researchers, however, have observed a change in the diet of sheepshead, at about 35 to 50 mm (SL), from one consisting primarily of copepods, amphipods, chironomids, mysids, and polychaetes, to a more diversified diet consisting mostly of encrusting forms, including molluscs, barnacles, and algae (Odum and Heald, 1972; Springer and Woodburn, 1960). Ogburn (1984) found that juvenile sheepshead (52-63 mm SL) were omnivorous, like the adults, but consumed significantly greater volumes of filamentous brown algae and invertebrates, and significantly less red algae than the adults. In a study of the food habits of sheepshead collected from offshore hard-bottom reefs, Sedberry (in prep.) noted that smaller sheepshead (< 350 mm SL) had a diet dominated by bryozoans, whereas larger sheepshead also fed heavily on bryozoans but, in addition, consumed more bivalves, echinoderms, and ascidians than their smaller counterparts.

Diplodus holbrooki - Five specimens of the spottail pinfish (100-195 mm SL) were analyzed from spring, summer, and fall collections. By proportion of total food volume, algae were dominant in spring, mussels (Brachidontes exustus) were dominant in summer, and amphipods (primarily Caprella penantis) were dominant in fall specimens (Tables 15-18; Appendix 3.33). Other prey items included hydroids, gastropods, barnacles, isopods, decapods, sipunculans, and bryozoans. Most of the prey species consumed were typical of the jetty biota, but some (e.g., the sipunculans and the phoxocephalid amphipod, Rhepoxynius epistomus) were probably consumed in adjacent sand bottom habits. Lindquist et al. (1985) found that, like sheepshead, spottail pinfish had a diet dominated by algae; however, the latter species generally consumed lesser amounts of encrusting organisms and greater amounts of free-living amphipods, copepods, and isopods.

No changes in diet with increasing predator size could be detected, on the basis of so few specimens; however Carr and Adams (1973) observed three major dietary trends for spottail pinfish. Small juveniles (11-25 mm SL) were primarily planktivorous, while larger juveniles (21-60 mm SL) obtained a "modest" portion of their diet by cleaning ectoparasites and scales from other fish. Carr and Adams (1973) also found that spottail pinfish larger than 25 mm (SL) became very dependent on epiphytic algae, while animals (including sponges, copepods, shrimp, mysids, and small crabs) were of secondary importance. Darcy (1985) reviewed several other studies on the food of spottail pinfish.

Lagodon rhomboides - Pinfish ranging in size from 62 to 176 mm (SL), consumed a wide variety of prey species whose relative contributions to the diet of this predator changed with size and season (Tables 15-18; Appendix 3.34). Among the eight pinfish collected in spring, fish remains composed about 87 % of the total prey volume. In summer specimens, however, fish accounted for only 25 % of the prey volume, whereas algae made up more than 30 % and decapods accounted for almost as much (21 %) of the total diet as fish. Smaller contributions were made by amphipods, hydroids, mussels, barnacles, mysids, isopods, and bryozoans. In fall specimens, amphipods (primarily Caprella penantis and Cerapus tubularis) dominated the diet both numerically and volumetrically, while mussels (Brachidontes exustus) ranked second in importance. Epifaunal amphipods also contributed most of the prey volume in winter specimens; however infaunal polychaetes, which composed almost one-third of the diet in winter, were also important. Seasonal changes in diet have been noted by other researchers as well (Hansen, 1969; Stoner, 1980). Hansen (1969) found that pinfish collected near Pensacola, Florida, had consumed mostly vegetation (including diatoms, filamentous algae, and vascular plants) in summer and fall; whereas, crustaceans (including amphipods, copepods, crabs, cyprids, isopods, mysids, and shrimp), polychaetes, and chordates (Amphioxus and fish) were the dominant food items in winter and spring.

A comparison of food habits among different size classes (Fig. 15) indicates a decrease in the importance of fish (blennies, gobies, and menhaden), and an increase in the importance of decapods, algae, and mussels with increasing predator size. Amphipods were most important in the intermediate size class (126-150 mm SL). The diet of pinfish also appears to become more diverse with increasing size, as demonstrated by the fact that no single taxon dominated the diet of fish in the largest size class (151-175 mm SL). Ontogenetic changes in the diet of pinfish have been well documented (Adams, 1976; Carr and Adams, 1973; Darcy, 1985; Darnell, 1958, 1961; Hansen, 1969; Stoner, 1980). Our study results are most similar to those of Darnell (1958) and Stoner (1980), both of whom noted a gradual transition from a more carnivorous habit to a more herbivorous one (within the size range encompassed by fish examined in our study). Other researchers who have investigated the food habits of pinfish include Diener et al. (1974), Hildebrand and Schroeder (1928), Lindquist et al. (1985), and SCWMRD (1984).

Cynoscion nebulosus - The diet of the spotted seatrout was composed entirely of fish in spring and fall (Tables 15, 17; Appendix 3.35). Spot (Leiostomus xanthurus) accounted for 100 % of the stomach contents in the spring specimen; whereas, rough silversides (Membras martinica) and thread herring (Opisthonema oglinum) accounted for about 97 % of the diet in fall specimens. The diet of spotted seatrout collected in summer was somewhat more varied, although fish (primarily, anchovies, spot, and thread herring) still made up most of the food volume (Table 16). Decapods (specifically, the caridean shrimp Ogyrides sp.) were numerically dominant in summer specimens and accounted for > 15 % of the total prey volume. The only other

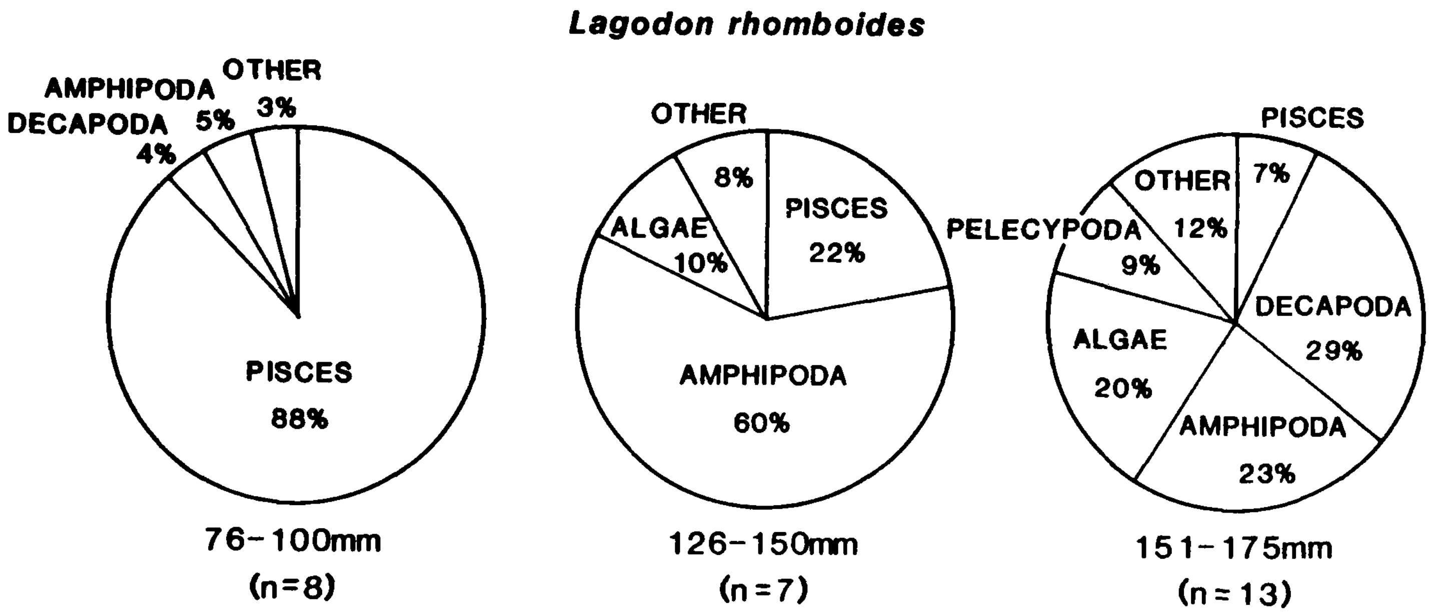


Figure 15. Percent volume displacement of major prey taxa consumed by pinfish (Lagodon rhomboides) of different size classes (n = number of fish in each size class, all seasons combined).

prey items consumed were squid. Smaller spotted seatrout (250-300 mm TL) consumed a higher percentage, by volume, of decapods (18.78 %) and squid (12.79 %) than did larger fish (300-350 mm). The comparable percentages of prey for spotted seatrout in the larger size class were 6.42 % (decapods) and 5.88 % (squid). However, larger seatrout consumed more fish, by volume (87.70 %) than did smaller ones (68.43 %). The food habits of this commercially and recreationally important fish have been studied and reviewed by numerous authors (Carr and Adams, 1973; Darnell, 1958, 1961; Mercer, 1984a; Odum and Heald, 1972; Overstreet and Heard, 1982; Pearson, 1929). Fish constituted the major food source in most of these studies, with crustaceans (usually penaeid and palaemonid shrimp) ranking second in importance. Pearson (1929), however, noted that shrimp (usually *Penaeus*) were more important than fish in the diet of spotted seatrout collected along the Texas coast, regardless of predator size. Other researchers have reported seasonal and size-related shifts in the relative importance of fish and crustaceans in the diet of spotted seatrout (Darnell, 1958; Hildebrand and Schroeder, 1928; Overstreet and Heard, 1982). In all of these studies, as in our study, crustaceans were more important as prey among smaller seatrout, while fish composed a greater share of the diet among larger seatrout.

Cynoscion regalis - The stomach contents of 12 weakfish (255-400 mm TL) collected during spring, summer, and fall consisted entirely of fish (Tables 15-18; Appendix 3.36). Spot (*Leiostomus xanthurus*) composed most of the prey volume in spring specimens while thread herring (*Opisthonema oglinum*) accounted for most of the prey volume in summer. The stomach contents of fall specimens were composed almost equally of anchovies (*Anchoa hepsetus*) and spot. Smaller weakfish (250-300 mm TL) consumed thread herring and spot in equal proportions (39 %, by volume, for each species), while the rest of their diet consisted of anchovies. Larger weakfish (> 300 mm TL) ate mostly spot (85 %, by volume), with smaller amounts of anchovies (10 %), silversides (2 %), thread herring (< 1 %), and unidentified fish remains (3 %) composing the rest of their diet. Merriner (1975) reported that the dominant food items in stomachs of weakfish collected in North Carolina waters were penaeid and mysid shrimp, anchovies, and clupeid fishes. Among the fish consumed, thread herring were most important, while anchovies and menhaden ranked second and third, respectively. Smaller weakfish fed more on mysids, and larger weakfish fed more on fishes in Merriner's (1975) study. Chao and Musick (1977) reported that fish (mostly *Anchoa mitchilli*) and planktonic crustaceans (primarily the mysid *Neomysis americana*) constituted the major portion of the diet of weakfish collected from the York River Estuary, Virginia. *Neomysis americana* and fish were also important in the diet of weakfish collected in estuaries between Georgetown, South Carolina and Jacksonville, Florida (Stickney et al., 1975).

Leiostomus xanthurus - Stomachs from postlarval, juvenile, and adult spot (12-208 mm SL) were examined from all four seasons. Their diet appeared to consist of prey from both jetty and sand-bottom habitats (Appendix 3.37). Amphipods accounted for > 50 % of the total prey volume in spring and fall, and > 80 % of the total prey volume in winter specimens (Tables 15, 17, and 18). Copepods (mostly pelagic forms) ranked second by volume displacement in spring specimens but were unimportant in the diet of spot during other seasons. A similar seasonal decline in the consumption of zooplankton has been reported by Currin et al. (1984). Pelecypods, primarily coquina clams

(Donax variabilis), ranked first by volume displacement in summer specimens, while decapods and mysids ranked second and third, respectively, contributing almost equal shares to the total prey volume. The mussel Brachidontes exustus composed almost half of the food volume in fall, but relatively little during other seasons. Additional prey items included algae, hydroids, polychaetes, gastropods, cumaceans, barnacles, isopods, bryozoans, ophiuroids, and ascidians. As a consequence of its diversity of prey, spot has been described as an omnivore by some researchers (Kobylinski and Sheridan, 1979) and as an opportunistic generalist by others (Currin et al. 1984).

Spot exhibited a marked change in food habits with increasing size (Fig. 16). In the smallest size class (1-25 mm), copepods accounted for almost two-thirds of the total prey volume, and amphipods constituted the other third. In the next larger size class (26-50 mm) amphipods were the dominant taxon, contributing more than two-thirds of the total prey volume, while copepods decreased drastically in importance. In the third size class (151-175 mm), amphipods were still dominant but accounted for somewhat less of the total prey volume than in the smaller size class, whereas the relative volume of pelecypods was substantially greater than it was in smaller specimens. Brachidontes exustus accounted for 23 %, and D. variabilis accounted for 12 % of the prey volume in this size class. This trend toward a greater consumption of bivalves (particularly mussels) and a smaller consumption of amphipods continued with increasing predator size (176-200 mm SL). In this size class, B. exustus accounted for 46 % while D. variabilis accounted for only 5 % of the total prey volume, suggesting an increased dependence on jetty fauna as food for adult spot.

As one of the dominant estuarine finfishes in the Southeast, spot have been included in numerous investigations and reviews of food habits (Adams, 1976; Chao and Musick, 1977; Currin et al., 1984; Darnell, 1958, 1961; Diener et al., 1974; Govoni et al., 1983, 1986; Hales and Van den Avyle, 1985; Hildebrand and Schroeder, 1928; Hodson et al., 1981; Kjelson et al., 1975; Kobylinski and Sheridan, 1979; Roelofs, 1954; Sheridan and Trimm, 1983; Smith et al., 1984; Stickney et al., 1975). It is apparent from many of these studies that the diet of spot changes both ontogenetically and with habitat. A fairly consistent trend, which was also observed in this study, is one in which larval and postlarval spot (up to 25 mm SL) feed almost exclusively on zooplankton, while juveniles and adults switch to a primarily benthic mode of feeding, consuming both infaunal and epifaunal organisms. In eelgrass communities and other marsh systems, detritus may be the dominant food for spot, especially larger ones that have changed to a bottom-feeding habit (Adams, 1976; Darnell, 1958, 1961; Chao and Musick, 1977). Aside from the current study, there have been no published reports on the diet of spot collected near rubble weir jetties.

Menticirrhus americanus - Five southern kingfish (227-278 mm SL) were analyzed from spring, summer, and fall collections (Tables 15-17; Appendix 3.38). Decapods dominated the diet of this species in all three seasons. The pinnotherid crab Pinnixa cristata composed 100 % of the stomach contents of the spring specimen. The stomach contents of the only specimen collected in summer consisted mostly of the caridean shrimp Ogyrides hayi, with lesser amounts of the stomatopod Nanosquilla sp. The mole crab (Emerita talpoida) was dominant, by volume, in fall specimens, while unidentified fish remains

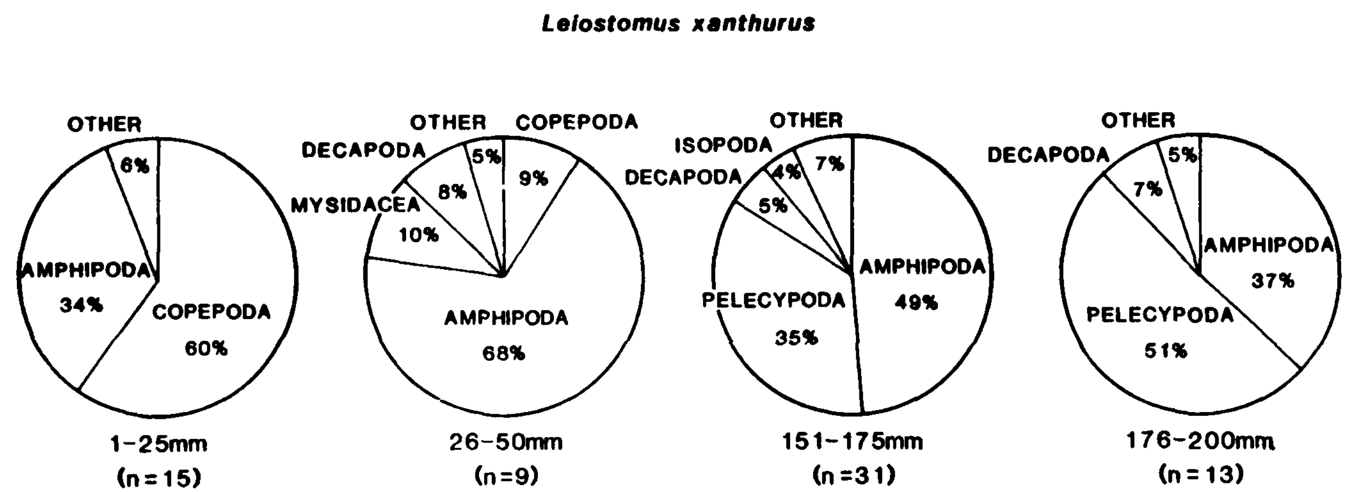


Figure 16. Percent volume displacement of major prey taxa consumed by spot (Leiostomus xanthurus) of different size classes (n = number of fish in each size class).

ranked second. Other prey included algae and mussels. These results are generally consistent with those of Hildebrand and Schroeder (1928) who noted that the food of this fish, as shown by the contents of 21 stomachs, consists primarily of crustaceans and secondarily of fish. Bearden (1963) observed that species of the genus Menticirrhus are primarily bottom feeders and that crustaceans and polychaetes were the most frequent items in the diet of all sizes of M. americanus examined.

Menticirrhus littoralis - The diet of 41 gulf kingfish (239-368 mm SL), collected in spring, summer, and fall consisted almost entirely of decapods (Tables 15-17; Appendix 3.39). These included a number of brachyuran crabs, as well as penaeid and caridean shrimps. The mole crab dominated the stomach contents of spring and fall specimens, by volume displacement; whereas, summer specimens had diets composed almost equally of the caridean shrimp Ogyrides hayi and the portunid crab Ovalipes ocellatus. Haustoriid amphipods and pelecypods were abundant in the diets of spring and summer specimens, respectively; however, neither taxonomic group accounted for much of the prey volume. Other prey items included gastropods, mysids, and fish. While pelecypods did not constitute a substantial portion of the total prey volume in any one season, bivalves (particularly Donax variabilis) were important in the diet of small (201-250 mm SL) gulf kingfish (Figure 17). Larger gulf kingfish (> 250 mm SL) consumed decapods almost exclusively. Bearden (1963) found that juveniles (25-80 mm SL) had fed almost entirely on beach fleas (Orchestia sp.), while adults had eaten fish, mole crabs (Emerita sp.), and stomatopods (Squilla sp.). Hildebrand and Schroeder (1928) found only crustaceans in the stomachs of specimens collected from the Chesapeake Bay.

Micropogonias undulatus - The stomach contents of four Atlantic croaker (176-267 mm SL) collected in summer consisted almost entirely of decapods (Table 16; Appendix 3.40). Penaeid shrimp made up more than half of the total food volume, and unidentified decapod remains constituted most of the remainder. Other prey items included mysids and caridean shrimp. Like spot, croaker is one of the most abundant estuarine finfishes in the Southeast (although the numbers collected in this study do not reflect this fact). Consequently, its food habits have been the subject of numerous investigations (Chao and Musick, 1977; Currin et al., 1984; Darnell, 1958, 1961; Diener et al. 1974; Govoni et al., 1983, 1986; Hansen, 1969; Kobylinski and Sheridan, 1979; Overstreet and Heard, 1978b; Pearson, 1929; Reid et al., 1956; Roelofs, 1954; Sheridan and Trimm, 1983; Stickney et al., 1975). Many of the comments concerning ontogenetic, seasonal, and regional differences in the diet of spot are relevant to croaker as well. Croaker, however, have been reported to feed less on meiofauna and more on large motile epifauna than spot (Currin et al., 1984). Other differences between the diets of these two sciaenids have been related to feeding behavior and gill raker morphology (Chao and Musick, 1977; Roelofs, 1954). Larval and postlarval croaker feed on zooplankton, while juveniles feed on small benthic invertebrates (especially polychaetes, bivalves, and amphipods), as well as small fish and organic debris (Currin et al., 1984; Darnell, 1958; Pearson, 1929). Large croaker (such as those examined in this study) feed more on larger crustaceans, especially penaeid shrimp and crabs (Hansen, 1969; Overstreet and Heard, 1978b; Pearson, 1929). Croaker have been variously described as omnivores (Kobylinski and Sheridan, 1979) or carnivores (Hansen, 1969), depending upon whether the vegetation component was viewed as important or incidental in the diet of this fish.

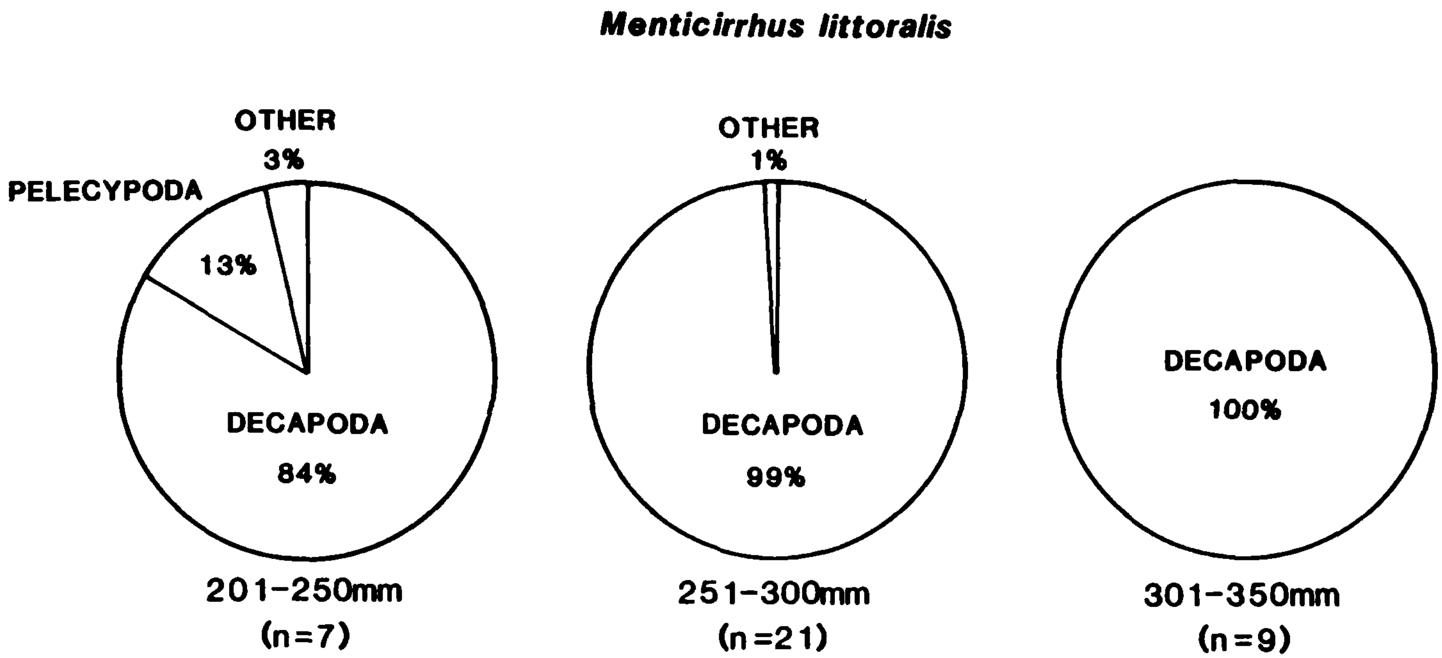


Figure 17. Percent volume displacement of major prey taxa consumed by gulf kingfish (Menticirrhus littoralis) of different size classes (n = number of fish in each size class, all seasons compbined).

Pogonias cromis - The diet of 12 black drum (222-463 mm SL) collected during spring, summer, and fall sampling periods, consisted primarily of mussels (Appendix 3.41; Tables 15-17). Brachidontes exustus accounted for at least two-thirds of the prey volume during each of the three seasons. Decapods, especially brachyuran crabs, were important in the diet of black drum collected in spring and summer, but not in fall. Other prey items present in smaller amounts included algae, hydroids, polychaetes, gastropods, barnacles, mysids, isopods, amphipods, ascidians, and fish. Smaller black drum (300-400 mm SL) consumed more decapods (37 % by volume) and fewer mussels (62 % by volume) than larger black drum, which fed almost exclusively on mussels (98 % by volume). These results are consistent with those reported in the literature (Darnell, 1958, 1961; Diener et al., 1974; Hildebrand and Schroeder, 1928; Overstreet and Heard, 1982; Pearson, 1929). Hildebrand and Schroeder (1928) noted that the black drum is a bottom-feeder relying mostly on molluscs and crustaceans, which it is able to crush before swallowing. Darnell (1958) suggested that very young drum (< 100 mm) feed on planktonic or bottom-dwelling "microcrustaceans," while individuals within the 100- to 200-mm class are largely dependent on small molluscs, crustaceans, fish, and annelids. Larger individuals (> 500 mm) were found by Darnell (1958) to subsist mostly on molluscs. Similarly, Pearson (1929) observed that smaller black drum (< 200 mm), having less powerful crushing teeth, were more apt to prey on softer food organisms (e.g., fish, worms, and small crustaceans), while medium-sized drum (210-500 mm) abandoned the softer prey for molluscs, crabs, and shrimp. The largest specimens in Pearson's (1929) study (800-990 mm) consumed mostly molluscs.

Sciaenops ocellatus - The stomach contents of five red drum (242-462 mm SL) collected in summer and fall consisted entirely of fish and decapods (Tables 16 and 17; Appendix 3.42). In summer specimens, fish (primarily anchovies) constituted most of the prey volume, although decapods were more abundant. Penaeid shrimp accounted for most of the prey volume in fall specimens and were numerically dominant, as well.

Although there were too few specimens collected in this study to draw any conclusions about size-related changes in diet, other researchers have observed such differences (Bass and Avault, 1975; Darnell, 1958; Hildebrand and Schroeder, 1928; Mercer, 1984b; Odum and Heald, 1972; Overstreet and Heard, 1978a). Bass and Avault (1975) found that red drum collected from a Louisiana salt marsh exhibited three modes of feeding as a function of body size: 1) fish < 15 mm SL consumed zooplankton; 2) fish between 15 and 75 mm SL fed on small benthic invertebrates and fish fry; and 3) fish > 75 mm SL ate larger crustaceans and fish. Crabs, shrimp, and fish were the prey most often consumed by adult specimens in all of the studies cited above; however, their relative importance in the diet of red drum appeared to change seasonally, as well as with habitat and size of the adult (Boothby and Avault, 1971; Overstreet and Heard, 1978a). Blue crabs are reputedly more important in the diet of red drum collected from inshore habitats, while penaeid shrimp are predominant in the diet of red drum collected from marine waters (Darnell, 1958). The latter situation seems to prevail among red drum collected near the jetties at Murrells Inlet, as well. Pearson (1929) observed that red drum consume both benthic and pelagic prey, suggesting that the feeding habits of this species are intermediate between the bottom-feeding black drum and the pelagic predator, the spotted seatrout.

Chaetodipterus faber - The stomach contents of eight spadefish (135-230 mm SL) collected in summer and fall consisted almost entirely of jetty biota (Tables 16 and 17; Appendix 3.43). Algae was the most frequently consumed food in summer, while amphipods (primarily the corophoid Cerapus tubularis) were the most abundant prey items. Sponge tissue composed most of the food volume in summer specimens, but was not present in either of the two stomachs examined from fall collections. In the two fall specimens, amphipods (primarily Caprella penantis) were dominant, both numerically and volumetrically, while algae ranked second, by volume. Unidentified anemones were important in the diet of both summer and fall specimens, ranking second by volume in summer and third by volume in fall. Other prey items included hydroids (which occurred frequently in both seasons), octocorals, pycnogonids, isopods, decapods, bryozoans, ophiuroids, and ascidians. These results are similar to those reported by Van Dolah et al. (1984) in that sessile biota, particularly sponges, constituted most of the food volume in spadefish collected in both studies. The importance of algae and sessile epifauna in the diet of spadefish has been documented by other researchers as well (Gallaway et al., 1981). Randall and Hartman (1968) reported that 7 of 22 spadefish with food in their stomachs had eaten only sponges. Additional food items reported in the literature include pteropods, fish, pelecypods, small crustaceans, and organic debris (Hildebrand and Schroeder, 1928; Reid et al., 1956).

Tautoga onitis - Eleven tautog collected in spring, summer, and fall (188-288 mm SL) fed mostly on jetty biota; however, there were marked seasonal differences in the proportions of the various food items consumed (Tables 15-17; Appendix 3.44). The mussel Brachidontes exustus composed almost two-thirds of the prey volume in spring, but less than one-third in summer specimens. This decline in mussel consumption continued into fall, when B. exustus accounted for < 7 % of the tautog's diet. Barnacles (Balanus improvisus) were the most important food items in summer specimens but were not consumed during any other season. Decapods (mostly xanthid crabs) ranked second in spring and third in summer, by volume displacement. Amphipods, primarily the corophoid Cerapus tubularis, were numerically and volumetrically dominant in the two fall specimens. Other prey items included algae, hydroids, polychaetes, gastropods, pycnogonids, isopods, bryozoans, and ascidians. In this study, there were no obvious dietary changes with increasing size of the tautog, within the range of specimens examined; however, Lindquist et al. (1985) found that larger tautog consumed greater quantities of mussels (B. exustus), while smaller tautog (< 120 mm SL) ate more caprellid and gammarid amphipods. Lindquist et al. (1985) concluded from their dietary analyses that tautog around rubble-mound jetties in North Carolina are dependent on reef-associated prey. In contrast to these findings, Steimle and Ogren (1982) found that, although tautog collected at artificial reef sites in the New York Bight fed extensively on reef-related faunal groups, tautogs consumed even greater quantities of nonreef fauna such as sand dollars and Cancer crabs. The authors concluded that the tautog is an "opportunistic benthic omnivore" that is not obligated for sustenance to the sessile biota on artificial reefs. Hildebrand and Schroeder (1928) observed that the food of tautog is varied, consisting largely of small molluscs and crustaceans, and is nearly identical to that of the sheepshead. Olla et al. (1974) reported that the blue mussel, Mytilus edulis, was the principal food for tautog collected along the south shore of the Great South

Bay, Long Island, New York. The only tautog collected near the Murrells Inlet jetty by Van Dolah et al. (1984) had been feeding on isopods, amphipods, and decapods commonly found on the rocks.

Astroscopus y-graecum - One specimen of the southern stargazer (260 mm SL) was collected in summer. Its stomach contained a single red cleaning shrimp (Lysmata wurdemanni), which constituted most of the food volume, and the remains of an unidentified fish (Appendix 3.45). Diener et al. (1974) reported the presence of fish in the stomach of one small southern stargazer (45 mm SL), while Hildebrand and Schroeder (1928) found fish and isopods in four stomachs of a more northern congeneric species (Astroscopus guttatus).

Hypleurochilus geminatus - The stomach contents of 70 crested blennies (26-79 mm TL) reflected the intimate association of this species with the jetties (Appendix 3.46). The diet of specimens collected in spring consisted primarily of caprellid and gammarid amphipods (Table 15). These faunal groups composed a negligible portion of the blenny's diet in summer, when H. geminatus fed mostly on hydroids, ascidians, and bryozoans (Table 16). Hydroids were dominant in the diets of fall and winter specimens, as well (Tables 17-18). Mussels and amphipods were also important in the diet of fall specimens, while isopods were more important in winter. These results suggest a greater dependence on motile epifauna during spring, and on sessile epifauna during the other three seasons. Additional prey items included algae, polychaetes, gastropods, pelecypods (other than mussels), pycnogonids, copepods, ostracods, cumaceans, barnacles and decapods. Smaller crested blennies (25-50 mm SL) consumed greater quantities of ascidians and smaller quantities of mussels than did larger blennies (51-75 mm SL). However, fish in both size classes consumed mostly hydroids and amphipods. The dietary dependence of crested blennies on sessile and motile epifauna associated with reef-like structures has been documented by other researchers as well (Gallaway et al., 1981; Lindquist and Dillaman, 1986; SCWMRD, 1984).

Hypsoblennius hentzi - Like the crested blenny, the feather blenny fed mostly on jetty biota (Appendix 3.47). Forty-five feather blennies (19-62 mm TL) were analyzed from all four seasons (Tables 15-18). Caprellid and gammarid amphipods dominated the stomach contents (by volume displacement) of specimens collected in spring and fall. These taxa were also dominant in the stomachs of feather blennies collected from the littoral and sublittoral zones of southeastern North Carolina (Lindquist and Dillaman, 1986). Tubicolous polychaetes were the dominant prey taxa in summer, and isopods were dominant in winter. Barnacle cirri ranked second during spring, summer, and fall, accounting for about one-third of the total prey volume in each of the three seasons. Hydroids and polychaetes were the only prey items, other than isopods, consumed in winter. Ascidians, mussels, bryozoans, decapods, ostracods, and foraminiferans were also consumed in one or more seasons. Smaller feather blennies (1-25 mm TL) ate greater quantities of barnacle cirri and tubicolous polychaetes, and smaller quantities of caprellid and gammarid amphipods than did larger blennies (25-50 mm TL). Hildebrand and Schroeder (1928) found that the food of this blenny consists of small crustaceans, molluscs, and ascidians.

Gobiosoma ginsburgi - The 87 seaboard gobies (12-42 mm TL) collected during all four seasons contained a wide variety of prey items from both jetty and nonjetty habitats (Appendix 3.48). Caprellid and gammarid amphipods accounted for the greatest percentage of total prey volume in every season (Tables 15-18). The importance of amphipods in the diet of this goby appears to increase steadily from a low in summer to a high in spring. In addition to amphipods, copepods, as well as tubicolous polychaetes and mussels, were important in the diet of summer specimens. Mussels were the only prey items, other than amphipods, that composed a substantial proportion of the total prey volume in fall. Isopods and tubicolous polychaetes were secondarily important in the diet of winter specimens. Amphipods and mussels were the dominant prey for both small (1-25 mm SL) and large (26-50 mm SL) gobies; however, copepods were consumed only by fish in the smaller size class. Hildebrand and Schroeder (1928) noted that two specimens of the seaboard goby had fed on small crustaceans, chiefly Gammarus. Monroe and Lotspeich (1979) found that seaboard gobies collected from Rhode Island waters had eaten a variety of benthic invertebrates but fed most heavily on harpacticoid copepods.

Scomberomorus cavalla - One king mackerel (190 mm FL) collected in summer contained only anchovies (Anchoa hepsetus) in its stomach (Appendix 3.49). Naughton and Saloman (1981) reported that juvenile king mackerel (100-400 mm) collected near Cape Canaveral consumed mostly fish, along with small quantities of squid. Berrien and Finan (1977) cite several studies that demonstrate S. cavalla is a carnivore, feeding principally on fish, crustaceans and molluscs.

Scomberomorus maculatus - The food of 27 Spanish mackerel collected in summer and fall (253-418 mm FL) consisted entirely of fish (Tables 16 and 17; Appendix 3.50). Thread herring (Opisthonema oglinum) constituted most of the food volume in summer; whereas, silversides (Membras martinica) and anchovies (Anchoa hepsetus) were the only prey species consumed in fall. Fish (primarily engraulids and clupeids) also composed most of the food volume in stomachs of juvenile (100-400 mm SL) Spanish mackerel collected from Cape Canaveral and Galveston Bay (Naughton and Saloman, 1981). Berrien and Finan (1978) review other studies on the food habits of S. maculatus.

Peprilus alepidotus - The stomach contents of nine harvestfish (125-154 mm SL) collected in spring consisted mostly of unidentifiable flocculent debris. However, fish scales were easily recognized and composed most of the identifiable food (Appendix 3.51). The only other recognizable prey were gastropod shell fragments. Our findings are similar to those of Hildebrand and Schroeder (1928) who found that the stomach contents of this fish "are always ground to a pulp"; however, occasionally fish bones and scales could be detected. Mansueti (1963) described a symbiotic association between the harvestfish and the sea nettle, Chrysaora quinquecirrha. The association is initially commensal, but becomes ectoparasitic as the fish later feeds upon its host. This relationship was observed in the Chesapeake Bay from July to October, after which the harvestfish became non-symbiotic but continued to feed through autumn as a predator on jellyfish.

Paralichthys dentatus - One summer flounder (152 mm SL) collected in spring had fed primarily on mysids (Neomysis americana) and, to a lesser extent, on the portunid crab Ovalipes ocellatus (Appendix 3.52). Similarly, Smith et al. (1984) found that small summer flounder (81-160 mm SL) collected in marsh habitats consumed substantial quantities of the mysid Neomysis americana, although fish were the major prey of summer flounder in that study. Fish have been reported to be the primary food of summer flounder by several other authors as well (Adams, 1976; Hildebrand and Schroeder, 1928; Langton and Bowman, 1981). Additional prey items noted in these studies include squids, shrimps, crabs, molluscs, worms, and sand dollars.

Paralichthys lethostigma - One southern flounder (395 mm SL) collected in fall had fed on an undetermined species of kingfish (Menticirrhus sp.) (Appendix 3.53). No other prey items were found in its stomach. Darnell (1958) reported that adult southern flounder (113-380 mm) collected from Lake Pontchartrain, Louisiana, were "highly predaceous," having fed on a variety of small fishes and smaller quantities of crabs, shrimps, and other invertebrates. Overstreet and Heard (1982) found that fishes and penaeid shrimps constituted the major prey items of southern flounder collected from Mississippi Sound. The latter two authors present a comprehensive review of recent literature on the food habits of the southern flounder.

Monacanthus hispidus - The single planehead filefish (158 mm SL) collected in fall consumed mostly caprellid amphipods (Caprella equilibra) and smaller quantities of the ascidian Distaplia bermudensis (Table 17; Appendix 3.54). Other prey items of lesser importance included gastropods, pelecypods, and isopods. Hildebrand and Schroeder (1928) reported that seven specimens from the Chesapeake Bay had eaten mostly annelids, while several specimens from Beaufort, North Carolina, had eaten bryozoans, crustaceans, molluscs, gastropod eggs, annelids, sea urchins, and algae.

Sphoeroides maculatus - Two northern puffers (170 and 179 mm SL) were collected, one in summer and one in fall (Appendix 3.55). The summer specimen had eaten an unidentifiable crab, while the puffer collected in fall had eaten mostly mussels. Negligible quantities of barnacles and a penaeid shrimp had also been consumed in the fall. The food of this species, according to the results of Hildebrand and Schroeder (1928), consists mainly of small crustaceans (including crabs, shrimp, isopods, and amphipods), with smaller amounts of molluscs, annelids, and algae.

Comparison of Food Habits Among Fishes: Dietary similarities between fishes were generally low (< 0.20 on a scale of 0 to 1) during all four seasons. The low overlap in diets was largely a function of the wide variety of prey species available to predators in both the jetty and adjacent nonjetty habitats. Even among those predators that did feed on several of the same species, the relative proportions of those species consumed often differed substantially. In many cases, those similarity values that were high (> 0.60) were less indicative of extensive overlap in diets than they were of the presence of one or two unusual food items in the stomachs of predators that might otherwise have fed on very different prey. In such cases, predators that consumed only a few prey species were more likely to exhibit erroneously high dietary similarities with other predators that happened to consume the same one or two prey species. High interspecific similarities in diet are particularly suspect in those cases where one or both predators are represented by fewer than three specimens each (see Appendix 3 for the number of specimens analyzed for each predator). Nevertheless, there were some cases in which high similarity values were actually a reflection of significant (in an ecological sense) dietary overlap between predators. These are discussed for each season below.

Spring - In spring, several piscivorous species had highly similar diets due to their heavy consumption of juvenile spot (Leiostomus xanthurus) and anchovies (mostly Anchoa hepsetus) (Figure 18). These predators included scalloped hammerhead sharks (Sphyrna lewini), smooth butterfly rays (Gymnura micrura), spotted seatrout (Cynoscion nebulosus), and weakfish (Cynoscion regalis). Atlantic silversides (Menidia menidia) had a diet highly similar to that of northern pipefish (Syngnathus fuscus) in spring. Both species fed extensively on zooplankton and motile epifauna, primarily pelagic copepods and caprellid amphipods. Atlantic silversides were also highly similar to crested blennies (Hypleurochilus geminatus) in their consumption of tubicolous and errant polychaetes (Hydroides dianthus and Nereis sp., respectively). Sheepshead (Archosargus probatocephalus), black drum (Pogonias cromis), and tautog (Tautoga onitis) had highly similar diets in spring, primarily due to the large volume of mussels (Brachidontes exustus) ingested by each of the three species. In addition, all three fish species consumed algae, hydroids, and bryozoans (as well as caprellid and corophoid amphipods), indicating a heavy reliance on jetty biota.

Summer - Only three pairs of predator species collected in summer exhibited a high degree of interspecific similarity in food habits (Figure 19). Oyster toadfish (Opsanus tau) and bluefish (Pomatomus saltatrix) were similar by virtue of their having consumed large volumes of small menhaden (Brevoortia tyrannus), which were abundant in the water column during our summer sampling period. Black sea bass (Centropristis striata) were also consumed by both bluefish and toadfish, but to a lesser extent than menhaden. Despite their high similarity in food habits, as measured by the Bray-Curtis index, toadfish ate many more species of invertebrates and relatively few species of fish in comparison to bluefish. Atlantic needlefish (Strongylura marina) and weakfish (Cynoscion regalis) were highly similar in their almost exclusive consumption of thread herring (Opisthonema oglinum); whereas, lookdown (Selene vomer) and king mackerel (Scomberomorus cavalla) ate mostly anchovies (Anchoa hepsetus).

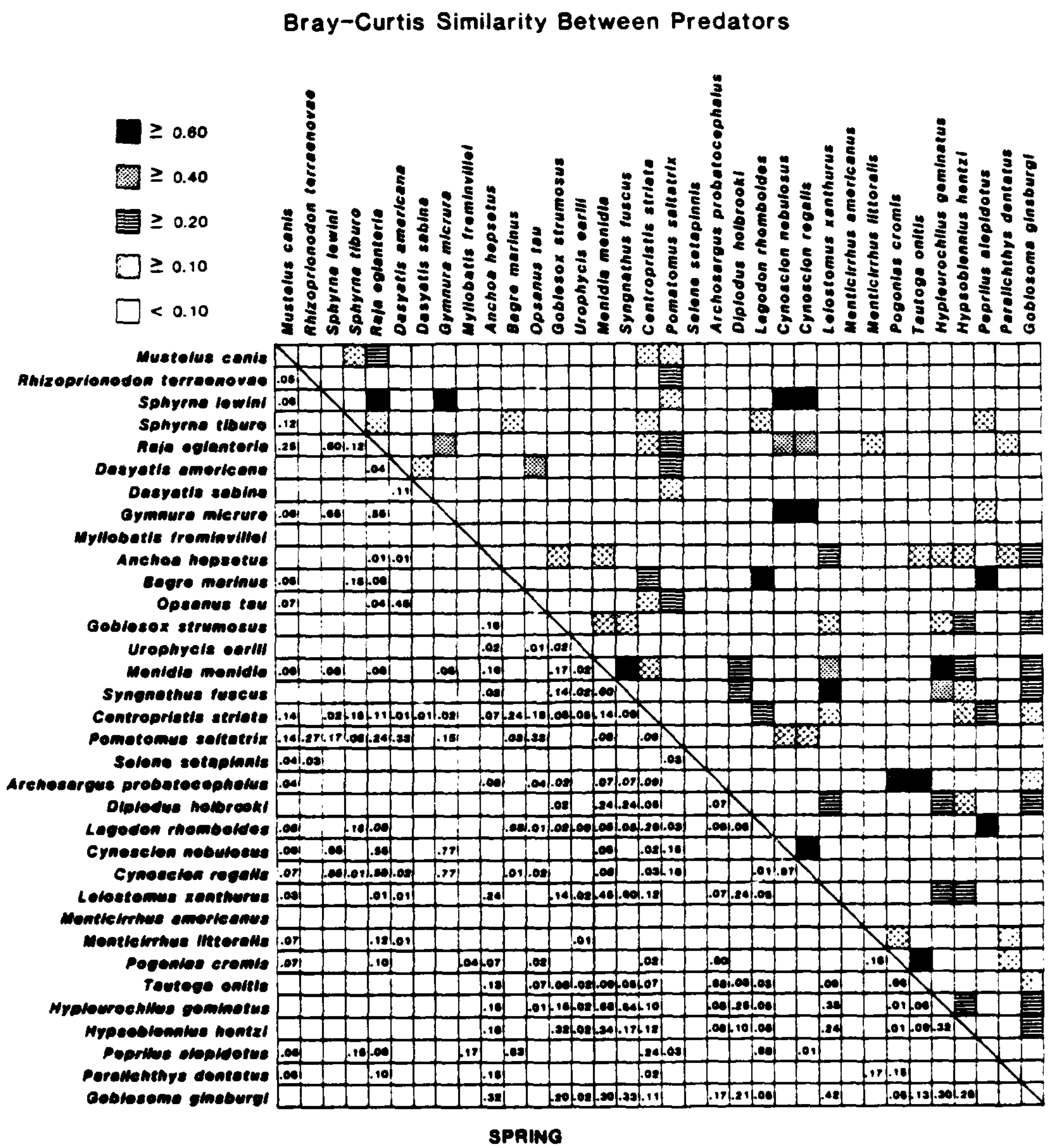


Figure 18. Bray-Curtis similarity of food habits (based on volumetric data) between predators collected in spring.

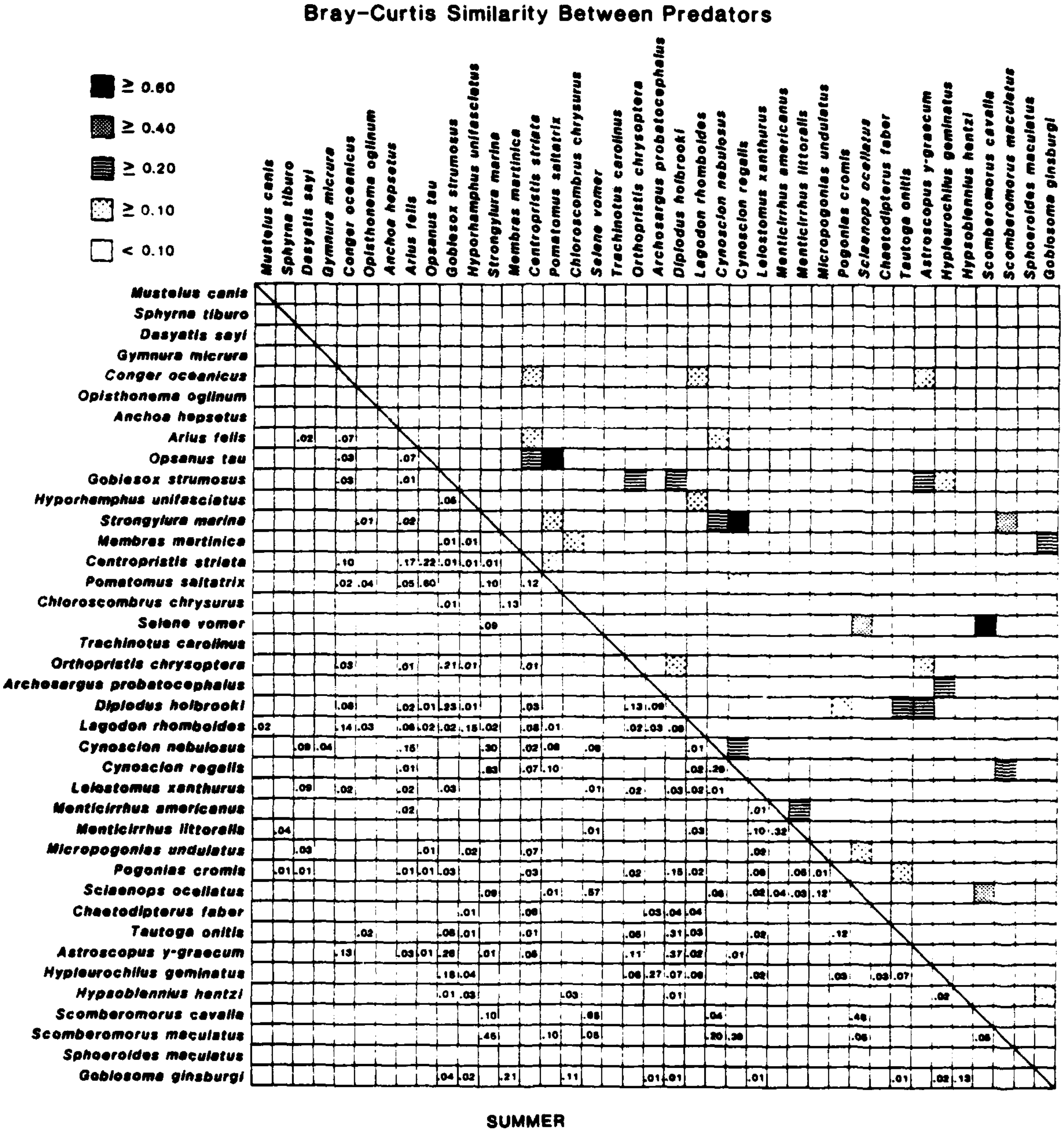


Figure 19. Bray-Curtis similarity of food habits (based on volumetric data) between predators collected in summer.

Fall - Ladyfish (Elops saurus), Atlantic needlefish (Strongylura marina) and Spanish mackerel (Scomberomorus maculatus) had highly similar diets in fall that consisted mostly of rough silversides (Membras martinica) (Figure 20). Spadefish (Chaetodipterus faber) and tautog (Tautoga onitis) fed mostly on epifaunal amphipods (Caprella penantis) in fall. These two predators also consumed several other sessile and motile epifaunal species commonly found on the jetties. No other predators displayed an extensive overlap in food habits during the fall.

Winter - None of the species collected in winter exhibited a very high degree of interspecific similarity in food habits (Figure 21). Three species (skilletfish, Gobiesox strumosus; sheepshead, Archosargus probatocephalus; and feather blennies, Hypsoblennius hentzi) had somewhat similar diets that included moderate to large volumes of the isopod Paradella quadripunctata. Two other predators, spot (Leiostomus xanthurus) and seaboard gobies (Gobiosoma ginsburgi), had diets that were moderately similar with respect to the high proportion of corophoid amphipods (Jassa falcata) they contained.

The results of the normal cluster analysis show eight predator groups (Figure 22). Species in Groups A, B, and C are characterized by their highly piscivorous habits. Species in Group A (Atlantic needlefish, Strongylura marina, and Spanish mackerel, Scomberomorus maculatus) ate mostly thread herring and lesser amounts of rough silversides and striped anchovies. Species in Group B (clearnose skates, Raja eglanteria; weakfish, Cynoscion regalis; lookdown, Selene vomer; red drum, Sciaenops ocellatus; and spotted seatrout, Cynoscion nebulosus) consumed large quantities of juvenile spot and striped anchovies, as well as other fish and decapod crustaceans. Predators in Group C (toadfish, Opsanus tau; black sea bass, Centropristis striata; and bluefish, Pomatomus saltatrix) fed heavily on small menhaden and, to a lesser extent, on other fishes and invertebrates. Toadfish and black sea bass were much more omnivorous than bluefish, which fed almost exclusively on fish.

Fishes in Groups D and E (with the exception of harvestfish, Peprilus alepidotus) fed mostly on crustaceans (including decapods, stomatopods and haustoriid amphipods), as well as other invertebrates typical of sand-bottom habitat. Two of the species in Group D (smooth dogfish, Mustelus canis, and bonnethead sharks, Sphyrna tiburo) ate mostly portunid crabs and stomatopods, while the other two species (southern kingfish, Menticirrhus americanus, and gulf kingfish, M. littoralis) fed mostly on mole crabs and, to a lesser extent, on stomatopods, portunid crabs and other invertebrates. Group E cannot reasonably be considered a valid group based on similarity of food habits, since the only prey items shared by the two constituent species (bullnose rays, Myliobatis freminvillei, and harvestfish, Peprilus alepidotus) were unidentified gastropod shell fragments. In fact, bullnose rays consumed an almost equal volume of hermit crabs, suggesting that gastropod shells may have been eaten coincidentally. Harvestfish, on the other hand, were characterized by stomach contents which were, for the most part, unidentifiable masses of flocculent debris. Of the stomach contents that could be identified, fish remains comprised 83% of the total volume, while gastropod shell comprised only 17%. Thus, it is likely that these two predators, in reality, feed on very different prey species. Their inclusion in the same group is probably a function of their mutual dissimilarity to other predators and, as such, represents an artifact of the sorting strategy.

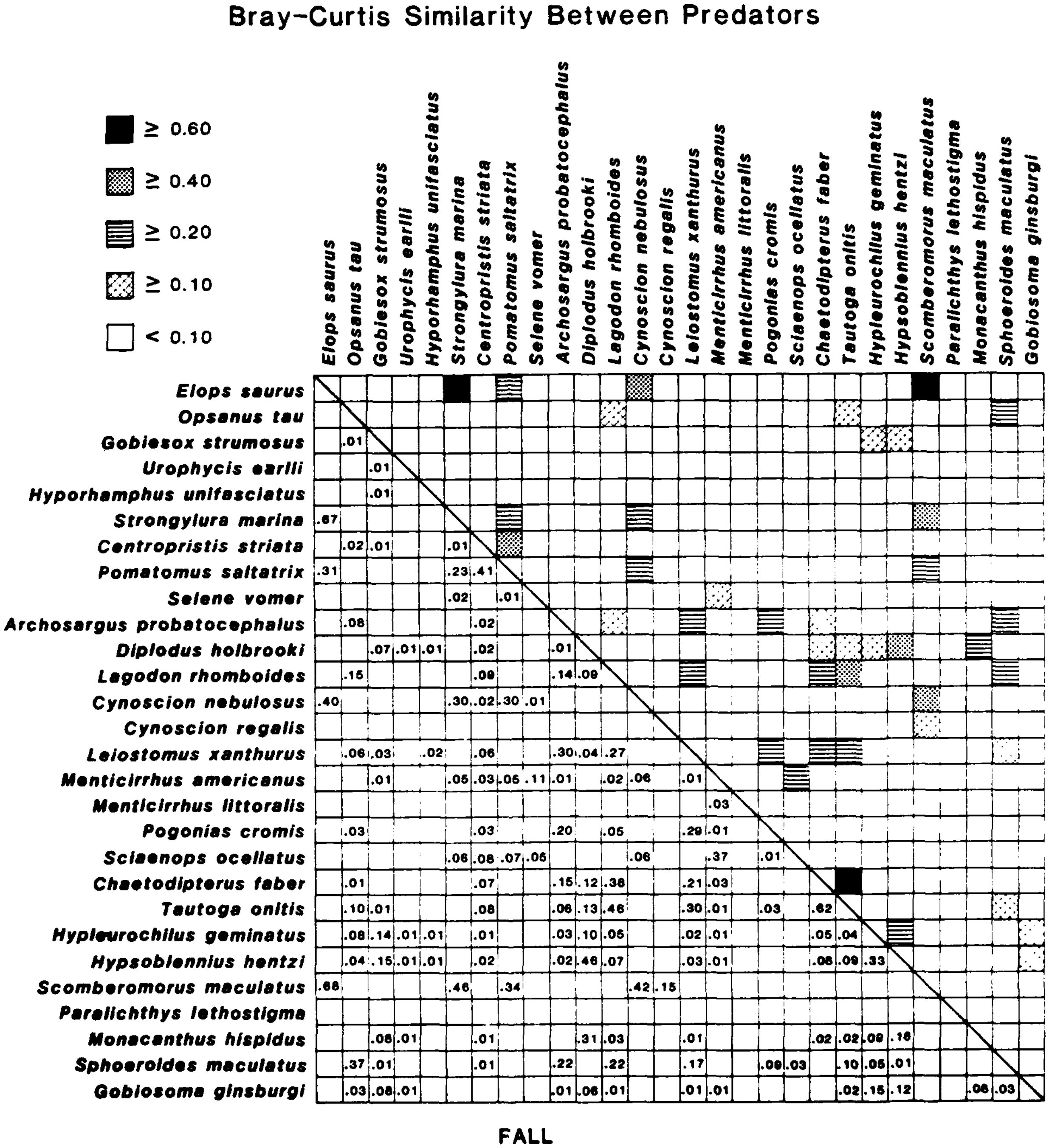


Figure 20. Bray-Curtis similarity of food habits (based on volumetric data) between predators collected in fall.

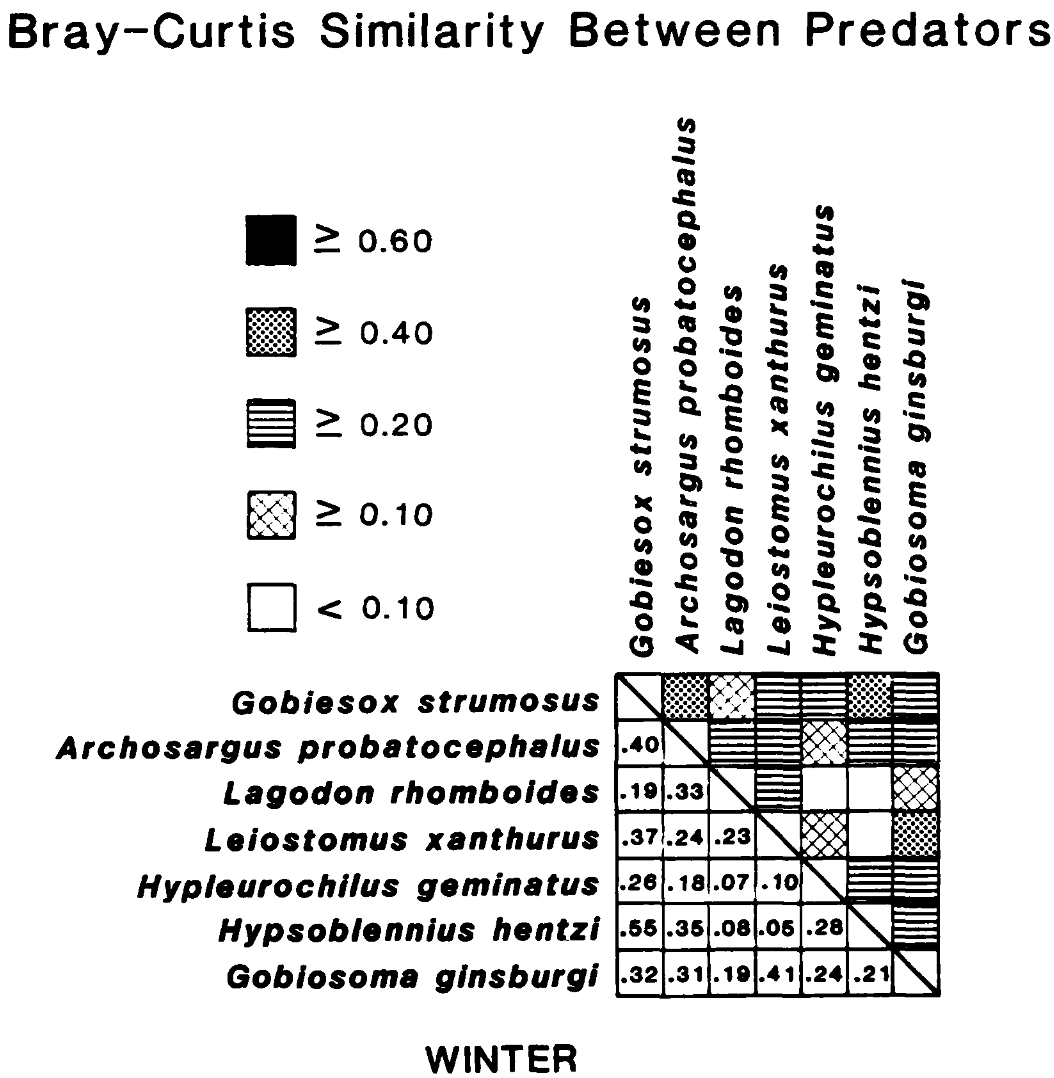


Figure 21. Bray-Curtis similarity of food habits (based on volumetric data) between predators collected in winter.

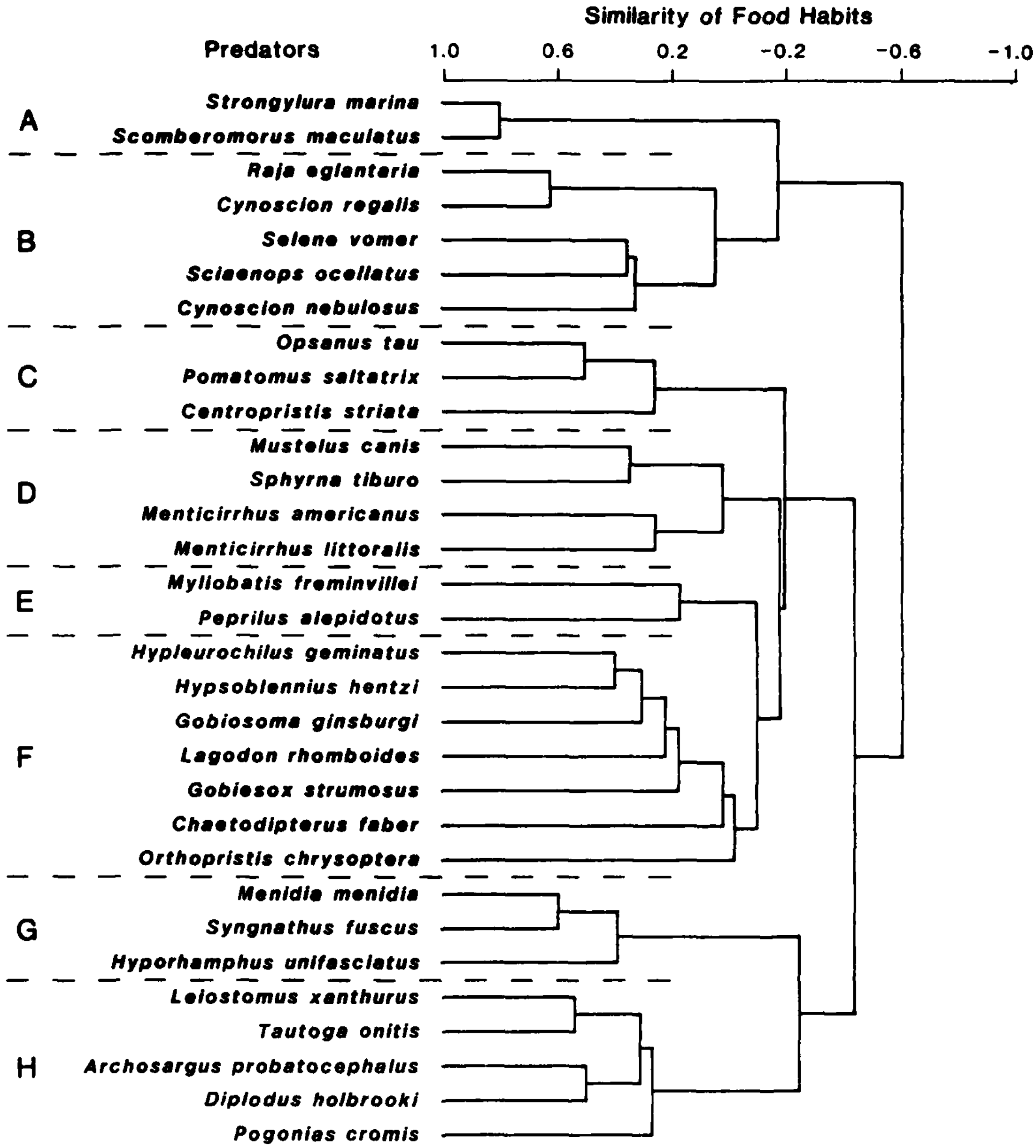


Figure 22. Numerical classification of predator species (flexible sorting, $\beta = -0.25$) based on Bray-Curtis similarity of food habits for all seasons combined.

Species in Groups F, G and H had diets that were composed primarily of jetty biota. Predators in Group F (crested blennies, Hypleurochilus geminatus; feather blennies, Hypsoblennius hentzi; seaboard gobies, Gobiosoma ginsburgi; pinfish, Lagodon rhomboides; skilletfish, Gobiesox strumosus; spadefish, Chaetodipterus faber; and pigfish, Orthopristis chrysoptera) consumed mostly motile epifauna, particularly caprellid and corophoid amphipods. These predators also ate sessile jetty biota, as well as fish and sand-bottom invertebrates, but to a lesser extent. Similarly, fishes in Group G (Atlantic silversides, Menidia menidia; northern pipefish, Syngnathus fuscus; and halfbeaks, Hyporhamphus unifasciatus) consumed large quantities of caprellid and corophoid amphipods, but a substantial portion of their diets consisted of zooplankton (copepods, decapod larvae, fish larvae, and insects) as well. Finally, species in Group H (spot, Leiostomus xanthurus; tautog, Tautoga onitis; sheepshead, Archosargus probatocephalus; spottail pinfish, Diplodus holbrooki; and black drum, Pogonias cromis) were distinguished by their heavy consumption of mussels (Brachidontes exustus); however, all of these predators fed on a wide variety of other sessile and motile jetty biota, as well as on sand-bottom fauna.

In summary, there appear to be three major trophic groups represented by the fishes near the Murrells Inlet jetties. Each group is characterized by one of three types of prey that constitutes the greatest proportion of total food volume: 1) fish, 2) sand-bottom epifauna, or 3) jetty biota (and in some cases, zooplankton). Within each of these major groups, there was considerable variation in diet among the constituent predators. Furthermore, many fishes exhibited pronounced ontogenetic and seasonal changes in food habits. Seasonal variations probably reflected parallel changes in prey abundance. With the exception of some strictly piscivorous species, very few predators were restricted to any one type of prey. Nevertheless, our results indicate that 15 of the 31 species included in the normal cluster analysis feed primarily on jetty biota during one or more seasons. Among these are spadefish, sheepshead, and black drum, all of which are popular with recreational fishermen. Additionally, many smaller fishes which fed heavily on jetty biota (including blennies, gobies, anchovies, silversides and, to some extent, spot) were major prey items for piscivorous species such as bluefish, black sea bass, spotted seatrout, weakfish, red drum, and Spanish mackerel. These predators are also favored by sport and commercial fishermen alike. Clearly, then, our study has demonstrated that numerous fishes are either directly or indirectly feeding on organisms associated with the Murrells Inlet jetties. These results confirm those of Van Dolah et al. (1984), who concluded, on the basis of more limited food habits analyses, that the jetty biota at Murrells Inlet is an important food source for several recreationally important fishes.

3. Crab Assemblages

Traps deployed for 12-hr sets around the north jetty captured a total of 349 crabs representing eight species (Appendix 4). The stone crab, Menippe mercenaria, numerically dominated the catch during the spring, summer, and fall, comprising 90 % of all crabs found in the traps during those seasons. No stone crabs were captured in the traps during winter, although they were observed among the rocks by divers. Other crab species occasionally collected around the jetties included Callinectes sapidus, Libinia spp., and Portunus spp.

There was a significant change in the seasonal abundance of stone crabs captured around the north jetty ($F_{(3,36)} = 36.76$; $P < 0.01$). Greatest catches occurred during the spring on both sides of this jetty, followed by a substantial decline in crab catches during the summer and fall (Figure 23). Statewide commercial landings of stone crab claws, which are primarily harvested from inshore bays and sounds of South Carolina, also generally show a decline during the summer and fall relative to spring landings (Wenner and Stokes, 1983; Theiling, 1984-1985). There are several possible reasons for the seasonal decrease in catch size. Some of the decline in abundance may be due to mortality from crabbing around the jetties. Commercial pots were observed being fished around the outer sections of both jetties during most sampling periods. Although only one claw can be legally harvested from stone crabs in South Carolina, Davis et al. (1978) noted considerable mortalities (28 %) among crabs that had only one claw removed using commercially accepted techniques. This mortality was primarily due to physiological stress resulting from fluid loss. The loss of a claw may also indirectly increase mortality from predation and competition.

Seasonal declines in the crab catches may also be due to normal crab movements away from the jetties. Bender (1971) noted some seasonal inshore-offshore migrations of *M. mercenaria* in Florida, and although *Menippe* migrations have not been documented in South Carolina, there is a considerable area of suitable habitat for stone crabs in slightly deeper waters off the Grand Strand (Van Dolah and Knott, 1984). The absence of stone crabs in the traps during winter is most probably due to cold water temperatures, which induces burrowing and sluggish behavior in *M. mercenaria* (Bender, 1971).

Stone crab catches were consistently lower on the channel side of the jetty than on the seaward side (Fig. 23), with the differences being statistically significant during August and October (Table 19). There is no obvious cause for this trend. However, commercial traps were observed more frequently in the channel area between the jetties than on the exposed sides. Food resources utilized by *M. mercenaria* may also have been different between the exposed side and the channel side of the north jetty.

Significantly more stone crabs were collected in the traps fished at night than in the traps fished during the day (Fig. 24, Table 19). This indicates active nocturnal foraging among the *M. mercenaria* inhabiting the jetty rocks. Although it is generally believed that stone crabs are nocturnal, the diurnal activities of *M. mercenaria* are not well understood. Powell and Gunter (1968) found no obvious difference in crab activity between night and day, and Williams (1984) cited studies which suggested that stone crab activities were greatest in the evening before dark. Our traps were generally set immediately before sunset. Therefore, most of the crabs would have entered the traps at dusk or during the night, suggesting either a crepuscular or nocturnal foraging strategy.

Female *M. mercenaria* dominated the catch during the spring and summer, but not during the fall (Fig. 25, Table 19). Over all seasons combined, the female:male sex ratio was 2.2:1. Caldwell (1986) and Wenner and Stokes (1983) have also documented a numerical dominance of females in estuarine habitats within South Carolina, and Bender (1971) noted that the inshore

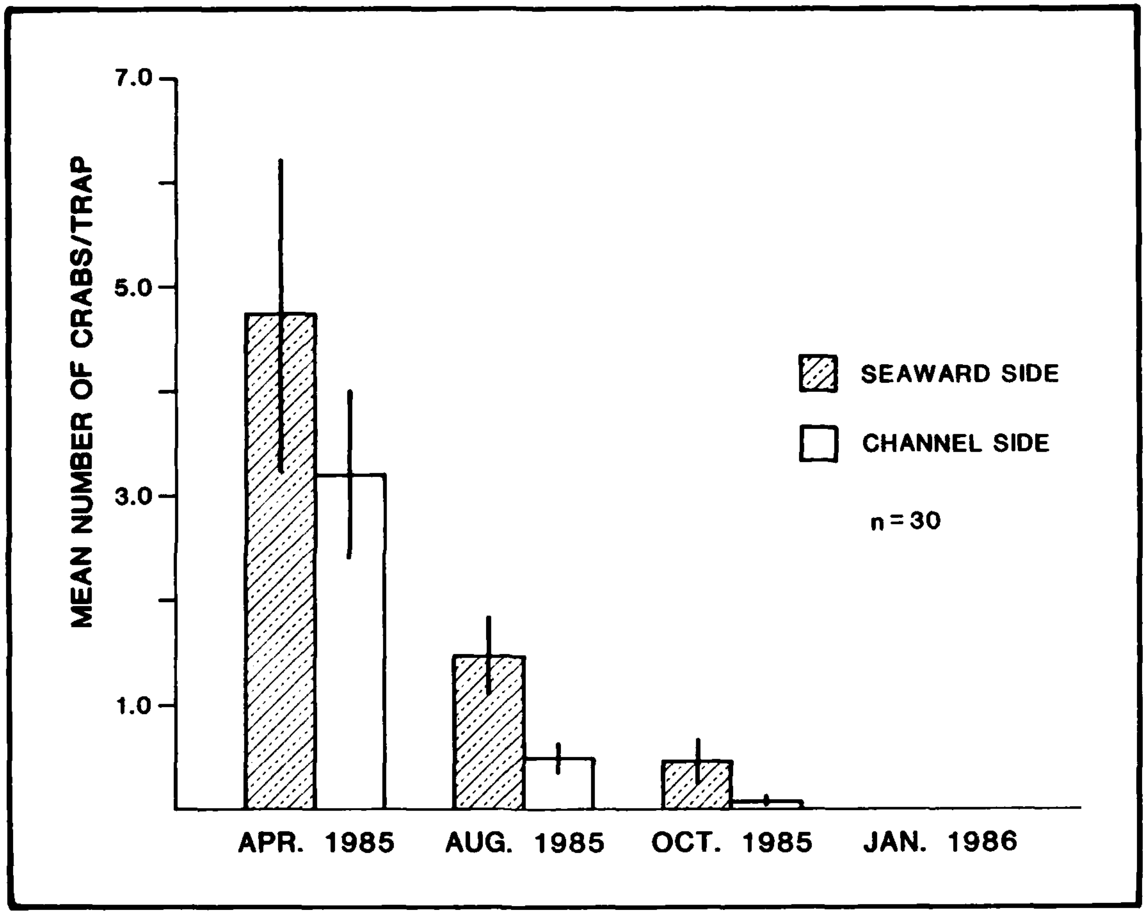


Figure 23. Average number of stonecrabs (Menippe mercenaria) collected in traps on the seaward and channel sides of the north jetty at Murrells Inlet. Error bars represent ± 1 standard error.

Table 19. Comparisons of *Menippe mercenaria* catches in traps deployed for 12-hr sets around the north jetty at Murrells Inlet. Analysis of variance (ANOVA) tests were based on log (x + 1) transformation of crab abundance in each replicate trap set.

Sampling Date	Seaward Side No. of Crabs	Seaward Side No. Trap Hauls	Seaward Side Crabs/Trap	Channel Side No. of Crabs	Channel Side No. Trap Hauls	Channel Side Crabs/Trap	ANOVA Results F	ANOVA Results df	ANOVA Results P
April	142	30	4.73	97	30	3.23	0.28	1/58	>0.05
August	44	30	1.47	15	30	0.50	5.34	1/58	<0.05
October	14	30	0.47	2	30	0.07	4.33	1/58	<0.05
January	0	30	0.00	0	30	0.00	----	----	----

Sampling Date	Night Sets No. of Crabs	Night Sets No. Trap Hauls	Night Sets Crabs/Trap	Day Sets No. of Crabs	Day Sets No. Trap Hauls	Day Sets Crabs/Trap	ANOVA Results F	ANOVA Results df	ANOVA Results P
April	190	30	6.33	49	30	1.63	7.75	1/58	<0.01
August	47	30	1.57	12	30	0.40	9.97	1/58	<0.01
October	16	30	0.53	0	30	0.00	10.41	1/58	<0.01
January	0	30	0.00	0	30	0.00	-----	----	-----

Sampling Date	Females No. of Crabs	Females No. Trap Hauls	Females Crabs/Trap	Males No. of Crabs	Males No. Trap Hauls	Males Crabs/Trap	ANOVA Results F	ANOVA Results df	ANOVA Results P
April	174	60	2.90	65	60	1.08	11.34	1/118	<0.01
August	40	60	0.67	19	60	0.32	4.22	1/118	<0.05
October	3	60	0.05	13	60	0.22	2.88	1/118	>0.05
January	0	60	0.00	0	60	0.00	-----	-----	-----

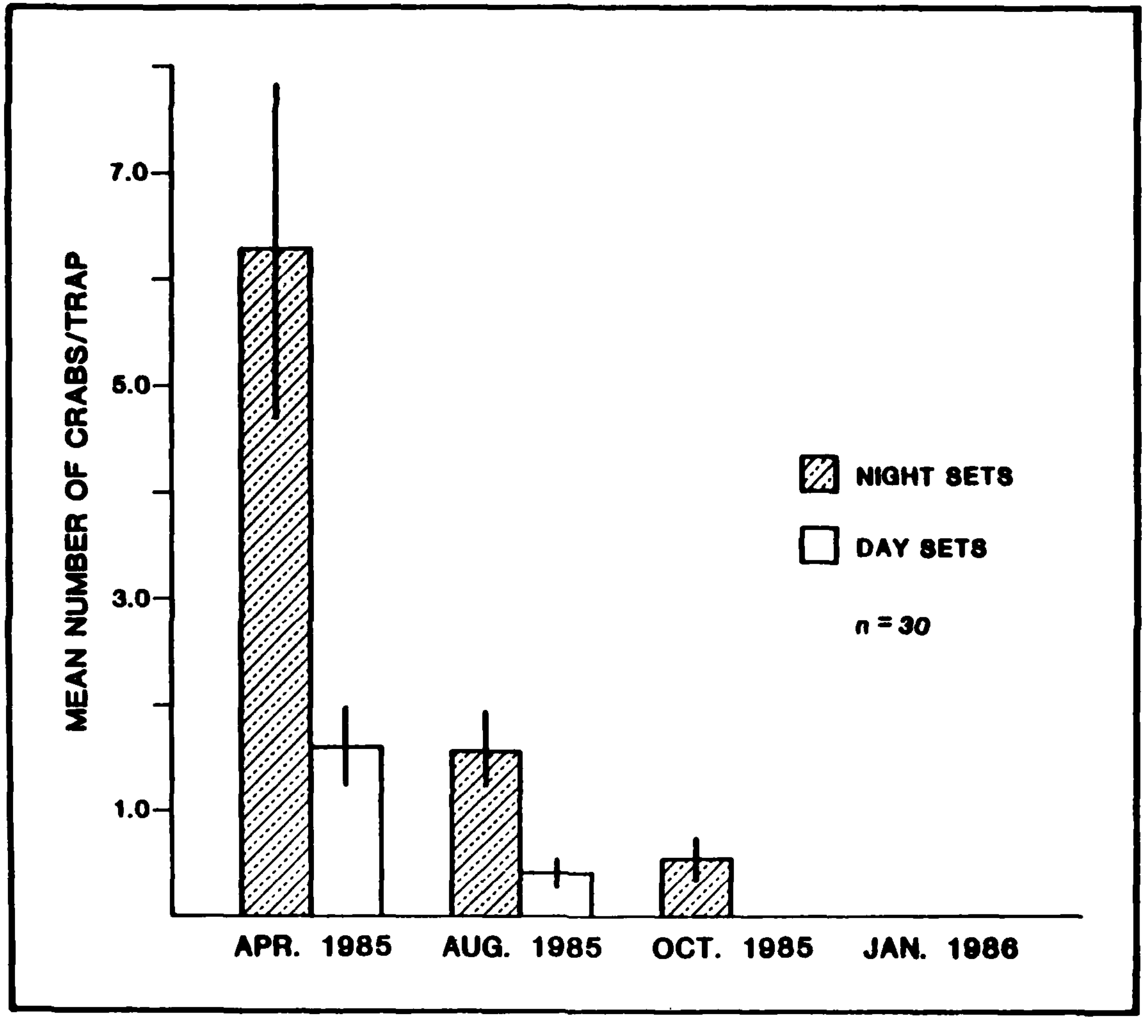


Figure 24. Average number of stonecrabs (Menippe mercenaria) collected in traps during night and day sets around the north jetty at Murrells Inlet. Error bars represent ± 1 standard error.

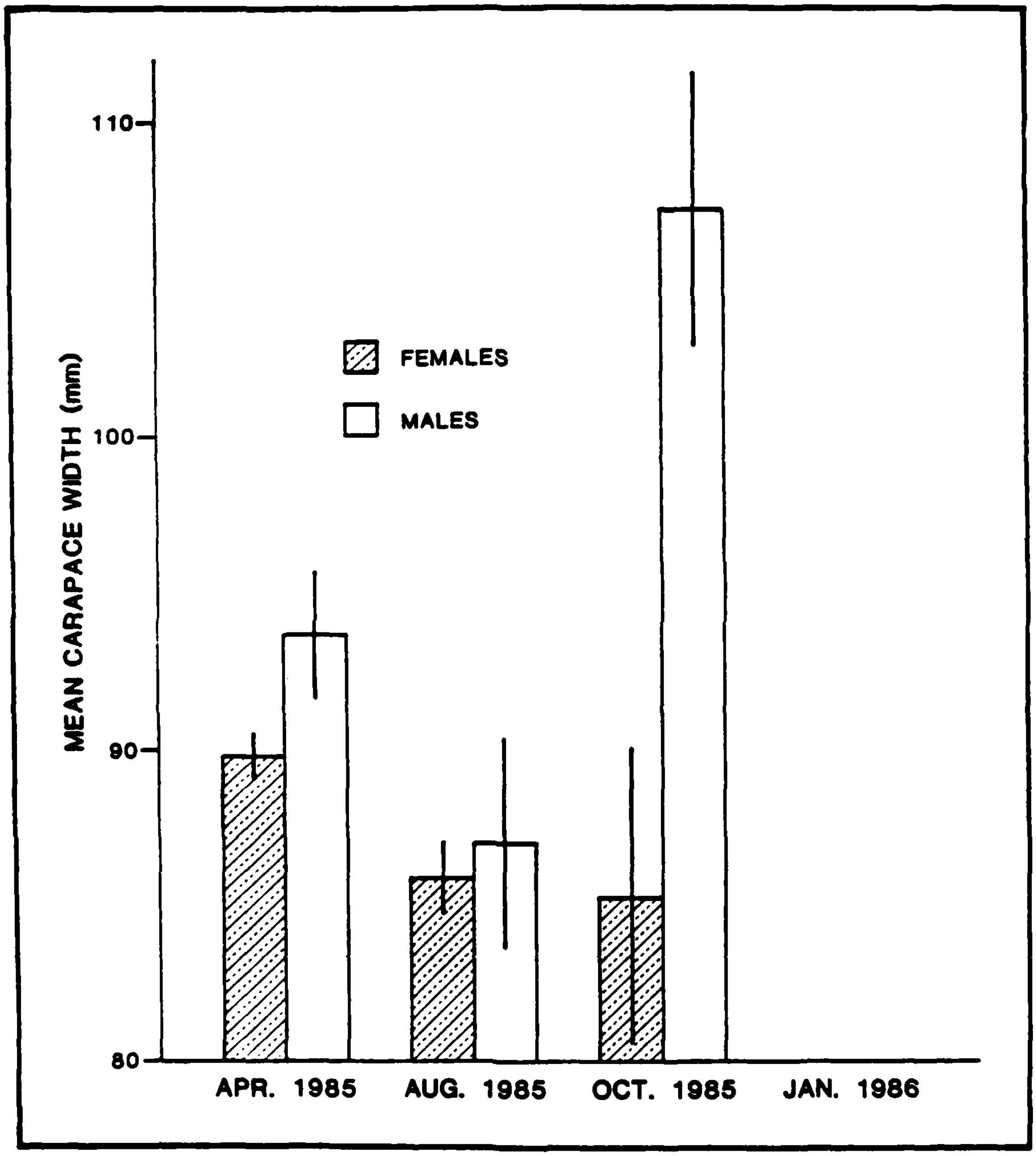


Figure 25. Mean number of male and female stone crabs, _Menippe mercenaria_ collected in traps set around the north jetty at Murrells Inlet. Error bars represent ± 1 standard error.

resident populations of stone crabs in Florida were composed primarily of females. During all three seasons, the male population at Murrells Inlet had a larger mean carapace width, with the greatest difference in mean size noted during October. The size frequency distributions of males and females captured during each season are shown in Fig. 26. All of the M. mercenaria captured in the traps were adults based on Caldwell's (1986) estimated size at sexual maturity for this species (55 mm). Juvenile stone crabs were observed among the rocks at Murrells Inlet by divers, but these crabs were not effectively sampled by the traps, which had a mesh size of 37 mm.

Based on the stone crab catches in this study, it is unlikely that the Murrells Inlet jetties can support more than an incidental stone crab fishery and, to our knowledge, no crabbers were fishing solely around the jetty rocks. Our observations also indicated that recreational crabbing was rare (see the following section).

4. Recreational Fishing Activities

Recreational fishing activities were similar during all seasons. Fishing pressure was consistently greatest around the north jetty, with an average of 40 % of all boats occurring around this jetty each season (Table 20). The largest number of boats was located at or near the seaward point of the north jetty (Fig. 27). The south jetty averaged 13 % of the boats during all seasons except summer, when the percentage increased. As the region around the north jetty became overcrowded during the summer months, additional boats fished off the south jetty. Approximately 12 % of the total number of boats counted each season was located in the channel between the jetties, or in the area around the weir section and its deposition basin. The channel inland from the jetties averaged over 20 % of the boats each season except summer, when the number of boats fell to under 15 % of the total.

Bank-fishing was restricted to the south jetty, as the weir made the north jetty inaccessible by land. Shoaling along the outside of the south jetty made much of this area unfishable; thus, the majority of bank-fishing occurred along the channel side of the jetty seaward of the bend or on the exposed side of the jetty near the seaward end. Each season some anglers fished off Garden City Beach into the weir and deposition basin. This area is located in a privately owned section of Garden City and, therefore, is not widely utilized by fishermen.

The average number of boats and bank-fishermen occurring daily and seasonally in the area can be estimated based on counts made in the census. Because boats and anglers enter and leave the region randomly or change locations throughout the day, actual numbers are difficult to obtain without keeping track of each individual boat or angler throughout the day. Daily averages were, therefore, based on the maximum number of anglers counted at any one time during a day and, as such, represent only the minimum number present during that day. A rough estimate of the total number of boats and bank-fishermen utilizing the Murrells Inlet jetties during each season was determined (2 x average weekend observations + 5 x average weekday observations x 13 weeks per season). As expected in a resort area, the greatest number of boats and bank-fishermen were present during the summer, with successively lower numbers observed during the fall, spring, and winter, respectively (Table 21). Although the annual estimated usage of 4100 boats

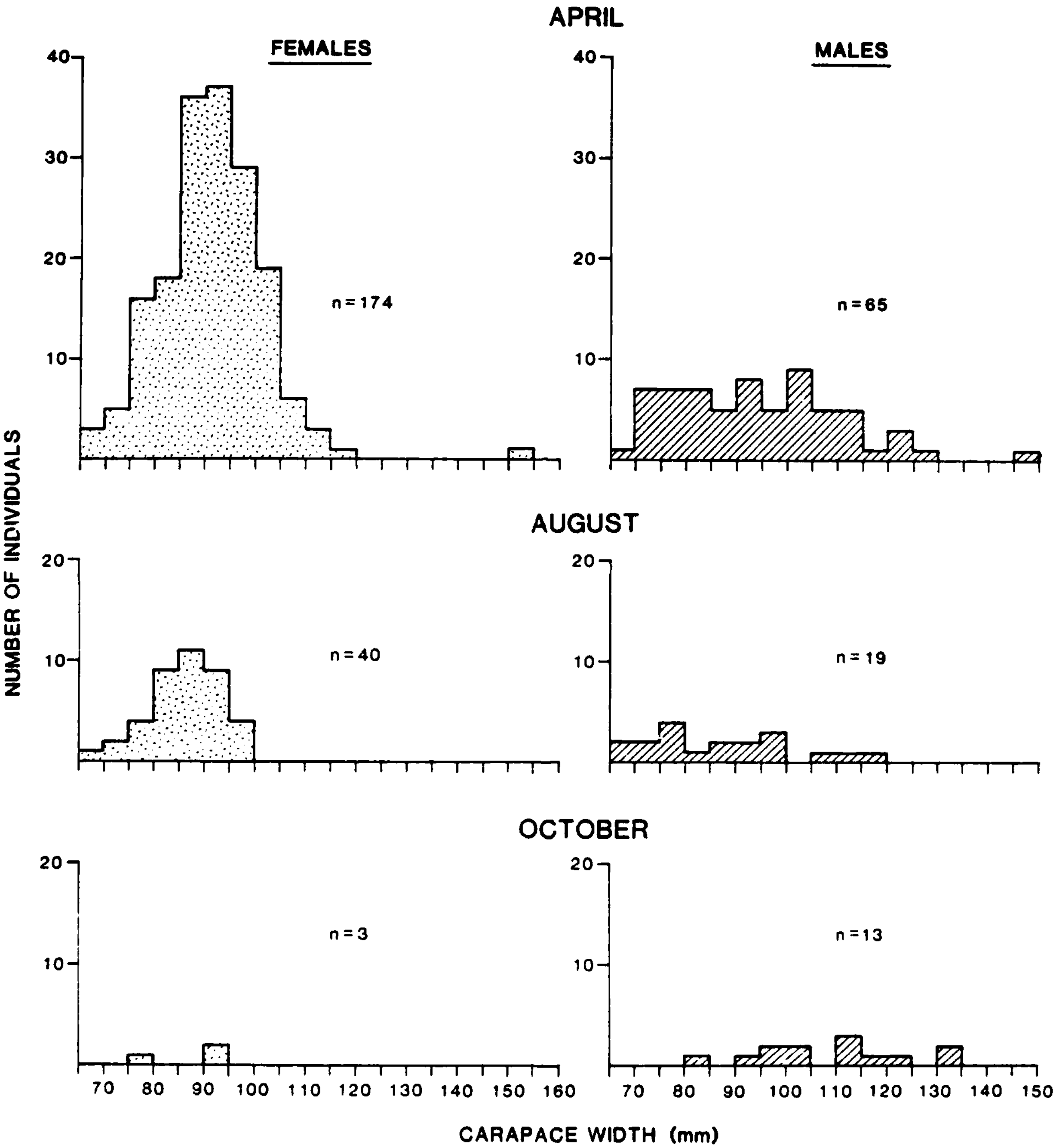


Figure 26. Size frequency distributions of male and female stone crabs (*Menippe mercenaria*) captured in traps near the north jetty at Murrells Inlet.

Table 20. Number and percentage of boats occurring in various locations around the Murrells Inlet jetties during each seasonal sampling period.

	Spring		Summer		Fall		Winter		Total	
	N	%	N	%	N	%	N	%	N	%
North jetty	105	41.3	125	42.4	82	35.6	6	46.1	318	40.1
South jetty	25	9.8	63	21.4	32	13.9	2	15.4	122	15.4
Main channel	32	12.6	26	8.8	36	15.6	1	7.7	95	12.0
Weir/deposition basin	36	14.2	38	12.9	24	10.4	1	7.7	99	12.5
Inland channel	56	22.0	43	14.6	56	24.3	3	23.1	158	19.9
Total	254		295		230		13		792	

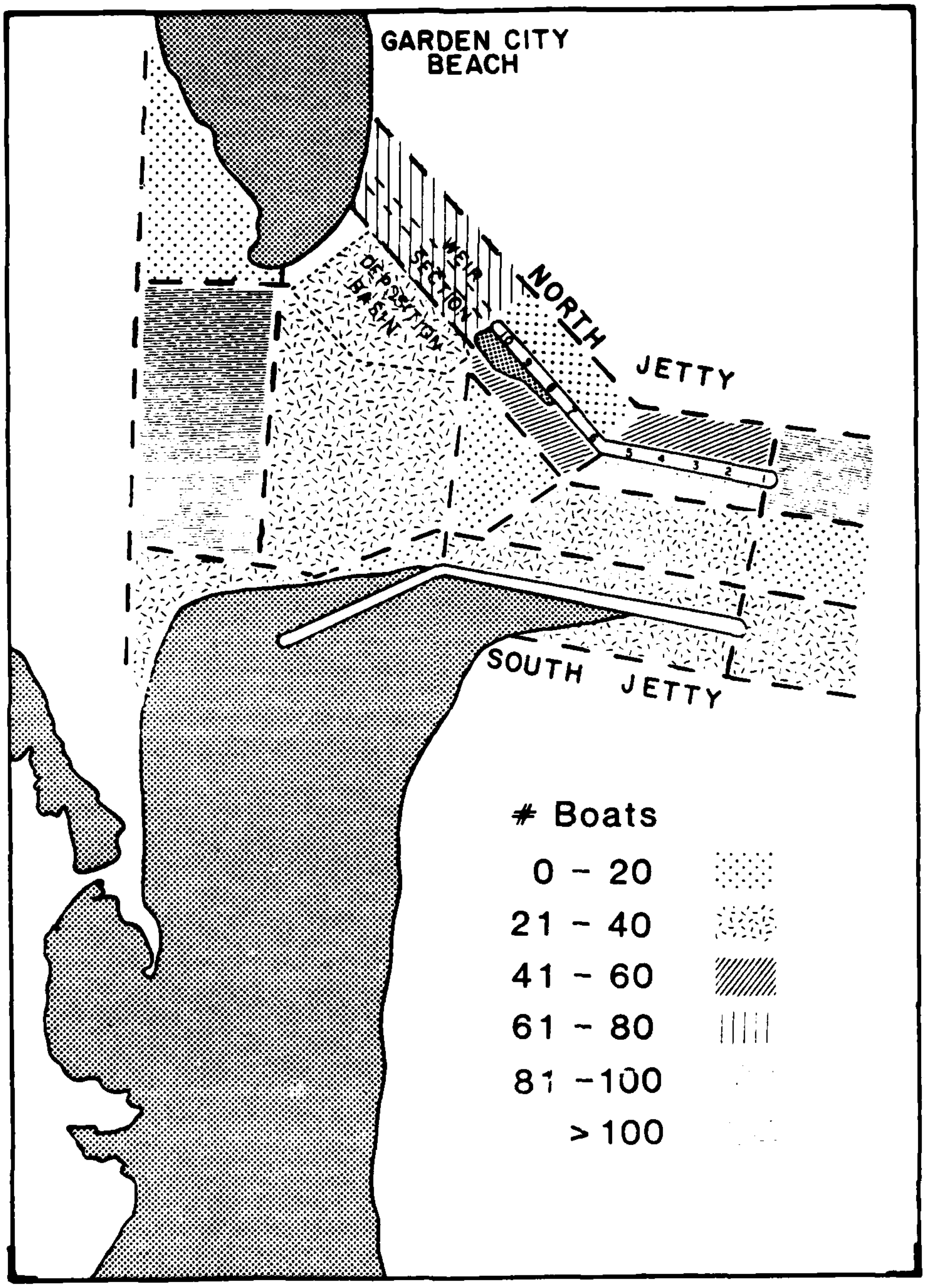


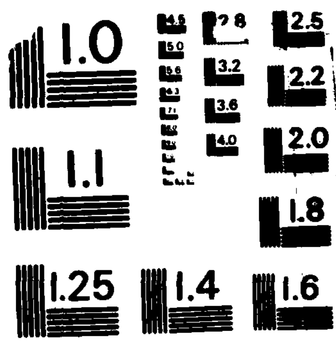
Figure 27. Map showing recreational fishing pressure in each survey zone around the Murrells Inlet jetties. Boat densities represent totals from all seasons combined.

Table 21. Average number of boats and bank-fishermen (B/F) occurring daily on weekdays and weekend days for each season. Number of interviews conducted appears in parentheses.

	Spring	Summer	Fall	Winter	Total
	B/F	B/F	B/F	B/F	B/F
Weekdays	7/6 (40)	16/14 (65)	13/11 (52)	2/1 (8)	10/8 (165)
Weekends	22/24 (121)	22/21 (77)	18/21 (82)	1/4 (15)	16/18 (295)
Total *	1027/1014 (161)	1612/1456 (142)	1313/1261 (134)	156/169 (23)	4108/3900 (460)

* Total numbers of boats and bank-fishermen for each season are extrapolated based on average numbers per day, 5 weekdays and 2 weekend days per week, and 13 weeks per season.

AD-A187 676 ENVIRONMENTAL IMPACT RESEARCH PROGRAM ECOLOGICAL 2/2
EFFECTS OF RUBBLE WEIR J..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS ENVIR..
UNCLASSIFIED R F VAN DOLAH ET AL. AUG 87 WES/TR/EL-84-4 F/G 8/1 NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
3.2
3.6
4.0

and 3900 bank-fishermen includes many fishermen who were counted more than once because they fished on consecutive survey days, it is clear that the jetties serve as a valuable resource for recreational fishing activities.

During the four survey periods, 460 interviews were conducted with anglers around the Murrells Inlet jetties. The percentage of interviews conducted on weekdays and on weekend days varied seasonally depending on the number of anglers present (Table 21). Most interviews took place on weekend days during every season; however, in summer, the percentage of interviews conducted on weekdays was nearly as great. This was due to an increased number of vacationers remaining in the area throughout an entire week during the summer months. Over the entire one-year survey period, 36 % of all interviews were conducted on weekdays and 64 % on weekend days (Table 21). The total number of interviewed parties in the area decreased steadily from a high of 161 in spring to a low of 23 in winter.

Interviewed anglers sought a total of 14 fish species (Table 22). Red drum (Sciaenops ocellatus) was the most frequently sought fish throughout the survey, being specified by 42 % of all fishing parties. Other popular species were flounder (Paralichthys sp.), 28 %; spot (Leiostomus xanthurus), 8 %; bluefish (Pomatomus saltatrix), 4 %; king mackerel (Scomberomorus cavalla), 4 %; and sheepshead (Archosargus probatocephalus), 4 %. There was little seasonal variation in the species sought by anglers, except for spot and king mackerel, which were more popular in the fall than in other seasons. Spot fishing often increases in many coastal areas in late fall as these fish migrate from bays and sounds offshore to spawn (Hildebrand and Cable, 1930). King mackerel move inshore in the fall to feed on estuarine fishes such as mullet (Mugil sp.), which move offshore at this time. Fall is generally the only season in which king mackerel are available to inshore fishermen (in South Carolina) and, consequently, the only season in which they were sought or caught by anglers in the Murrells Inlet area.

A total of 818 fish representing 23 species were caught by anglers interviewed during the survey (Table 23). The greatest number of fish and the greatest number of species were caught during summer. Overall, black sea bass, Centropristis striata, was the most frequently caught fish, with large numbers captured during every season but winter. The smooth dogfish, Mustelus canis, was the second most frequently captured fish; however, its occurrence in the area was highly seasonal. Ninety-four percent of the smooth dogfish were caught in spring when they are known to migrate north along the coast (Bigelow and Schroeder, 1953). Gill net collections confirmed that these fish were abundant only during spring (see Section IV.1). Other fishes frequently collected were bluefish, red drum, flounder, and spot (Table 23). Each of these species was caught during at least three seasons, while all species sought by recreational anglers were collected by fishermen during at lease one season.

There was often a relationship between where anglers fished and what species they sought. Similarly, there was a relationship between where an angler fished and which species were actually caught. Table 24 lists the regions around the jetties where fish species were sought and caught by recreational anglers.

Table 22 . Total number and percentage of interviewed anglers seeking various fish species around the Murrells Inlet jetties during each sampling period.

Species	Spring		Summer		Fall		Winter		Total	
	N	%	N	%	N	%	N	%	N	%
Red drum (*Sciaenops ocellatus*)	47	40.5	51	42.5	48	42.9	4	36.4	150	41.8
Flounder (*Paralichthys* sp.)	53	45.7	38	31.7	11	9.8	---	----	102	28.4
Spot (*Leiostomus xanthurus*)	8	6.9	3	2.5	19	17.0	---	----	30	8.4
Bluefish (*Pomatomus saltatrix*)	4	3.4	4	3.3	5	4.5	---	----	13	3.6
King mackerel (*Scomberomorus cavalla*)	---	----	---	----	13	11.6	---	----	13	3.6
Sheepshead (*Archosargus probatocephalus*)	---	----	9	7.5	3	2.7	1	9.1	13	3.6
Spotted seatrout (*Cynoscion nebulosus*)	---	----	3	2.5	3	2.7	5	45.4	11	3.1
Black drum (*Pogonias cromis*)	1	0.8	4	3.3	2	1.8	1	9.1	8	2.2
Croaker (*Micropogonias undulatus*)	1	0.8	1	0.8	3	2.7	---	----	5	1.4
Spanish mackerel (*Scomberomorus maculatus*)	---	----	4	3.3	---	----	---	----	4	1.1
Kingfish (whiting)(*Menticirrhus* sp.)	---	----	1	0.8	3	2.7	---	----	4	1.1
Black sea bass (*Centropristis striata*)	---	----	1	0.8	2	1.8	---	----	3	0.8
Shark (any species)	2	1.7	---	----	---	----	---	----	2	0.6
Florida pompano (*Trachinotus carolinus*)	---	----	1	0.8	---	----	---	----	1	0.3
Total	116		120		112		11		359	

Table 23 . Total number and percentage of fishes caught by interviewed anglers around the Murrells Inlet jetties during each seasonal sampling period.

Species	Spring		Summer		Fall		Winter		Total	
	N	%	N	%	N	%	N	%	N	%
Black sea bass (Centropristis striata)	50	16.5	39	10.6	35	24.1	---	----	124	15.2
Smooth dogfish (Mustelus canis)	109	36.0	7	1.9	---	----	---	----	116	14.2
Bluefish (Pomatomus saltatrix)	34	11.2	56	15.2	17	11.7	---	----	107	13.1
Red drum (Sciaenops ocellatus)	23	7.6	50	13.6	20	13.8	1	100.	94	11.5
Flounder (Paralichthys sp.)	23	7.6	40	10.8	3	2.1	---	----	66	8.1
Spot (Leiostomus xanthurus)	24	7.9	12	3.3	23	15.9	---	----	59	7.2
Pinfish (Lagodon rhomboides)	---	----	33	8.9	13	9.0	---	----	46	5.6
Florida pompano (Trachinotus carolinus)	---	----	40	10.8	4	2.8	---	----	44	5.4
Skate (several species)	34	11.2	5	1.4	---	----	---	----	39	4.8
Sheepshead (Archosargus probatocephalus)	---	----	32	8.7	---	----	---	----	32	3.9
Croaker (Micropogonias undulatus)	---	----	25	6.8	2	1.8	---	----	27	3.3
Kingfish (whiting)(Menticirrhus sp.)	4	1.3	6	1.6	8	5.5	---	----	18	2.2
Tautog (Tautoga onitis)	1	0.3	---	----	12	8.3	---	----	13	1.6
Spanish mackerel (Scomberomorus maculatus)	---	----	8	2.2	---	----	---	----	8	1.0
Black drum (Pogonias cromis)	1	0.3	5	1.4	1	0.7	---	----	7	0.9
King mackerel (Scomberomorus cavalla)	---	----	---	----	4	2.8	---	----	4	0.5
Sea catfish (Arius felis)	---	----	4	1.1	---	----	---	----	4	0.5
Spotted seatrout (Cynoscion nebulosus)	---	----	2	0.5	---	----	---	----	2	0.2
Crevalle jack (Caranx hippos)	---	----	2	0.5	---	----	---	----	2	0.2
Porgy (Calamus sp.)	---	----	1	0.3	1	0.7	---	----	2	0.2
Pigfish (Orthopristis chrysoptera)	---	----	1	0.3	1	0.7	---	----	2	0.2
Spadefish (Chaetodipterus faber)	---	----	1	0.3	---	----	---	----	1	0.1
Ladyfish (Elops saurus)	---	----	---	----	1	0.7	---	----	1	0.1
Total caught	303		369		145		1		818	

Table 24. Number of fishing parties fishing for (sought-s) various species and the number of each species caught (c) by anglers in the various sampling zones at Murrells Inlet, all seasons combined.

	North jetty		South jetty		Main channel		Weir/Depos. basin		Inland channel	
	s	c	s	c	s	c	s	c	s	c
Red drum	88	37	34	12	6	1	17	44	5	--
Flounder	28	15	17	8	15	12	23	22	19	9
Spot	4	1	2	5	4	2	3	12	17	39
Bluefish	4	36	4	10	1	24	4	27	--	10
King mackerel	--	--	7	3	6	1	--	--	--	--
Sheepshead	6	28	7	4	--	--	--	--	--	--
Spotted seatrout	3	--	2	2	1	--	2	--	3	--
Black drum	4	2	2	3	1	--	1	1	--	1
Croaker	1	1	--	3	--	7	2	13	2	3
Spanish mackerel	2	8	1	--	--	--	1	--	--	--
Kingfish (whiting)	1	--	--	11	--	1	2	6	1	--
Black sea bass	--	45	3	56	--	11	--	10	--	2
Shark (dogfish)	--	25	1	82	1	1	--	8	--	--
Florida pompano	--	--	--	--	--	--	1	44	--	--
Total	141	198	80	199	35	60	56	187	47	64

The most frequently sought fish, red drum, was caught almost exclusively around the rubble jetty structures. This species was primarily fished for around the north jetty, where it was caught most frequently in the weir/deposition basin area (Table 24). Similar trends were also noted for flounder and bluefish, which were commonly caught in the main channel as well. The deeper waters associated with these areas may have attracted these fishes. Spot, which is primarily an inshore species, was fished for and caught in the inland portion of the channel. The two most frequently caught fishes, black sea bass and smooth dogfish, showed definite affinities for jetty structures, with very few caught elsewhere.

Overall, the total number of fishes collected by recreational fishermen was nearly equal in all areas associated with rubble jetty structures, and the catches were much greater than those in nonjetty areas.

Recreational shrimping and crabbing proved to be almost nonexistent around the Murrells Inlet jetties. Throughout the survey, no interviewed parties indicated that they had been or intended to do any shrimping in the area. In the spring, 2 of the 161 interviewed parties were engaged in crabbing with hand lines and drop nets, but recreational crabbing was not observed during other seasons.

V. SUMMARY AND CONCLUSIONS

1. Fishes and crabs associated with a jetty system at Murrells Inlet were sampled over a one-year period to: (a) identify changes in the distribution, relative abundance, and community composition of species present during each season; (b) characterize the food habits of most fish species collected; and (c) identify seasonal trends in recreational fishing around the jetties.

2. The Murrells Inlet jetty system was constructed between 1977 and 1980 and consists of two rubble structures, each approximately 1000 m long. The jetties are located at the entrance of an inlet situated in the southern portion of the Grand Strand, an economically important tourist area in South Carolina.

3. All sampling was conducted at quarterly intervals from April 1985 to February 1986. Fish communities were assessed by using replicate sets of gill nets (three mesh sizes), traps, rotenone collections, and by performing diver surveys. Food habits of most fish species collected were determined through stomach content analyses. Decapods were sampled using replicate sets of crab traps. Interview-count surveys were conducted at various times on weekends and weekdays during each season to identify areas of recreational fishing activity and species sought, as well as the species and number of fishes caught.

4. Gill net, trap, and rotenone sampling around the jetties resulted in the collection of 75 species of fish representing 53 families. Greatest catches were obtained in spring and smallest catches in winter. Gill net and trap collections, as well as diver observations, showed distinct seasonal differences in the community composition of fishes around the jetties; however, the species composition and abundance of fishes observed by divers was markedly different from that of fishes collected in gill nets and traps. Seasonal differences were not as apparent in rotenone collections. The species composition of fishes found around the jetties was similar to that of fishes associated with other shallow-water artificial and natural reef structures in the South Atlantic Bight. In general, the Murrells Inlet jetties appear to: (a) attract species that are normally associated with reef structures, (b) attract species that are commonly found around estuarine inlets, and (c) attract species which seasonally migrate along the coast. The Murrells Inlet jetties also serve as nursery habitat for a variety of fish species commonly found in deeper offshore waters.

5. Although small sample sizes precluded a definitive analysis of some species' diets, the results of our food habits study suggested the existence of three major trophic groups among the fishes collected near the Murrells Inlet jetties: (a) fish that are mostly piscivorous, (b) fish that feed primarily on sand-bottom epifauna, and (c) fish that feed principally on jetty biota and, in some cases, zooplankton. Among the recreationally important fishes, spadefish, sheepshead, and black drum fed primarily on jetty biota, while bluefish, black sea bass, spotted seatrout, weakfish, red drum, and Spanish mackerel consumed mostly smaller fishes (e.g. blennies, gobies, silversides, anchovies, and, to

some extent, spot) all of which fed heavily on jetty biota. Seasonal and ontogenetic variations in food habits were exhibited by a number of fishes.

6. Eight species of crabs were captured in the blue crab traps set around the north jetty. The stone crab, Menippe mercenaria, was numerically dominant, comprising 90 % of the total catch. Stone crab catches were greatest in spring and declined in all subsequent seasons. None were caught in winter. Stone crab catches were consistently lower on the channel versus exposed side of the jetty, and significantly more crabs were caught at night than during the day. The overall sex ratio of the stone crab catch was 2.2:1 (females to males), but males had a greater mean carapace width. Based on the size of catches in this study, it is unlikely that the Murrells Inlet jetties can support more than an incidental stone crab fishery.

7. Considerable recreational fishing activity was observed in the vicinity of the Murrells Inlet jetties, especially around the north jetty. Bank fishing was restricted to the south jetty, which has a walkway along the top. Most fishing activity was observed on weekend days versus weekdays, although this difference was not as great during summer. Interviewed anglers primarily sought red drum, flounder, spot, bluefish, king mackerel, and sheepshead. There was little seasonal difference in the species sought by anglers, except for spot and king mackerel. Of the 23 species collected by anglers who were interviewed during the one-year survey period, black sea bass and smooth dogfish were the species most frequently captured. The greatest number of fish and the greatest number of species were caught during summer, and overall catches were much greater around the jetty structures than in nonjetty areas.

VI. LITERATURE CITED

ADAMS, S.M., "Feeding ecology of eelgrass fish communities," Trans. Amer. Fish. Soc., Vol. 105, 1976, pp. 514-519.

BASS, R.J., and AVAULT, J.W., Jr., "Food habits, length-weight relationship, condition factor, and growth of juvenile red drum, *Sciaenops ocellata*, in Louisiana," Trans. Amer. Fish. Soc., Vol. 104, 1975, pp. 35-45.

BEARDEN, C.M., "A contribution to the biology of the king whitings genus *Menticurrhus*, of South Carolina," Cont. Bears Bluff Lab., Vol. 38, 1963, pp. 27.

BENDER, E.S., "Studies of the life history of the stone crab, *Menippe mercenaria* (SAY), in the Cedar Key area," M.S. Thesis, Univ. of Fla., Dept. of Zool., Gainesville, Fla., 1971, 110 pp.

BENGTSON, D.A., "Resource partitioning by *Menidia menidia* and *Menidia beryllina* (Osteichthyes:Atherinidae)," Mar. Ecol. Prog. Ser., 1984, pp. 21-30.

BERRIEN, P., and FINAN, D., "Biological and fisheries data on Spanish mackerel, *Scomberomorus maculatus* (Mitchill)," NMFS Sandy Hook Lab. Tech. Ser. Rep. 9, 1978.

BERRIEN, P. and FINAN, D., "Biological and fisheries data on king mackerel, *Scomberomorus cavalla* (Cuvier)," NMFS Sandy Hook Lab. Tech. Ser. Rep. 8, 1977.

BIGELOW, H.B., and SCHROEDER, W.C., "Sharks," Pages 59-546 in J. Tee-Van (ed.), Fishes of the Western North Atlantic, Part I, Sears Foundation for Marine Research, Yale Univ., New Haven, Conn., 1948.

BIGELOW, H.B., and SCHROEDER, W.C., "Fishes of the Gulf of Maine," Fish. Bull., Vol. 53, 1953, pp. 1-577.

BOHNSACK, J.A., and SUTHERLAND, D.L., "Artificial reef research: a review with recommendations for future priorities," Bull. Mar. Sci., Vol. 37, 1985, pp. 11-39.

BOOTHBY, R.N., and AVAULT, J.W., Jr., "Food habits, length-weight relationship, and condition factor of the red drum (*Sciaenops ocellata*) in Southeastern Louisiana," Trans. Amer. Fish. Soc., Vol. 100, 1971, pp. 290-295.

BRAY, J.R., and CURTIS, J.T., "An ordination of the upland forest communities of southern Wisconsin," Ecol. Monogr., Vol. 27, 1957, pp. 325-349.

BUCHANAN, C.C., "Effects of an artificial habitat on the marine sport fishery and economy of Murrells Inlet, South Carolina," Mar. Fish. Rev., Vol. 35 (9), 1973, pp. 15-22.

BUCKLEY, R.M., "Marine habitat enhancement and urban recreational fishing in Washington," Mar. Fish. Rev., Vol. 44, 1982, pp. 28-37.

BURCHMORE, J.J., POLLARD, D.A., BELL, J.D., MIDDLETON, M.J., PEASE, B.C., and MATHEWS, J., "An ecological comparison of artificial and natural rocky reef fish communities in New South Wales, Australia," Bull. Mar. Sci., Vol. 37, 1985, pp. 70-85.

CALDWELL, M.A., "Autecology of the stone crab, Menippe mercenaria (SAY), near the northern extent of its range," Master's Thesis, College of Charleston, Dept. of Biology, 1986, 72 pp.

CARR, W.E.S., and ADAMS, C.A., "Food habits of juvenile marine fishes occupying seagrass beds in the estuarine zone near Crystal River, Florida," Trans. Amer. Fish. Soc., Vol. 102, 1973, pp. 511-540.

CHAO, L.N., and MUSICK, J.A., "Life history, feeding habits, and functional morphology of juvenile sciaenid fishes in the York River Estuary, Virginia," Fish. Bull., Vol. 75, 1977, pp. 657-702.

CURRIN, B.M., REED, J.P., and MILLER, J.M., "Growth, production, food consumption, and mortality of juvenile spot and croaker: a comparison of tidal and non-tidal nursery areas," Estuaries, Vol. 7, 1984, pp. 451-459.

DARCY, G.H., "Synopsis of biological data on the spottail pinfish, Diplodus holbrooki (Pisces:Sparidae)," NOAA Tech. Rep., NMFS Vol. 19, 1985, 11 pp.

DARCY, G.H., "Synopsis of biological data on the pinfish, Lagodon rhomboides (Pisces:Sparidae)," NOAA Tech. Rep., NMFS Vol. 23, 1985, 32 pp.

DARCY, G.H., "Synopsis of biological data on the pigfish, Orthopristis chrysoptera (Pisces:Haemulidae)," NOAA Tech. Rep., NMFS Circ. 449, 1983, 23 pp.

DARNELL, R.M., "Food habits of fishes and larger invertebrates of Lake Pontchartrain, Louisiana, an estuarine community," Publ. Inst. Mar. Sci. Univ. Texas, Vol. 5, 1958, pp. 353-416.

DARNELL, R.M., "Trophic spectrum of an estuarine community, based on studies of Lake Pontchartrain, Louisiana," Ecology, Vol. 42, 1961, pp. 553-568.

DAVIS, G.E., BAUGHMAN, D.S., CHAPMAN, J.D., MACARTHUR, D., and PIERCE, A.C., "Mortality associated with declawing stone crabs, Menippe mercenaria," US Natl. Park Serv., South Florida Res. Cent. Rept. T-522, 1978, 23 pp.

DIENER, R.A., INGLIS, A., and ADAMS, G.B., "Stomach contents of fishes from Clear Lake and tributary waters, a Texas estuarine area," Contrib. Mar. Sci., Vol. 18, 1974, pp. 7-17.

GALLAWAY, B.J., MARTIN, L.R., HOWARD, R.L., BOLAND, G.S., and DENNIS, G.D., "Effects on artificial reef and demersal fish and macrocrustacean communities," Pages 237-299 in B.S. Middleitch (ed.), Environmental Effects of Offshore Oil Production, Plenum Publishing Corp., 1981.

GOVONI, J.J., HOSS, D.E., and CHESTER, A.J., "Comparative feeding of three species of larval fishes in the northern Gulf of Mexico: Brevoortia patronus, Leiostomus xanthurus, and Micropogonias undulatus," Mar. Ecol. Prog. Ser., Vol. 13, 1983, pp. 189-199.

GOVONI, J.J., ORTNER, P.B., AL-YAMANI, F., and HILL, L.C., "Selective feeding of spot, Leiostomus xanthurus, and Atlantic croaker, Micropogonias undulatus, larvae in the northern Gulf of Mexico," Mar. Ecol. Prog. Ser., Vol. 28, 1986, pp. 175-183.

GRANT, G.C., "Predation of bluefish on young Atlantic menhaden in Indian River, Delaware," Ches. Sci., Vol. 3, 1962, pp. 45-47.

GRANT, J.J., WILSON, K.C., GROVER, A., and TOGSTAD, H.A., "Early development," Mar. Fish. Rev., Vol. 44, 1982, pp. 53-60.

HALES, L.S., and CALDER, D.R., "A study of fish and shellfish migration across the weir of a weir jetty, Murrells Inlet, South Carolina," Summary Report, Coastal Engineering Research Center, Fort Belvoir, Va., 1979.

HALES, L.S., and VAN DEN AVYLE, M., "Species profiles: life histories and environmental requirements of coastal fishes and invertebrates. South Atlantic Bight. Spot (Leiostomus xanthurus)," US Fish and Wildlife Service, Division of Bio. Serv., 1985.

HANSEN, D.J., "Food, growth, migration, reproduction, and abundance of pinfish, Lagadon rhomboides, and Atlantic croaker, Micropogon undulatus, near Pensacola, Florida," Fish. Bull., Vol. 68, 1969, pp. 135-146.

HASTINGS, R.W., "Rock jetty fish fauna as an enhanced shore based fishery," Mar. Rec. Fish., Vol. 3, 1978, pp. 29-36.

HILDEBRAND, S.F., and CABLE, L.E., "Development and life history of fourteen teleostean fishes at Beaufort, N.C.," Bull. U.S. Bur. Fish., Vol. 46, 1930, pp. 383-488.

HILDEBRAND, S.F., and SCHROEDER, W.C., "Fishes of Chesapeake Bay," Bull. U.S. Bur. Fish., Vol. 43, 1928, pp. 1-366.

HODSON, R.G., HACKMAN, J.O., and BENNETT, C.R., "Food habits of young spots in nursery areas of the Cape Fear River Estuary, North Carolina," Trans. Amer. Fish. Soc., Vol. 110, 1981, pp. 495-501.

HURME, A.K., "Rubble-mound structures as artificial reefs," Proc. Specialty Conf. on Coastal Structures 79, ASCE/Alexandria, Va., 1979, pp. 1042-1051.

HYNES, H.B.N., "The food of freshwater sticklebacks (Gasterosteus aculeatus and Pygosteus pungetius), with a review of the methods used in studies of the food of fishes," J. Anim. Ecol., Vol. 19, 1950, pp. 36-58.

KJELSON, M.A., PETERS, D.S., THAYER, G.W., and JOHNSON, G.N., "The general feeding ecology of postlarval fishes in the Newport River Estuary", Fish. Bull., Vol. 73, 1975, pp. 137-144.

KNOTT, D.M., CALDER, D.R., and VAN DOLAH, R.F., "Macrobenthos of sandy beach and nearshore environments at Murrells Inlet, South Carolina, USA," Est. Coast. and Shelf. Sci., Vol. 16, 1983, pp. 573-590.

KNOTT, D.M., VAN DOLAH, R.F., and CALDER, D.R., "Ecological effects of rubble weir jetty construction at Murrells Inlet, South Carolina; Volume II: changes in macrobenthic communities of sandy beach and nearshore environments," Tech. Rept. EL-84-4, prepared by Marine Resources Research Institute, Charleston, S. C., for Environmental Laboratory, US Army Engineer Waterways Experiment Station, Vicksburg, Miss., 1984, 50 pp.

KOBYLINSKI, G.J., and SHERIDAN, P.F., "Distribution, abundance, feeding and long-term fluctuations of spot, Leiostomus xanthurus, and croaker, Micropogonias undulatus, in Apalachicola Bay, Florida, 1972-1977," Contrib. Mar. Sci., Vol. 22, 1979, pp. 149-161.

LAGLER, K.F., "Capture, sampling and examination of fishes", Pages 7-44 in W.E. Ricker (ed.), Methods for Assessment of Fish Production in Fresh Waters, Int. Biol. Prog. Handbook 3, Blackwell Scientific Publications, 1971.

LANCE, G.N., and WILLIAMS, W.T., "A general theory of classificatory sorting strategies. I. Hierarchical systems," Comput. J., Vol. 9, 1967, pp. 373-380.

LANGTON, R.W., and BOWMAN, R.E., "Food of eight Northwest Atlantic Pleuronectiform fishes," NOAA Tech. Rept. NMFS SSRF-749, 1981, 16 pp.

LINDQUIST, D.G., and DILLAMAN, R.M., "Trophic morphology of four western Atlantic blennies (Pisces:Blenniidae)," Copeia, 1986, pp. 207-213.

LINDQUIST, D.G., OGBURN, M.V., STANLEY, W.B., TROUTMAN, H.L., and PEREIRA, S.M., "Fish utilization patterns on temperate rubble-mound jetties in North Carolina," Bull. Mar. Sci., Vol. 37, 1985, pp. 244-251.

MANSUETI, R., "Symbiotic behavior between small fishes and jelly fishes, with new data on that between the stromateid, Peprilus alepidotus, and the scyphomedusa, Chrysaora quinquecirrha," Copeia, 1963, pp. 40-80.

McEACHRAN, J.D., BOESCH, D.F., and MUSICK, J.A., "Food division within two sympatric species-pairs of skates (Pisces: Rajidae)," Mar. Biol., Vol. 35, 1976, pp. 301-317.

MERCER, L.P., "A biological and fisheries profile of spotted seatrout, Cynoscion nebulosus," Special Sci. Rept. No. 40, Project SF-13, NMFS, 1984a, 87 pp.

MERCER, L.P., "A biological and fisheries profile of red drum, Sciaenops ocellatus," Special Sci. Rept. No. 41, Project SF-13, NMFS, 1984b, 89 pp.

MERRINER, J.V., "Food habits of the weakfish, Cynoscion regalis, in North Carolina waters," Ches. Sci., Vol. 16, 1975, pp. 74-76.

MUNROE, T.A., and LOTSPEICH, R.A., "Some life history aspects of the seaboard goby (Gobiosoma ginsburgi) in Rhode Island," Estuaries, Vol. 2, 1979, pp. 22-27.

NATIONAL OCEAN SURVEY, "Tide tables 1986. High and low water predictions, east coast of North and South America including Greenland," National Oceanic and Atmospheric Administration, Washington, DC, 1986, 288 pp.

NAUGHTON, S.P., and SALOMAN, C.H., "Stomach contents of juveniles of king mackerel (Scomberomorus cavalla) and Spanish mackerel (S. maculatus)," N.E. Gulf Sci., Vol. 5, 1981, pp. 71-74.

ODUM, W.E., and HEALD, E.J., "Trophic analyses of an estuarine mangrove community," Bull. Mar. Sci., Vol. 22, 1972, pp. 671-738.

OGBURN, M.V., "Feeding ecology and the role of algae in the diet of sheepshead Archosargus probatocephalus (Pisces: Sparidae) on two North Carolina jetties," M.S. Thesis, Univ. North Carolina, Wilmington, 1984, 68 pp.

OLLA, B.L., BEJDA, A.J., and MARTIN, A.D., "Daily activity, movements, feeding, and seasonal occurrence in the tautog, Tautoga onitis," Fish. Bull., Vol. 72, 1974, pp. 27-35.

OVERSTREET, R.M., and HEARD, R.W., "Food of the red drum, Sciaenops ocellata, from Mississippi Sound," Gulf Res. Rep., Vol. 6, 1978a, pp. 131-135.

OVERSTREET R.M., and HEARD, R.W., "Food of the Atlantic croaker, Micropogonias undulatus, from Mississippi Sound and the Gulf of Mexico," Gulf Res. Rept., Vol. 6, 1978b, pp. 145-152.

OVERSTREET, R.M., and HEARD, R.W., "Food contents of six commercial fishes from Mississippi Sound," Gulf Res. Rept., Vol. 7, 1982, pp. 137-149.

PARKER, R.O., Jr., STONE, R.B., and BUCHANAN, C.C., "Artificial reefs off Murrells Inlet, South Carolina," Mar. Fish. Rev., 1979, pp. 12-23.

PEARSON, J.C., "Natural history and conservation of redfish and other commercial sciaenids on the Texas coast," Bull. U.S. Bur. Fish., Vol. 44, 1929, pp. 129-214.

PINKAS, L., OLIPHANT, M.S., and IVERSON, I.L.K., "Food habits of albacore, bluefin tuna, and bonito in California waters," Fish. Bull., Calif. Dept. of Fish & Game, Vol. 152, 1971, 105 pp.

POWELL, E.H., Jr., and GUNTER, G., "Observations of the stone crab, Menippe mercenaria (SAY), in the vicinity of Port Aransas, Texas," Gulf Res. Rept., Vol. 2, 1968, pp. 285-299.

RANDALL, J.E. and HARTMAN, W.D., "Sponge-feeding fishes of the West Indies," Mar. Biol., Vol. 1, 1968, pp. 216-225.

REID, G.K., INGLIS, A., and HOESE, H.D., "Summer foods of some fish species in East Bay, Texas," Southwestern Nat., Vol. 1, 1956, pp. 100-104.

RICHARDS, S.W., "Age, growth, and food of bluefish (*Pomatomus saltatrix*) from east-central Long Island Sound from July through November 1975," *Trans. Amer. Fish. Soc.*, Vol. 105, 1976, pp. 523-525.

ROELOFS, E.W., "Food studies of young sciaenid fishes, *Micropogon* and *Leiostomus*, from North Carolina," *Copeia*, 1954, pp. 151-153.

SEDBERRY, G.R., In prep. "Feeding habits of sheepshead, *Archosargus probatocephalus* (Pisces, Sparidae), in offshore reef habitats of the southeastern continental shelf."

SEDBERRY, G.R., and VAN DOLAH, R.F., "Demersal fish assemblages associated with hard bottom habitat in the South Atlantic Bight of the U.S.A.," *Env. Bio. Fish.*, Vol. 11, 1984, pp. 241-258.

SEKAVEC, G.B., "Summer foods, length-weight relationship, and condition factor of juvenile ladyfish, *Elops saurus* Linnaeus, from Louisiana coastal streams," *Trans. Amer. Fish. Soc.*, Vol. 103, 1974, pp. 472-476.

SHERIDAN, P.F., and TRIMM, D.L., "Summer foods of Texas coastal fishes relative to age and habitat," *Fish. Bull.*, Vol. 81, 1983, pp. 643-647.

SMITH, S.M., HOFF, J.G., O'NEIL, S.P., and WEINSTEIN, M.P., "Community and trophic organization of nekton utilizing shallow marsh habitats, York River, Virginia," *Fish. Bull.*, Vol. 82, 1984, pp. 455-467.

SOUTH CAROLINA WILDLIFE AND MARINE RESOURCES DEPARTMENT (SCWMRD), "South Atlantic OCS Area Living Marine Resources Study, Phase III, Vol. I," Final Report prepared for Minerals Management Service, under Contract 14-12-001-29185, 1984, 223 pp.

SPRINGER, V.G., and WOODBURN, K.D., "An ecological study of the fishes of the Tampa Bay area," Fla. Bd. Conserv. Mar. Res. Lab. Prof. Pap. Ser. 1, 1960, 104 pp.

STEIMLE, F.W., Jr., and OGREN, L., "Food of fish collected on artificial reefs in the New York Bight and off Charleston, South Carolina," *Mar. Fish. Rev.*, Vol. 44, 1982, pp. 49-52.

STICKNEY, R.R., TAYLOR, G.L., and WHITE, D.B., "Food habits of five species of young southeastern United States estuarine Sciaenidae," *Ches. Sci.*, Vol. 16, 1975, pp. 104-114.

STONER, A.W., "Feeding ecology of *Lagadon rhomboides* (Pisces: Sparidae): variation and functional responses," *Fish. Bull.*, Vol. 78, 1980, pp. 337-352.

THEILING, D., "Fisheries statistics landings," (available from South Carolina Wildlife and Marine Resources Dept., Charleston, S.C.), 1984, 1985.

VAN DOLAH, R.F., and KNOTT, D.M., "A biological assessment of beach and nearshore areas along the South Carolina Grand Strand," Final Report to US Dept. of Interior, Fish and Wildlife Service under Agreement No. 14-16-004-84-924, 1984, 59 pp.

VAN DOLAH, R.F., KNOTT, D.M., and CALDER, D.R., "Ecological effects of rubble weir jetty construction at Murrells Inlet, South Carolina; Volume I: Colonization and community development on new jetties," Tech. Rept. EL-84-4, prepared by Marine Resources Research Institute, Charleston, S.C. for US Army Engineer Waterways Experiment Station, Vicksburg, Miss., 1984, 69 pp.

WENNER, C.A., ROUMILLAT, W.A., and WALTZ, C.W., "Contributions to the life history of black sea bass, Centropristis striata, off the southeastern United States," Fish. Bull., Vol. 84, 1986, in press.

WENNER, E.L., and STOKES, A.D., "Preliminary observations on the distribution and abundance of the stone crab, Menippe mercenaria, in South Carolina waters," South Carolina Marine Resources Center, Tech. Rept. No. 55, 1983, 30 pp.

WHITTAKER, R.H., and FAIRBANKS, C.W., "A study of plankton copepod communities in the Columbia Basin, southeastern Washington," Ecology, Vol. 39, 1958, pp. 46-65.

WILLIAMS, A.B., Shrimps, Lobsters, and Crabs of the Atlantic Coast of the Eastern United States, Maine to Florida, Smithsonian Institution Press, Washington, DC, 1984, 550 pp.

WINDELL, J.T., "Food analysis and rate of digestion," Pages 215-226 in W.E. Ricker (ed.), Methods for Assessment of Fish Production in Fresh Water, Blackwell Scientific Publications, Oxford, 1971.

Appendix 1. Seasonal species composition, numbers (n), and lengths in millimeters of fishes taken in gill net collections on the outside of the north and south jetties at Murrells Inlet.

Season Family	Species	Spring n	Spring $\bar{x}$TL	Spring range TL	Summer n	Summer $\bar{x}$TL	Summer range TL	Fall n	Fall $\bar{x}$TL	Fall range TL	Winter n	Winter $\bar{x}$TL	Winter range TL
Carcharhinidae	Mustelus canis	468	648	574-1062	1	460		---			---		
	Rhizoprionodon terraenovae	1	630		---			---			---		
Sphyrnidae	Sphyrna tiburo	1	567		3	877	842-924	---			---		
Rajidae	Raja eglanteria	81	429	219-614	---			---			---		
Dasyatidae	Dasyatis sabina*	2	295	287-304	2	395	375-415	---			---		
	Dasyatis sayi*	---			1	315		---			---		
	Gymnura micrura*	3	372	335-422	---			---			---		
Myliobatidae	Myliobatis fremenvillei*	8	359	307-389	---			---			---		
	Rhinoptera bonasus*	---			---			1	478		---		
Elopidae	Elops saurus**	---			1	298		4	298	286-307	---		
Clupeidae	Alosa aestivalis**	5	250	238-257	---			---			---		
	Alosa mediocris**	3	380	352-394	---			---			---		
	Alosa sapidissima**	5	418	366-480	---			---			10	458	390-510
	Brevoortia smithi**	---						2	289	283-294	---		
	Brevoortia tyrannus**	1	305		36	199	180-250	4	218	189-240	1	290	
	Dorosoma cepedianum**	3	325	318-329	---			---			---		
	Opisthonema oglinum**	---			12	177	168-190	---			---		
Engraulidae	Anchoa hepsetus**	1	110		1	55		---			---		
Ariidae	Arius felis**	---			3	267	245-307	---			---		
Serranidae	Centropristis striata	---			---			3	224	208-239	---		
Pomatomidae	Pomatomus saltatrix**	188	314	228-433	64	294	215-385	18	306	159-422	---		
Carangidae	Caranx hippes**	---			7	156	148-163	---			---		
	Chloroscombrus chrysurus**	1	168		1	172		---			---		
	Selene setipinnis**	6	181	169-190	6	181	169-190	2	181	178-185	---		
	Selene vomer**	---			3	153	116-203	12	181	142-241	---		
Haemulidae	Orthopristis chrysoptera**	1	565		1	287		---			---		
Sparidae	Archosargus probatocephalus**	---			1	252		7	349	242-490	---		
	Diplodus holbrooki**	---			---			2	139	135-143	---		
	Lagodon rhomboides**	---			7	182	162-195	2	157	153-162	---		
Sciaenidae	Cynoscion nebulosus	---			18	351	309-396	4	389	378-412	---		
	Cynoscion regalis	7	357	270-482	3	372	305-405	---			---		
	Leiostomus xanthurus	4	194	160-215	27	215	195-243	306	232	192-272	3	236	226-248
	Menticirrhus americanus	1	285		1	332		3	294	277-308	---		
	Menticirrhus littoralis	25	338	287-425	6	310	291-393	16	337	276-442	---		
	Micropogonias undulatus	---			5	234	209-257	---			---		
	Pogonias cromis	3	538	482-573	3	460	370-514	3	363	275-526	---		
	Sciaenops ocellatus	---			1	294		7	398	372-442	---		
Ephippidae	Chaetodipterus faber	---			3	194	161-242	2	195	190-200	---		
Labridae	Tautoga onites	2	228	226-230	3	285	249-310	4	309	275-347	---		
Mugilidae	Mugil cephalus**	---			10	280	257-337	1	390		---		
Uranoscopidae	Astroscopus y-graecum	---			1	320		---			---		
Scombridae	Scomberomorus cavalla**	---			1	198		---			---		
	Scomberomorus maculatus**	1	565		136	306	226-458	2	335	305-366	---		
Stromateidae	Peprilus alepidotus**	22	160	135-194	1	149		2	100	98-102	---		
Bothidae	Paralichthys lethostigma	4	341	271-430	2	438	379-497	3	493	437-571	1	294	
	Scophthalmus aquosus	---			---			1	212		3	208	188-233
Soleidae	Trinectes maculatus	1	164		1	170		---			---		

Notes: $\bar{x}$ = mean length; * following species = disc width; ** following species = fork length; all other = total length.

Appendix 2. Seasonal species composition, numbers (n), and total lengths (TL) in millimeters of fishes taken in rotenone collections on the inside of the north jetty at Murrells Inlet.

Season Family	Species	Spring n	Spring $\bar{x}$TL	Spring range TL	Summer n	Summer $\bar{x}$TL	Summer range TL	Fall n	Fall $\bar{x}$TL	Fall range TL	Winter n	Winter $\bar{x}$TL	Winter range TL
Engraulidae	Anchoa cubana	---			1	*		---			---		
	A. hepsetus	2	113	109-118	---			---			---		
Batrachoididae	Opsanus tau	---			1	26		---			---		
Gobiesocidae	Gobiesox strumosus	82	53	36-73	24	35	15-73	24	42	23-76	12	48	27-79
Gadidae	Urophycis earlli	4	129	114-145	2	266	266-267	1	295		---		
Exocoetidae	Hyporhamphus unifasciatus	---			---			1	148		---		
Cyprinodontidae	Fundulus majalis	6	57	50-80	---			---			---		
Atherinidae	Membras martinica	---			---			2	48	40-56	---		
	Menidia menidia	5	93	86-104	---			---			---		
Syngnathidae	Syngnathus fuscus	3	109	98-128	---			1	118		1	131	
Serranidae	Centropristis striata	1	35		---			---			---		
Carangidae	Caranx bartholomaei	---			---			1	67		---		
Haemulidae	Orthopristis chrysoptera	---			2	129	128-130	---			---		
Sparidae	Archosargus probatocephalus	2	106	97-115	---			---			---		
	Diplodus holbrooki	---			1	122		---			---		
	Lagodon rhomboides	---			---			---			4	16	15-16
Sciaenidae	Leiostomus xanthurus	41	28	17-39	---			---			20	19	16-21
Mugilidae	Mugil cephalus	---			---			---	1	28			
Blenniidae	Hypleurochilus geminatus	18	59	37-83	55	48	17-96	32	42	26-72	16	53	37-73
	Hypsoblennius hentzi	10	42	26-50	9	22	14-32	85	36	16-74	2	35	34-37
Gobiidae	Gobiosoma ginsburgi	61	36	27-47	84	17	11-27	110	25	18-31	40	30	20-49
Cynoglossidae	Symphurus plagiusa	1	33		---			---			1	26	
Monacanthidae	Monacanthus hispidus	---			1	27		1	58		---		

Notes: $\bar{x}$TL = mean total length. * = specimen damaged; Gerreidae not included.

Appendix 3: *Percent frequency (F), number (N) and volume (V) of food items consumed by fishes collected near the Murrells Inlet jetties in spring, summer, fall, and winter.*

3.1 *Mustelus canis*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Annelida												
Polychaeta												
Diopatra cuprea	4.0	1.1	1.1									
Undetermined				100.0	20.0	0.1						
Total Polychaeta	4.0	1.1	1.1	100.0	20.0	0.1						
Mollusca												
Pelecypoda												
Anadara sp.	4.0	1.1	<0.1									
Cephalopoda												
Lolliguncula brevis	4.0	1.1	1.1									
Crustacea												
Stomatopoda												
Nannosquilla grayi	4.0	1.1	0.4									
Squilla empusa	24.0	6.4	4.2									
Squilla neglecta	20.0	5.4	16.3									
Total Stomatopoda	48.0	12.8	20.9									
Decapoda												
Albunea paretii	16.0	5.4	2.2									
Callinectes sp.				100.0	40.0	8.8						
Cancer irroratus	32.0	12.9	6.7									
Emerita talpoida	4.0	2.2	0.4									
Lepidopa websteri	8.0	3.2	0.7									
Libinia sp.	8.0	2.2	3.0									
Libinia emarginata	8.0	2.2	4.4									
Natantia undetermined				100.0	20.0	2.6						
Ovalipes sp.				100.0	20.0	88.4						
Ovalipes ocellatus	32.0	10.8	5.6									
Ovalipes stephensoni	16.0	5.4	21.0									
Pagurus pollicaris	8.0	2.2	0.2									
Penaeus setiferus	4.0	1.1	0.6									
Portunidae undetermined	8.0	2.2	2.7									
Portunus gibbesii	40.0	16.1	12.1									
Portunus spinimanus	4.0	1.1	0.3									
Trachypenaeus constrictus	12.0	3.2	0.9									
Xanthidae undetermined	4.0	1.1	0.3									
Total Decapoda	96.0	71.3	61.1	100.0	80.0	99.8						
Chordata												
Pisces												
Brevoortia tyrannus	20.0	7.5	4.9									
Leiostomus xanthurus	4.0	1.1	6.0									
undetermined	20.0	5.4	4.8									
Total Pisces	44.0	14.0	15.7									
Number of stomachs examined:	25			1								
Examined stomachs with food:	25			1								

3.2 *Rhizoprionodon terraenovae*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Chordata												
Pisces												
Brevoortia tyrannus	100.0	100.0	100.0									
Number of stomachs examined:	2											
Examined stomachs with food:	1											

3.3 *Sphyrna lewini*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Chordata												
Pisces												
Anchoa hepsetus	100.0	50.0	64.6									
Leiostomus xanthurus	100.0	50.0	35.4									
Total Pisces	100.0	100.0	100.0									
Number of stomachs examined:	1											
Examined stomachs with food:	1											

3.4 *Sphyrna tiburo*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Crustacea												
Stomatopoda												
Squilla empusa	33.3	12.5	81.2									
Squilla neglecta				33.3	11.1	4.6						
Total Stomatopoda	33.3	12.5	81.2	33.3	11.1	4.6						
Decapoda												
Cancer irroratus				33.3	11.1	8.1						
Libinia sp.	33.3	12.5	4.2									
Ovalipes ocellatus				33.3	22.2	42.2						
Portunus gibbesii				33.3	33.3	15.9						
Portunus sayi				33.3	22.2	29.2						
Total Decapoda	33.3	12.5	4.2	100.0	88.8	95.4						
Chordata												
Pisces												
Unidentified	66.7	75.0	14.6									
Number of stomachs examined:	3			3								
Examined stomachs with food:	3			3								

3.5 Raja eglanteria

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Mysidacea												
Bowmaniella sp.	12.0	5.4	0.3									
Mysidopsis bigelowi	4.0	0.7	<0.1									
Neomysis americana	36.0	50.3	0.5									
Undetermined	8.0	2.7	<0.1									
Total Mysidacea	48.0	59.1	0.8									
Stomatopoda												
Squilla empusa	4.0	0.7	3.9									
Undetermined	8.0	1.4	1.0									
Total Stomatopoda	12.0	2.0	4.9									
Decapoda												
Albunea paretti	4.0	0.7	3.2									
Ogyrides hayi	4.0	0.7	<0.1									
Ovalipes ocellatus	56.0	14.3	9.8									
Periclemenes longicaudatus	16.0	2.7	0.1									
Pinnixa sp.	8.0	2.0	0.2									
Pinnixa cristata	8.0	1.4	0.1									
Portunus gibbesii	4.0	0.7	0.7									
Portunidae undetermined	4.0	0.7	0.4									
Trachypenaeus constrictus	12.0	2.7	2.2									
Xanthidae undetermined	4.0	0.7	<0.1									
Undetermined	4.0	0.7	0.2									
Total Decapoda	72.0	27.2	16.8									
Chordata												
Pisces												
Anchoa hepsetus	4.0	0.7	4.6									
Leiostomus xanthurus	20.0	3.4	54.9									
Menidia menidia	24.0	4.8	4.0									
Micropogonias undulatus	4.0	0.7	5.5									
Monacanthus hispidus	4.0	0.7	0.5									
Undetermined	8.0	1.4	7.8									
Total Pisces	60.0	11.6	77.4									

Number of stomachs examined: 25
Examined stomachs with food: 25

3.6 *Dasyatis americana*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Annelida												
Polychaeta												
Glycera dibranchiata	33.3	25.9	11.3									
Onuphis eremita	33.3	3.7	4.8									
Total Polychaeta	33.3	29.6	16.1									
Crustacea												
Mysidacea												
Bowmaniella sp.	33.3	3.7	0.6									
Amphipoda												
Acanthohaustorius millsi	33.3	3.7	<0.1									
Ampelisca sp.	33.3	7.4	3.8									
Protohaustorius deichmannae	33.3	37.0	2.0									
Rhepoxynius epistomus	33.3	3.7	<0.1									
Total Amphipoda	66.7	51.8	5.9									
Decapoda												
Cancer irroratus	33.3	3.7	<0.1									
Ogyrides hayi	33.3	3.7	2.9									
Total Decapoda	66.7	7.4	2.9									
Chordata												
Pisces												
Menidia menidia	33.3	7.4	74.3									

Number of stomachs examined: 3

Examined stomachs with food: 3

3.7 Dasyatis sabina

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Annelida												
Polychaeta												
Glycera americana	100.0	8.3	17.4									
Glycera dibranchiata	100.0	66.7	36.7									
Marphysa sanguinea	100.0	8.3	13.8									
Terebellidae undertermined	100.0	8.3	9.2									
Total Polychaeta	100.0	91.6	77.1									
Crustacea												
Decapoda												
Callianassa atlantica	100.0	8.3	22.9									
Number of stomachs examined:	2											
Examined stomachs with food:	1											

3.8 Dasyatis sayi

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Mysidacea												
Bowmaniella sp.				100.0	4.8	0.3						
Decapoda												
Ogyrides sp.				100.0	95.2	99.7						
Number of stomachs examined:				1								
Examined stomachs with food:				1								

3.9 *Gymnura micrura*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Decapoda												
Ogyrides alphaerostris	100.0	50.0	23.1									
Chordata												
Pisces												
Leiostomus xanthurus	100.0	50.0	76.9	100.0	100.0	100.0						
Number of stomachs examined:	5			2								
Examined stomachs with food:	1			1								

3.10 *Myliobatis freminvillei*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Gastropoda undetermined	90.9	46.4	54.2									
Crustacea												
Decapoda												
Caridea undetermined	9.1	0.4	<0.1									
Paguristes hummi	27.3	4.6	5.5									
Pagurus hendersoni	81.8	38.8	23.8									
Pagurus longicarpus	45.4	8.0	13.9									
Pagurus pollicaris	18.2	1.7	2.7									
Total Decapoda	100.0	53.6	45.8									
Number of stomachs examined:	12											
Examined stomachs with food:	11											

3.11 *Elops saurus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Chordata												
Pisces												
Membras martinica							100.0	100.0	100.0			
Number of stomachs examined:				1			4					
Examined stomachs with food:				0			1					

3.12 *Conger oceanicus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Decapoda												
Brachyura				50.0	25.0	37.5						
Lysmata wurdemanni				50.0	25.0	11.7						
Total Decapoda				50.0	50.0	49.2						
Chordata												
Pisces												
Gobiesox strumosus				50.0	25.0	37.5						
Brevoortia tyrranus				50.0	25.0	13.3						
Total Pisces				50.0	50.0	50.8						
Number of stomachs examined:				2								
Examined stomachs with food:				2								

3.13 *Opisthonema oglinum*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Annelida												
Polychaeta												
Nereis succinea				66.7	76.5	96.4						
Crustacea												
Copepoda				33.3	16.8	<0.1						
Decapoda												
Acetes americana				33.3	2.5	0.2						
Chordata												
Pisces												
Blenniidae (larvae)				33.3	4.2	3.3						
Number of stomachs examined:				4								
Examined stomachs with food:				3								

3.14 *Anchoa hepsetus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Pelecypoda												
Brachidontes exustus	50.0	9.5	7.4									

__Anchoa__ __hepsetus__ - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Ostracoda	50.0	6.3	2.5									
Amphipoda												
__Caprella__ sp.	50.0	4.8	2.5									
__Erichthonius__ __brasiliensis__	100.0	20.6	14.8									
__Gammaropsis__ sp.	50.0	19.0	18.5									
__Jassa__ __falcata__	100.0	14.3	12.3									
Total Amphipoda	100.0	58.7	48.1									
Mysidacea												
__Bowmaniella__ sp.	50.0	3.2	2.5									
__Neomysis__ __americana__	50.0	9.5	14.8									
Total Mysidacea	50.0	12.7	17.3									
Decapoda												
Majidae undetermined				100.0	100.0	100.0						
__Ogyrides__ sp.	50.0	12.7	24.7									
Number of stomachs examined:	3			1								
Examined stomachs with food:	2			1								

3.15 __Arius__ __felis__

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Cephalopoda												
__Lolliguncula__ __brevis__				66.7	10.0	72.7						
Crustacea												
Cirripedia												
__Lepas__ __pectinata__				33.3	32.5	0.2						
Stomatopoda												
__Nannosquilla__ sp.				33.3	7.5	9.5						
Decapoda												
__Latreutes__ __parvulus__				33.3	2.5	<0.1						
__Lysmata__ __wurdemanni__				33.3	7.5	1.4						
__Ogyrides__ sp.				100.0	20.0	1.2						
__Pagurus__ sp.				33.3	2.5	0.2						
__Pinnixa__ sp.				33.3	2.5	0.1						
Portunidae undetermined				33.3	2.5	0.3						
__Portunus__ __gibbesii__				33.3	2.5	0.2						
Undetermined				33.3	2.5	0.7						
Total Decapoda				100.0	42.5	4.0						
Chordata												
Pisces												

Arius felis - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Brevoortia tyrannus				33.3	2.5	12.2						
Hypleurochilus geminatus				33.3	2.5	0.3						
Undetermined				33.3	2.5	1.0						
Total Pisces				100.0	7.5	13.4						
Number of stomachs examined:				3								
Examined stomachs with food:				3								

3.16 *Bagre marinus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Chordata												
Pisces												
Undetermined	100.0	100.0	100.0									
Number of stomachs examined:	1											
Examined stomachs with food:	1											

3.17 *Opsanus tau*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Cladophora laetiverens	16.7	2.8	<0.1	6.7	2.0	<0.1						
Hypnea musciformis	33.3	5.5	0.1									
Total Algae	33.3	8.3	0.1	6.7	2.0	<0.1						
Cnidaria												
Hydrozoa												
Hydroidea undetermined	16.7	2.8	0.1	6.7	2.0	<0.1						
Obelia geniculata							50.0	3.2	1.6			
Sertularia distans	33.3	5.5	<0.1									
Thyroscyphus marginatus	16.7	2.8	<0.1									
Total Hydrozoa	33.3	11.1	0.2	6.7	2.0	<0.1	50.0	3.2	1.6			
Annelida												
Polychaeta												
Serpulidae undetermined				6.7	2.0	<0.1						
Mollusca												
Pelecypoda												
Brachidontes exustus	33.3	13.9	0.2	6.7	6.0	0.1	100.0	58.1	40.4			

Opsanus tau - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Tellina sp.				6.7	2.0	<0.1						
Undetermined				6.7	2.0	<0.1						
Total Pelecypoda	33.3	13.9	0.2	6.7	10.0	0.1	100.0	58.1	40.4			
Crustacea												
Cirripedia												
Balanus venustus	16.7	2.8	<0.1				50.0	35.5	40.2			
Amphipoda												
Corophium sp.	16.7	2.8	<0.1									
Decapoda												
Cancer irroratus	66.7	19.4	42.6									
Cronius ruber							50.0	3.2	17.7			
Heterocrypta granulata				33.3	4.0	0.1						
Hexapanopeus angustifrons				6.7	2.0	0.1						
Libinia dubia	33.3	5.5	0.9									
Lysmata wurdemanni	16.7	2.8	2.7	13.3	4.0	0.5						
Neopanope sayi				26.7	16.0	0.9						
Pagurus longicarpus				13.3	12.0	0.4						
Panopeus herbstii	16.7	5.5	5.4	13.3	6.0	1.6						
Penaeidae undetermined				6.7	2.0	0.5						
Petrolisthes galathinus				6.7	2.0	0.7						
Xanthidae undetermined				6.7	2.0	0.1						
Undetermined				6.7	2.0	0.5						
Total Decapoda	83.3	33.3	51.6	53.3	52.0	5.5	50.0	3.2	17.7			
Bryozoa												
Bugula neritina	16.7	2.8	<0.1									
Crisia sp.	33.3	5.5	0.2									
Membranipora arborescens				6.7	2.0	<0.1						
Schizoporella floridana	16.7	2.8	0.2									
Total Bryozoa	33.3	11.1	0.4	6.7	2.0	<0.1						
Echinodermata												
Echinoidea												
Arbacia punctulata	16.7	2.8	2.2									
Chordata												
Pisces												
Blenniidae undetermined				6.7	2.0	0.2						
Brevoortia tyrannus				53.3	22.0	64.2						
Centropristis striata				6.7	2.0	27.0						
Gobiosoma ginsburgi	16.7	2.8	0.5									
Hypleurochilus geminatus				13.3	4.0	2.9						
Menidia menidia	16.7	8.3	44.7									
Undetermined	16.7	2.8	<0.1									
Total Pisces	50.0	13.9	45.1	66.7	30.0	94.3						
Number of stomachs examined:	9			18			2					
Examined stomachs with food:	6			15			2					

3.18 *Gobiesox strumosus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Algae C	11.1	1.1	18.5									
Cnidaria												
Hydrozoa												
Dynamena quadridentata	11.1	1.1	0.4									
Obelia geniculata										11.1	1.5	1.8
Total Hydrozoa	11.1	1.1	0.4							11.1	1.5	1.8
Mollusca												
Gastropoda												
Astyris lunata	33.3	3.2	18.5									
Pyramidellidae undetermined	11.1	1.1	0.7									
Total Gastropoda	33.3	4.3	19.2									
Pelecypoda												
Brachidontes exustus	11.1	1.1	0.4	15.0	3.9	25.1	5.5	0.6	2.0	11.1	3.0	3.6
Crustacea												
Ostracoda	11.1	2.1	0.4									
Copepoda	11.1	16.0	0.4	5.0	7.9	0.5						
Cirripedia	33.3	13.8	5.7				5.5	0.6	0.5	11.1	3.0	3.6
Cumacea										22.2	6.0	1.8
Isopoda												
Edotea montosa	11.1	1.1	0.4									
Erichsonella filiformis	11.1	1.1	5.3									
Paracerceis caudata				5.0	1.3	2.4						
Paradella quadripunctata	22.2	10.6	11.3	80.0	80.3	22.2	88.9	88.6	89.3	66.7	34.3	53.6
Sphaeroma quadridentatum	11.1	2.1	2.3				16.7	1.9	3.0			
Total Isopoda	55.5	14.9	19.2	80.0	81.6	24.6	88.9	90.5	92.3	66.7	34.3	53.6
Amphipoda												
Ampithoe valida	11.1	1.1	3.0									
Caprella equilibra	11.1	1.1	0.7				5.5	0.6	0.5	11.1	1.5	0.9
Caprella penantis	33.3	3.2	1.5	5.0	1.3	0.2				44.4	10.4	14.3
Corophium acherusicum	22.2	4.2	1.1									
Corophium lacustre	22.2	2.1	1.1									
Corophium sp.				5.0	1.3	0.2						
Erichthonius brasiliensis	11.1	1.1	0.7							11.1	1.5	0.9
Gammaropsis sp.	11.1	2.1	6.8									
Gammarus mucronatus	22.2	2.1	1.1									
Gammarus sp.										22.2	6.0	3.6
Jassa falcata	66.7	10.6	7.5				27.8	4.4	2.0	33.3	13.4	9.8
Melita appendiculata	11.1	1.1	2.3				16.7	1.9	2.2			
Parhyale hawaiensis	11.1	5.3	18.9									
Stenothoe georgiana	11.1	1.1	0.4							22.2	19.4	6.2
undetermined	33.3	8.5	5.7	5.0	1.3	0.2	11.1	1.3	0.5			
Total Amphipoda	100.0	43.6	50.9	15.0	3.9	0.7	55.5	8.2	5.2	66.7	52.2	35.7
Decapoda												
Lysmata wurdemanni				5.0	1.3	43.1						
Bryozoa												

Gobiesox strumosus - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Bugula neritina	11.1	1.1	2.3									
Crisia sp.	11.1	1.1	0.7									
Total Bryozoa	11.1	2.1	3.0									
Chordata												
Pisces												
Gobiosoma ginsburgi				5.0	1.3	6.0						
Number of stomachs examined:	11			24			24			13		
Examined stomachs with food:	9			20			18			9		

3.19 Urophycis earlli

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Mollusca												
Pelecypoda												
Tellina sp.							100.0	25.0	9.6			
Crustacea												
Isopoda												
Paradella quadripunctata							100.0	8.3	0.3			
Amphipoda												
Gammaropsis sp.	100.0	55.5	1.5									
Decapoda												
Eurypanopeus depressus	100.0	5.0	32.8									
Panopeus herbstii							100.0	33.3	75.0			
Pinnixa chaetopterana	100.0	10.0	2.7									
Pinnixa floridana	100.0	20.0	3.3									
Sicyonia laevigata							100.0	25.0	12.9			
Total Decapoda	100.0	35.0	38.8				100.0	58.3	87.9			
Chordata												
Pisces												
Gobiesox strumosus	100.0	5.0	53.7									
Gobiosoma ginsburgi	100.0	5.0	6.0				100.0	8.3	2.1			
Total Pisces	100.0	10.0	59.7				100.0	8.3	2.1			
Number of stomachs examined:	1			2			1					
Examined stomachs with food:	1			0			1					

3.20 Hyporhamphus unifasciatus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Algae A				8.3	<0.1	1.3	8.3	2.9	1.1			
Cladophora laetiverens				12.5	0.1	2.8	8.3	2.9	2.3			
Hypnea musciformis				12.5	0.1	1.3	8.3	2.9	0.7			
Porphyra leucosticta				8.3	<0.1	6.9						
Undetermined				4.2	<0.1	0.5	16.7	5.7	4.1			
Total Algae				25.0	0.3	12.8	33.3	14.3	8.2			
Cnidaria												
Hydrozoa												
Obelia geniculata				4.2	<0.1	<0.1						
Sertularia distans				4.2	<0.1	0.1						
Undetermined				8.3	<0.1	0.1						
Total Hydrozoa				16.7	0.1	0.2						
Annelida												
Polychaeta												
Nereis succinea				4.2	<0.1	<0.1						
Serpulidae undetermined				4.2	<0.1	<0.1						
Undetermined				8.3	<0.1	0.4						
Total Polychaeta				16.7	0.1	0.6						
Mollusca												
Pelecypoda												
Brachidontes exustus				8.3	0.1	0.4						
Undetermined				4.2	16.2	1.2						
Total Pelecypoda				12.5	16.2	1.6						
Crustacea												
Copepoda				33.3	72.2	26.5						
Cirripedia				41.7	4.7	11.6	8.3	17.1	0.7			
Isopoda												
Paradella quadripunctata				4.2	0.7	2.4						
Undetermined							8.3	2.9	0.2			
Amphipoda												
Caprella penantis				33.3	4.2	31.4						
Caprella sp.							8.3	28.6	1.1			
Corophium sp.				4.2	0.2	0.3						
Jassa falcata				8.3	0.3	0.3						
Stenothoe georgiana				12.5	0.2	0.2						
Undetermined				16.7	0.3	0.4						
Total Amphipoda				37.5	5.2	32.6	8.3	28.6	1.1			
Stomatopoda												
Undetermined				4.2	<0.1	0.1						

Hyporhamphus unifasciatus - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Decapoda												
Emerita talpoida (zoea)				12.5	1.0	8.6						
Pinnixa chaetopterana							25.0	17.1	64.8			
Undetermined zoea				4.2	<0.1	<0.1						
Undetermined				4.2	<0.1	2.9	16.7	5.7	0.9			
Total Decapoda				20.8	1.0	11.6	41.7	22.8	65.7			
Insecta												
Undetermined							41.7	14.3	24.1			
Number of stomachs examined:				25			24					
Examined stomachs with food:				24			12					

3.21 *Strongylura marina*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Annelida												
Polychaeta												
Nereis succinea				7.1	10.5	0.4						
Mollusca												
Cephalopoda												
Lolliguncula brevis				7.1	5.3	2.8						
Crustacea												
Decapoda												
Pinnixa sp.							8.3	5.5	0.1			
Chordata												
Pisces												
Anchoa hepsetus				7.1	10.5	5.2						
Anchoa mitchilli				14.3	15.8	5.9						
Anchoa sp.							16.7	27.8	34.2			
Membras martinica							58.3	44.4	61.8			
Opisthonema oglinum				57.1	47.4	84.5						
Undetermined				14.3	10.5	1.1	33.3	22.2	3.9			
Total Pisces				92.9	84.2	96.7	100.0	94.4	99.9			
Number of stomachs examined:				26			29					
Examined stomachs with food:				14			12					

3.22 *Membras martinica*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Copepoda				100.0	84.8	70.0						
Cirripedia												
Cypris larvae				100.0	12.1	20.0						
Decapoda												
Undetermined zoea				100.0	3.0	10.0						
Number of stomachs examined:				1			25					
Examined stomachs with food:				1			0					

3.23 *Menidia menidia*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Annelida												
Polychaeta												
Hydroides dianthus	8.0	0.5	0.7									
Nereis sp.	8.0	0.7	2.1									
Total Polychaeta	16.0	1.2	2.8									
Mollusca												
Pelecypoda												
Musculus lateralis	4.0	0.2	0.3									
Crustacea												
Copepoda	36.0	39.6	6.0									
Cirripedia	4.0	0.2	0.3									
Mysidacea	4.0	0.2	0.2									
Amphipoda												
Caprella equilibra	36.0	8.5	13.8									
Caprella penantis	80.0	31.5	50.2									
Cerapus tubularis	8.0	0.5	1.1									
Gammaropsis sp.	40.0	7.8	6.5									
Jassa falcata	32.0	8.5	9.0									
Total Amphipoda	88.0	56.9	80.6									
Decapoda												
Euceramus praelongus (zoea)	4.0	1.2	1.8									
Chordata												
Pisces												
Leiostumus xanthurus	8.0	0.5	7.9									
Number of stomachs examined:	25											
Examined stomachs with food:	25											

3.24 *Syngnathus fuscus*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Crustacea												
Copepoda	87.5	49.3	27.7									
Amphipoda												
Caprella equilibra	25.0	2.9	3.1									
Caprella penantis	50.0	23.2	47.7									
Corophium sp.	12.5	1.4	1.5									
Gammaropsis sp.	12.5	1.4	1.5									
Jassa falcata	12.5	1.4	1.5									
Undetermined	75.0	17.4	13.8									
Total Amphipoda	100.0	47.8	69.2									
Bryzoa												
Bugula neritina	25.0	2.9	3.1									

Number of stomachs examined: 26
Examined stomachs with food: 8

3.25 *Centropristis striata*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Algae												
Gracilaria foliifera	4.0	0.1	0.3				4.0	0.1	<0.1			
Hypnea musciformis	4.0	0.1	0.3	4.0	1.7	<0.1	20.0	0.7	0.1			
Total Algae	4.0	0.2	0.6	4.0	1.7	<0.1	24.0	0.8	0.2			
Cnidaria												
Hydrozoa												
Sertularia distans	12.0	0.2	<0.1				4.0	0.1	1.3			
Undetermined	4.0	0.1	<0.1	8.0	3.3	0.1						
Total Hydrozoa	16.0	0.3	<0.1	8.0	3.3	0.1	4.0	0.1	1.3			
Anthozoa												
Actiniaria undetermined				4.0	1.7	5.8						
Annelida												
Polychaeta												
Arabella iricolor							4.0	0.4	0.1			
Hydroides crucigera	4.0	0.1	0.3									
Hydroides dianthus	4.0	0.2	0.6									
Terebellidae undetermined	8.0	0.2	1.1									
Undetermined	20.0	0.6	5.7	4.0	1.7	<0.1						
Total Polychaeta	36.0	1.0	7.7	4.0	1.7	<0.1	4.0	0.4	0.1			
Mollusca												
Gastropoda												

Centropristis striata - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Astyris lunata							4.0	0.1	<0.1			
Turbonilla interrupta	4.0	0.1	<0.1									
Undetermined				4.0	1.7	<0.1						
Total Gastropoda	4.0	0.1	<0.1	4.0	1.7	<0.1	4.0	0.1	<0.1			
Pelecypoda												
Brachidontes exustus	8.0	0.2	<0.1	4.0	1.7	<0.1	4.0	0.3	0.2			
Musculus lateralis	4.0	0.1	<0.1									
Undetermined				4.0	1.7	<0.1						
Total Pelecypoda	12.0	0.2	<0.1	8.0	3.3	0.1	4.0	0.3	0.2			
Crustacea												
Copepoda	4.0	0.1	<0.1									
Mysidacea												
Neomysis americana	8.0	9.2	1.8									
Undetermined				4.0	1.7	<0.1						
Isopoda												
Erichsonella filiformis							8.0	0.4	<0.1			
Paracerceis caudata	8.0	0.2	0.2	8.0	3.3	<0.1						
Amphipoda												
Ampithoidae undetermined	4.0	0.2	<0.1									
Atylus sp.							8.0	0.9	<0.1			
Batea catharinensis	4.0	0.1	<0.1									
Caprella equilibra	40.0	6.9	1.5				16.0	8.8	0.7			
Caprella penantis	76.0	24.7	5.0				20.0	48.2	3.6			
Caprella sp.	4.0	5.3	0.1									
Cerapus tubularis							32.0	10.6	0.4			
Corophium acherusicum	4.0	0.8	0.1									
Corophium sp.	8.0	0.2	<0.1									
Elasmopus levis	4.0	0.2	<0.1									
Elasmopus sp.	4.0	0.3	<0.1									
Erichthonius brasiliensis	48.0	7.6	0.6				20.0	11.0	0.5			
Gammaropsis sp.	60.0	26.9	3.9				8.0	0.5	<0.1			
Jassa falcata	36.0	6.0	0.4				8.0	2.0	0.1			
Lembos smithi	4.0	0.1	<0.1	4.0	1.7	<0.1						
Leucothoe spinicarpa	4.0	0.1	<0.1									
Lysianopsis alba	12.0	0.4	0.1									
Melita appendiculata	8.0	0.5	0.1				4.0	0.4	<0.1			
Photis sp.	4.0	0.3	<0.1									
Stenothoe georgiana	8.0	0.2	<0.1				4.0	5.1	0.1			
Unciola dissimilis	4.0	0.1	<0.1									
Unciola sp.	4.0	0.1	<0.1									
Undetermined	8.0	0.3	<0.1									
Total Amphipoda	96.0	81.2	12.1	4.0	1.7	<0.1	48.0	87.6	5.5			
Decapoda												
Acetes americanus				8.0	10.0	0.1						
Brachyura undetermined							4.0	0.3	0.7			
Cancer irroratus	32.0	0.9	15.8									
Cronius ruber							12.0	0.4	0.8			

Centropristis striata - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Eurypanopeus depressus	4.0	0.2	1.8	4.0	3.3	0.8						
Heterocrypta granulata				8.0	3.3	0.5	8.0	0.4	0.3			
Hexapanopeus angustifrons	8.0	0.2	1.8				16.0	0.5	1.1			
Lysmata wurdemanni	41.0	0.1	1.8	8.0	5.0	2.4	8.0	0.3	3.0			
Menippe mercenaria							8.0	0.3	2.0			
Natantia undetermined							4.0	0.1	2.8			
Neopanope sayi	12.0	0.3	4.4	20.0	8.3	3.9	4.0	0.1	0.4			
Panopeus herbstii				4.0	1.7	5.5						
Pelia mutica				4.0	1.7	0.1						
Penaeidae undetermined	4.0	0.1	1.1									
Penaeus sp.	4.0	0.1	6.9				24.0	0.8	7.7			
Periclimenes longicaudatus	4.0	0.1	0.2									
Petrolisthes galanthinus				4.0	1.7	3.6						
Pilumnus sp.	4.0	0.1	0.7									
Pinnixa floridana	28.0	1.3	1.9									
Pinnixa sp.	12.0	0.3	0.3									
Portunidae undetermined							4.0	0.1	<0.1			
Rhithropanopeus harrisii							4.0	0.1	0.2			
Xanthidae undetermined	4.0	0.1	0.7				8.0	0.3	0.2			
Undetermined	4.0	0.1	1.2	4.0	1.7	4.1						
Total Decapoda	76.0	3.7	38.5	60.0	36.1	21.2	64.0	3.7	29.2			
Sipuncula	12.0	0.2	0.4									
Bryozoa												
Aeverrillia setigera				4.0	1.7	<0.1						
Anguinella palmata	4.0	0.1	<0.1									
Bugula neritina	12.0	0.2	<0.1									
Bugula turrita	4.0	0.1	<0.1									
Crisia sp.	12.0	0.2	<0.1									
Total Bryozoa	20.0	0.6	<0.1	4.0	1.7	<0.1						
Echinodermata												
Ophiuroidea												
Amphiodia pulchella	4.0	0.5	<0.1	4.0	1.7	<0.1						
Ophiothrix angulata	36.0	1.1	5.6	28.0	13.3	3.0	36.0	1.3	2.7			
Total Ophiuroidea	36.0	1.6	5.6	28.0	14.7	3.0	36.0	1.3	2.7			
Chordata												
Ascidiacea												
Distaplia bermudensis							28.0	2.4	6.3			
Pisces												
Brevoortia tyrannus				32.0	13.3	33.9	12.0	0.4	27.1			
Centropristis striata	4.0	0.1	2.0	4.0	1.7	3.9						
Gobiesox strumosus							12.0	0.8	11.5			
Gobiosoma ginsburgi				4.0	1.7	<0.1	12.0	0.5	0.8			

Centropristis striata - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Hypleurochilus geminatus	8.0	0.2	4.4				4.0	0.3	3.1			
Hypsoblennius hentzi							4.0	0.1	0.9			
Leiostomus xanthurus	4.0	0.6	2.0									
Menidia menidia	4.0	0.1	0.5									
Mugil cephalus				4.0	1.7	4.3						
Undetermined	24.0	0.5	23.9	24.0	10.0	27.6	16.0	0.7	10.9			
Total Pisces	44.0	1.4	32.9	68.0	27.9	69.7	56.0	2.8	54.4			
Number of stomachs examined:	25			25			25					
Examined stomachs with food:	25			25			25					

3.26 *Pomatomus saltatrix*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Annelida												
Polychaeta												
Nereis succinea				12.0	86.8	7.7						
Crustacea												
Stomatopoda												
Squilla sp.				4.0	0.5	<0.1						
Decapoda												
Arenaeus cribrarius				4.0	0.5	6.2						
Chordata												
Pisces												
Anchoa hepsetus	5.0	3.2	1.7									
Anchoa mitchilli	2.5	1.6	0.8									
Brevoortia tyrannus	27.5	17.5	27.2	48.0	6.8	65.0	28.6	28.6	57.2			
Centropristis striata				8.0	1.0	4.2						
Chloroscombrus chrysurus				4.0	0.5	1.1						
Clupeidae	37.5	23.8	19.3	4.0	0.5	1.3						
Leiostomus xanthurus	7.5	4.8	15.0									
Membras martinica							28.6	28.6	23.2			
Menidia menidia	10.0	42.9	32.6									
Micropogonias undulatus				4.0	0.5	6.9						
Opisthonema oglinum				20.0	2.4	5.5						
Pomatomus saltatrix							14.3	14.3	12.0			
Urophycis earlli				4.0	0.5	2.0						
Undetermined	10.0	6.3	3.3				28.6	28.6	7.5			
Total Pisces	100.0	100.0	100.0	92.0	12.2	86.1	100.0	100.0	100.0			
Number of stomachs examined:	40			25			18					
Examined stomachs with food:	40			25			7					

3.27 <u>Chloroscombrus chrysurus</u>

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Annelida												
Polychaeata undetermined				50.0	33.3	33.3						
Crustacea												
Copepoda undetermined				50.0	33.3	16.7						
Amphipoda undetermined				50.0	33.3	16.7						
Decapoda undetermined				50.0	33.3	33.3						
Number of stomachs examined:	1			2								
Examined stomachs with food:	0			2								

3.28 <u>Trachinotus carolinus</u>

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Crustacea												
Decapoda												
<u>Pagurus longicarpus</u>				100.0	100.0	100.0						
Number of stomachs examined:	1			8								
Examined stomachs with food:	0			1								

3.29 <u>Selene setapinnis</u>

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Mollusca												
Cephalopoda												
<u>Lolliguncula brevis</u>	100.0	50.0	96.8									
Chordata												
Pisces												
<u>Brevoortia tryannus</u>	100.0	50.0	3.2									
Number of stomachs examined:	1						2					
Examined stomachs with food:	1						0					

3.30 *Selene vomer*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Crustacea												
Mysidacea												
Bowmaniella sp.				33.3	12.5	0.6						
Decapoda												
Ogyrides sp.							66.7	66.7	64.5			
Chordata												
Pisces												
Anchoa hepsetus				33.3	50.0	95.0						
Blenniidae undetermined(larvae)				66.7	37.5	4.4						
Undetermined							33.3	33.3	35.5			
Total Pisces				100.0	87.5	99.4	33.3	33.3	35.5			
Number of stomachs examined:				3			5					
Examined stomachs with food:				3			3					

3.31 *Orthopristis chrysoptera*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Algae												
Undetermined				14.3	2.3	0.3						
Annelida												
Polychaeta												
Arabella iricolor				42.9	34.9	82.0						
Diopatra sp.				14.3	2.3	0.7						
Capitellidae undetermined				28.6	18.6	1.3						
Piromis eruca				14.3	2.3	0.7						
Terebellidae undetermined				14.3	2.3	0.1						
Total Polychaeta				57.1	60.4	84.9						
Mollusca												
Gastropoda												
Astyris lunata				14.3	2.3	0.1						
Undetermined				28.6	4.6	2.0						
Total Gastropoda				42.9	7.0	2.1						
Pelecypoda												
Brachidontes exustus				42.9	16.3	4.2						
Crustacea												
Isopoda												
Paradella quadripunctata				14.3	7.0	0.4						
Amphipoda												
Parhyale hawaiensis				14.3	2.3	0.2						

Orthopristis chrysoptera - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Stenothoe sp.				14.3	2.3	<0.1						
Total Amphipoda				14.3	4.6	0.3						
Decapoda												
Lysmata wurdemanni				14.3	2.3	7.8						
Number of stomachs examined:				7								
Examined stomachs with food:				7								

3.32 Archosargus probatocephalus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Clodophora laetiverens	100.0	0.6	4.1									
Gracilaria foliifera				100.0	12.5	21.6	33.3	0.4	35.7			
Hypnea musciformis							33.3	0.4	7.3			
Ulva sp.							33.3	0.4	4.3			
Total Algae	100.0	0.6	4.1	100.0	12.5	21.6	50.0	1.3	47.3			
Cnidaria												
Hydrozoa												
Clavidae undetermined	100.0	0.6	5.5									
Dynamena cornicina							16.7	0.2	0.3			
Obelia geniculta				100.0	12.5	1.3	66.7	0.8	5.5			
Sertularia distans							33.3	0.4	0.7			
Stomolophus meleagris							16.7	0.2	2.0			
Total Hydrozoa	100.0	0.6	5.5	100.0	12.5	1.3	66.7	1.7	8.5			
Annelida												
Polychaeta												
Sabellaria vulgaris										100.0	20.0	25.0
Mollusca												
Gastropoda												
Astyris lunata							16.7	0.2	<0.1	100.0	20.0	6.2
Pelecypoda												
Brachidontes exustus	100.0	69.9	79.6	100.0	12.5	0.2	66.7	31.9	34.8			
Chelicerata												
Pycnogonida												
Tanystylum tubirostrum							16.7	0.2	<0.1			
Crustacea												
Cirripedia												
Chthamalus fragilis							33.3	20.2	9.8			
Isopoda												

Archosargus probatocephalus - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Erichsonella filiformis	100.0	1.3	<0.1									
Paradella quadripunctata										100.0	20.0	25.0
Amphipoda												
Ampithoe valida							16.7	0.2	<0.1			
Caprella equilibra				100.0	12.5	0.2	16.7	0.8	<0.1			
Caprella penantis	100.0	20.3	6.9				66.7	4.2	0.2	100.0	20.0	37.5
Cerapus tubularis	100.0	0.6	0.2	100.0	12.5	0.2	50.0	22.1	0.9			
Erichthonius brasiliensis							16.7	3.8	0.1	100.0	20.0	6.2
Jassa falcata	100.0	5.9	0.2				66.7	13.1	0.4			
Stenothoe georgiana							16.7	0.2	<0.1			
Total Amphipoda	100.0	26.8	7.3	100.0	25.0	0.4	83.3	44.5	1.6	100.0	40.0	43.7
Decapoda												
Cancer irroratus	100.0	0.6	3.5									
Xanthidae undetermined				100.0	12.5	10.8						
Bryozoa												
Membranipora arborescens							16.7	0.2	<0.1			
Echinodermata												
Ophiuroidea undetermined				100.0	12.5	0.6						
Chordata												
Ascidiacea												
Eudistoma carolinense				100.0	12.5	64.9						
Number of stomachs examined:	1			1			9			1		
Examined stomachs with food:	1			1			6			1		

3.33 *Diplodus holbrooki*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Algae A	100.0	16.7	15.0									
Gracilaria foliifera				50.0	0.8	26.8						
Hypnea musciformis				50.0	0.8	0.2						
Porphyra leucosticta	100.0	16.7	43.1									
Total Algae	100.0	33.3	58.1	100.0	1.7	26.0						
Protozoa												
Foraminifera				50.0	1.7	<0.1						
Cnidaria												
Hydrozoa												
Dynamena quadridentata				50.0	0.8	0.2						
Obelia geniculata				100.0	1.7	0.5						
Total Hydrozoa				100.0	2.5	0.7						

Diplodus holbrooki - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Gastropoda												
Astyris lunata				50.0	0.8	1.7						
Pelecypoda												
Brachidontes exustus				50.0	46.1	36.6						
Crustacea												
Cirripedia				50.0	2.6	0.2	100.0	2.2	2.7			
Isopoda												
Paradella quadripunctata							100.0	3.1	4.0			
Sphaeromatidae undetermined				50.0	0.8	3.7						
Amphipoda												
Caprella equilibra				50.0	1.7	0.2	100.0	13.8	17.7			
Caprella penantis	100.0	50.0	23.9				100.0	42.0	53.6			
Cerapus tubularis				50.0	2.6	0.5						
Corophium tuberculatum				50.0	2.6	0.2						
Erichthonius brasiliensis				50.0	1.7	0.2						
Gammaropsis sp.				50.0	2.6	0.2						
Jassa falcata							100.0	13.8	11.4			
Lembos websteri				50.0	26.5	1.2						
Rhepoxynius epistomus							50.0	3.6	1.5			
Stenothoe georgiana							100.0	21.4	9.1			
Stenothoe sp.				50.0	0.8	0.1						
Total Amphipoda	100.0	50.0	23.9	100.0	38.5	2.7	100.0	94.6	93.3			
Decapoda												
Lysmata wurdemanni				50.0	2.6	26.8						
Sipuncula	100.0	16.7	18.0									
Bryozoa												
Bugula turrita				50.0	0.8	1.7						
Number of stomachs examined:	1			2			2					
Examined stomachs with food:	1			2			2					

3.34 *Lagodon rhomboides*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Algae A				25.0	0.4	0.6	22.2	<0.1	0.1			
Cladophora laetiverens				41.7	0.6	6.7	11.1	<0.1	<0.1			
Cladophora sp.	12.5	2.3	0.6									
Gelidium crinale				8.3	0.1	0.6						

Lagodon rhomboides - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Gracilaria foliifera				33.3	0.5	3.7	22.2	<0.1	0.5			
Hypnea musciformis				25.0	0.4	0.6	33.3	0.1	1.2			
Porphyra leucosticta				25.0	0.4	17.3						
Ulva sp.	12.5	2.3	0.2	8.3	0.1	1.2						
Undetermined							11.1	<0.1	<0.1			
Total Algae	25.0	4.5	0.8	58.3	2.5	30.6	66.7	0.2	1.9			
Protozoa												
Foraminifera							11.1	<0.1	<0.1			
Porifera												
Undetermined							11.1	<0.1	1.0			
Cnidaria												
Hydrozoa												
Clavidae undetermined	12.5	2.3	3.0									
Dynamena cornicina							22.2	<0.1	0.6			
Dynamena quadridentata							11.1	<0.1	0.5			
Eudendrium sp.							11.1	<0.1	0.3			
Hebella scandens							11.1	<0.1	<0.1			
Obelia dichotoma				25.0	0.4	0.3	22.2	<0.1	0.3			
Obelia geniculata				25.0	0.4	2.4	22.2	<0.1	0.5			
Plumulariidae undetermined				8.3	0.1	<0.1						
Sertularia distans							66.7	0.1	0.7			
Sertulariidae undetermined				8.3	0.1	<0.1						
Thyroscyphus marginatus				8.3	0.1	<0.1						
Undetermined							11.1	<0.1	<0.1			
Total Hydrozoa	12.5	2.3	3.0	41.7	1.1	2.8	77.8	0.3	3.1			
Annelida												
Polychaeta												
Ampharetidae undetermined							11.1	<0.1	0.6			
Arabellidae undetermined										50.0	10.0	30.8
Marphysa sanguinea							11.1	<0.1	2.1			
Sabellaria vulgaris										50.0	10.0	7.7
Schistomeringos rudolphi							11.1	<0.1	0.2			
Total Polychaeta							11.1	0.1	2.9	100.0	20.0	38.5
Mollusca												
Pelecypoda												
Brachidontes exustus				25.0	6.4	1.8	100.0	6.0	13.6			
Crustacea												
Copepoda	12.5	2.3	<0.1									
Cirripedia												
Lepadidae undetermined				8.3	5.1	1.8						
Undetermined				25.0	0.5	<0.1						
Total *Cirripedia*				33.3	5.6	1.9						
Mysidacea												
Bowmaniella sp.				8.3	0.4	0.2						
Undetermined				8.3	0.2	<0.1						
Total Mysidacea				16.7	0.6	0.3						

Lagodon rhomboides - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Isopoda												
Ancinus depressus				8.3	0.1	0.1						
Erichsonella filiformis							33.3	0.1	0.2			
Amphipoda												
Caprella equilibra				8.3	3.1	0.6	33.3	1.0	1.1			
Caprella penantis	37.5	68.2	4.5	8.3	15.3	4.8	88.9	18.7	24.0	50.0	10.0	19.2
Caprellidae undetermined				16.7	4.0	0.2						
Cerapus tubularis				8.3	0.2	<0.1	44.4	54.1	31.3	50.0	10.0	3.8
Corophium acherusicum				8.3	0.7	0.1						
Corophium lacustre				8.3	6.5	0.8	44.4	0.5	0.3			
Corophium sp.							11.1	<0.1	<0.1			
Erichthonius brasiliensis				8.3	0.5	0.1	55.5	3.1	1.6	100.0	20.0	11.5
Gammaropsis sp.										50.0	20.0	15.4
Jassa falcata				25.0	37.8	3.6	100.0	14.3	6.4	50.0	10.0	3.8
Lembos websteri							11.1	0.1	<0.1			
Stenothoe georgiana				8.3	6.4	0.6	66.7	1.2	0.4			
Undetermined							11.1	<0.1	<0.1			
Total Amphipoda	37.5	68.2	4.5	25.0	74.6	10.7	100.0	93.1	65.2	100.0	70.0	53.8
Decapoda												
Acetes americana				8.3	6.5	2.7						
Brachyura undetermined	25.0	4.5	4.0									
Callianassa biformis							11.1	<0.1	11.9			
Natantia undetermined				33.3	0.5	15.6						
Ogyrides sp.										50.0	10.0	7.7
Ovalipes ocellatus				8.3	0.1	0.9						
Paguridae undetermined				8.3	0.1	1.2						
Pinnixa cristata				8.3	0.1	0.6						
Reptantia undetermined				8.3	0.5	<0.1						
Xanthidae megalopa				8.3	0.1	<0.1						
Total Decapoda	25.0	4.5	4.0	50.0	8.0	21.0	11.1	<0.1	11.9	50.0	10.0	7.7
Bryozoa												
Bugula neritina				8.3	0.1	<0.1						
Crisia sp.				8.3	0.1	<0.1	33.3	0.1	0.2			
Membranipora sp.				8.3	0.1	<0.1						
Total Bryozoa				8.3	0.4	0.1	33.3	0.1	0.2			
Echinodermata												
Ophiuroidea												
Ophiothrix angulata							11.1	<0.1	<0.1			
Chordata												
Ascidiacea												
Didemnum candidum				8.3	0.1	6.0						

Lagodon rhomboides - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Pisces												
Blenniidae undetermined				8.3	0.1	4.2						
Brevoortia tyrannus				16.7	0.2	16.7						
Gobiosoma ginsburgi	12.5	4.5	19.8									
Undetermined	75.0	13.6	67.9	16.7	0.2	3.9						
Total Pisces	87.5	18.2	87.6	41.7	0.6	24.7						
Number of stomachs examined:	8			14			9			2		
Examined stomachs with food:	8			12			9			2		

3.35 Cynoscion nebulosus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Cephalopoda												
Lolliguncula brevis				35.3	3.1	11.1						
Crustacea												
Decapoda												
Alpheus sp.				5.9	0.4	0.6						
Ogyrides sp.				70.6	73.8	14.6						
Total Decapoda				76.5	74.2	15.2						
Chordata												
Pisces												
Anchoa hepsetus				64.7	13.1	36.9						
Leiostomus xanthurus	100.0	100.0	100.0	17.6	6.9	18.8						
Membras martinica							33.3	66.7	57.5			
Opisthonema oglinum				5.9	1.9	16.7	33.3	16.7	39.1			
Undetermined				11.8	0.8	1.3	33.3	16.7	3.4			
Total Pisces	100.0	100.0	100.0	100.0	22.7	73.7	100.0	100.0	100.0			
Number of stomachs examined:	2			18			4					
Examined stomachs with food:	1			17			3					

3.36 *Cynoscion regalis*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Chordata												
Pisces												
Anchoa hepsetus							75.0	80.0	44.7			
Leiostomus xanthurus	60.0	30.0	97.1				25.0	20.0	55.3			
Menidia menidia	20.0	10.0	2.2									
Opisthonema oglinum				66.7	75.0	90.4						
Undetermined	40.0	60.0	0.7	33.3	25.0	9.6						
Total Pisces	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0			
Number of stomachs examined:	8			3			4					
Examined stomachs with food:	5			3			4					

3.37 *Leiostomus xanthurus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Algae C							4.4	<0.1	<0.1			
Gracilaria foliifera							4.4	<0.1	<0.1			
Hypnea musciformis							4.4	<0.1	<0.1			
Total Algae							8.7	<0.1	<0.1			
Cnidaria												
Hydrozoa												
Obelia geniculata							13.0	<0.1	<0.1			
Sertularia distans							8.7	<0.1	<0.1			
Total Hydrozoa							17.4	<0.1	0.1			
Annelida												
Polychaeta												
Hydroides dianthus	5.5	0.2	1.4									
Nereis sp.				10.5	0.4	3.2						
Nereis succinea							8.7	0.1	0.2			
Undetermined	5.5	0.3	1.4									
Total Polychaeta	5.5	0.5	2.7	10.5	0.4	3.2	8.7	0.1	0.2			
Mollusca												
Gastropoda												
Astyris lunata				15.8	1.4	1.7	21.7	0.4	1.6			
Epitonium angulatum							8.7	<0.1	<0.1			
Total Gastropoda				15.8	1.4	1.7	26.1	0.4	1.6			
Pelecypoda												
Anomia simplex							4.4	<0.1	<0.1			
Brachidontes exustus				15.8	1.0	1.4	60.9	34.4	40.0	22.2	2.0	1.2
Donax variabilis				52.6	36.4	50.3	30.4	0.3	1.4	22.2	4.5	5.8
Tellina sp.				36.8	1.9	0.7						
Trachycardium muricatum				10.5	0.4	0.1						

Leiostomus xanthurus - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Undetermined							8.7	<0.1	0.1			
Total Pelecypoda				63.2	39.8	52.5	87.0	34.7	41.5	33.3	6.6	7.0
Crustacea												
Copepoda	50.0	93.6	31.5	15.8	3.2	0.1				66.7	1.8	0.4
Cumacea				15.8	1.0	0.1						
Cirripedia												
Lepas pectinata				15.8	1.5	3.3						
Mysidacea												
Bowmaniella sp.	16.7	0.7	6.2	63.2	26.8	15.2						
Metamysidopsis swifti							4.4	<0.1	<0.1			
Mysidopsis bigelowi				5.3	1.5	0.1						
Neomysis americana				5.3	0.1	0.1						
Undetermined	5.5	0.1	0.7				4.4	<0.1	<0.1			
Total Mysidacea	22.2	0.8	6.8	63.2	28.1	15.3	8.7	<0.1	<0.1			
Isopoda												
Ancinus depressus				10.5	0.3	0.1	8.7	<0.1	0.3			
Erichsonella filiformis				5.3	0.4	0.2	17.4	0.5	1.8	11.1	0.9	4.1
Paracerceis caudata				5.3	0.4	0.2						
Paradella quadripunctata							13.0	5.9	3.0	11.1	2.5	4.8
Sphaeroma quadridentatum							4.4	<0.1	0.1			
Undetermined							13.0	<0.1	0.1			
Total Isopoda				15.8	1.1	0.5	47.8	6.4	5.2	11.1	3.4	8.9
Amphipoda												
Acanthohaustorius millsi							4.4	0.1	0.2			
Atylus sp.				21.0	1.1	0.3						
Bathyporeia parkeri							4.4	<0.1	<0.1			
Caprella equilibra				5.3	0.4	0.1	21.7	0.6	0.5			
Caprella penantis	44.4	1.9	27.4				39.1	25.0	23.2	11.1	15.7	17.3
Caprella sp.							4.4	0.1	<0.1			
Caprellidae undetermined							4.4	<0.1	<0.1			
Cerapus tubularis	5.5	0.1	0.7	15.8	1.5	0.6	13.0	0.3	0.1	11.1	0.2	0.2
Corophiidae undetermined	5.5	0.1	1.4									
Corophium lacustre	5.5	0.2	1.4				13.0	0.1	<0.1			
Elasmopus levis							13.0	0.2	0.3			
Erichthonius brasiliensis	11.1	0.4	3.6				26.1	1.0	0.7	11.1	3.4	1.6
Eudevenopus honduranus				5.3	0.4	0.1						
Gammaropsis sp.	22.2	1.3	14.4	21.0	2.4	0.4	8.7	0.1	0.1			
Haustoriidae undetermined				31.6	4.4	2.0						
Hyperiidae undetermined	5.5	0.2	1.4									
Jassa falcata	16.7	0.4	3.4				34.8	19.4	11.9	11.1	49.4	54.6
Lembos smithi							4.4	0.1	0.1			
Lembos websteri							17.4	0.2	0.2	11.1	0.2	0.1
Melita appendiculata							4.4	<0.1	<0.1	11.1	1.4	3.3
Neohaustorius schmitzi							13.0	2.8	3.0			
Parahaustorius longimerus				21.0	6.0	3.2	13.0	0.1	3.6	11.1	0.4	0.6
Parhyale hawaiensis							4.4	<0.1	<0.1			
Protohaustorius deichmannae				10.5	1.5	0.3	17.4	0.4	0.5			

Leiostomus xanthurus - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Rhepoxynius epistomus				15.8	1.9	0.3						
Stenothoe georgiana							30.4	7.5	2.7	11.1	16.9	5.8
Sunampithoe sp.				5.3	0.1	<0.1						
Undetermined							4.4	<0.1	<0.1	11.1	0.2	0.1
Total Amphipoda	83.3	4.7	53.4	78.9	20.3	7.4	73.9	58.0	47.0	44.4	87.9	83.5
Decapoda												
Brachyura undetermined				5.3	0.1	4.1						
Dissodactylus mellitae				5.3	0.1	0.1						
Emerita talpoida				15.8	0.4	1.3	8.7	<0.1	0.3			
Eurypanopeus depressus							4.4	<0.1	0.3			
Grapsidae undetermined							4.4	<0.1	0.2			
Heterocrypta granulata				5.3	0.3	0.1						
Libinia dubia megalopa				5.3	0.3	0.1						
Libinia sp.				5.3	0.1	0.9						
Ogyrides hayi				10.5	0.6	0.9						
Ogyrides sp.				10.5	0.6	7.7						
Paguridae undetermined				5.3	0.1	<0.1						
Pagurus sp.				5.3	0.3	0.1						
Pinnixa chaetopterana							13.0	0.1	1.9			
Pinnixa cristata							8.7	0.1	1.2			
Pinnixa sp.				10.5	0.3	0.2						
Portunidae undetermined	5.5	0.1	4.1									
Portunus sp.							4.4	<0.1	<0.1			
Xanthidae undetermined							4.4	<0.1	0.5			
Undetermined zoea	11.1	0.3	1.4									
Total Decapoda	16.7	0.4	5.5	63.2	3.2	15.8	43.5	0.3	4.3			
Sipuncula							4.4	<0.1	0.1			
Bryozoa												
Aeverrillia setigera							4.4	<0.1	<0.1			
Bugula neritina							8.7	<0.1	<0.1			
Crisia sp.							8.7	<0.1	<0.1			
Membranipora sp.							4.4	<0.1	<0.1			
Total Bryozoa							21.7	0.1	0.1			
Echinodermata												
Ophiuroidea												
Ophiothrix angulata										11.1	0.2	0.2
Chordata												
Ascidiacea												
Eudistoma carolinense							4.4	<0.1	<0.1			
Number of stomachs examined:	20			26			25			23		
Examined stomachs with food:	18			19			23			9		

3.38 Menticirrhus americanus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Hypnea musciformis							33.3	11.1	4.8			
Mollusca												
Pelecypoda												
Brochidontes exustus							33.3	11.1	0.4			
Crustacea												
Stomatopoda												
Nannosquilla sp.				100.0	5.6	37.5						
Decapoda												
Emerita talpoida							33.3	11.1	38.5			
Ogyrides hayi				100.0	94.4	62.5						
Pinnixa cristata	100.0	100.0	100.0									
Portunus gibbesii							33.3	33.3	19.2			
Undetermined							33.3	11.1	7.7			
Total Decapoda	100.0	100.0	100.0	100.0	94.4	62.5	66.7	66.7	68.8			
Chordata												
Pisces												
Undetermined							33.3	11.1	25.9			
Number of stomachs examined:	1			1			3					
Examined stomachs with food:	1			1			3					

3.39 Menticirrhus littoralis

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Gastropoda												
Odostomia laevigata	4.3	0.9	<0.1									
Pelecypoda												
Brachidontes exustus	4.3	2.8	0.1	33.3	2.7	0.2						
Donax variabilis				50.0	21.6	7.4						
Total Pelecypoda	4.3	2.8	0.1	83.3	24.3	7.6						
Crustacea												
Mysidacea												
Bowmaniella sp.				66.7	9.5	1.8						
Neomysis americana	4.3	0.9	<0.1									
Amphipoda												
Lembos websteri	4.3	0.9	<0.1									
Parahaustorius longimerus	13.0	26.8	0.6	16.7	2.7	0.1	9.1	13.5	0.1			
Protohaustorius deichmannae	8.7	3.7	<0.1									

Menticirrhus littoralis - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Total Amphipoda	17.4	31.8	0.6	16.7	2.7	0.1	9.1	13.5	0.1			
Decapoda												
Callianassa major	4.3	2.8	11.3									
Emerita talpoida	52.2	14.8	54.2				90.1	81.1	99.8			
Ogyrides hayi	13.0	3.7	0.6	100.0	58.1	44.2						
Ogyrides sp.							9.1	2.7	<0.1			
Ovalipes ocellatus	21.7	20.4	17.3	16.7	1.3	42.2						
Ovalipes sp.	21.7	10.2	11.6									
Pinnixa chaetopterana	8.7	6.5	0.6									
Pinnixa cristata	4.3	1.8	0.1	33.3	4.0	4.1						
Portunus sp.							9.1	2.7	0.1			
Trachypenaeus constrictus	4.3	0.9	3.4									
Total Decapoda	95.6	61.7	99.2	100.0	63.5	90.5	100.0	86.5	99.9			
Chordata												
Pisces												
Undetermined	4.3	1.8	<0.1									
Number of stomachs examined:	30			6			16					
Examined stomachs with food:	23			6			11					

3.40 *Micropogonias undulatus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Mysidacea												
Bowmaniella sp.				25.0	42.8	0.1						
Decapoda												
Ogyrides sp.				25.0	14.3	1.7						
Penaeus sp.				50.0	28.6	54.8						
Undetermined				25.0	14.3	43.3						
Total Decapoda				100.0	57.2	99.9						
Number of stomachs examined:				7								
Examined stomachs with food:				4								

3.41 Pogonias cromis

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Algae A	33.3	0.1	<0.1									
Algae C	16.7	0.1	<0.1									
Algae D	16.7	0.1	<0.1									
Algae E	16.7	0.1	0.2									
Cladophora laetiverens							33.3	0.1	<0.1			
Gracilaria foliifera	16.7	0.1	0.2									
Hypnea musciformis	33.3	0.1	0.3				33.3	0.1	<0.1			
Porphyra leucosticta	16.7	0.1	<0.1									
Total Algae	66.7	0.6	0.8				66.7	0.1	<0.1			
Cnidaria												
Hydrozoa undetermined	16.7	0.1	<0.1									
Annelida												
Polychaeta												
Arabella iricolor							33.3	0.1	0.1			
Nereis sp.	33.3	0.3	<0.1									
Undetermined	16.7	0.1	0.1									
Total Polychaeta	50.0	0.4	0.1				33.3	0.1	0.1			
Mollusca												
Gastropoda												
Astyris lunata	16.7	0.1	<0.1	66.7	5.3	0.2	33.3	0.1	<0.1			
Epitonium sp.				33.3	1.2	0.1						
Pelecypoda												
Abra aequalis				33.3	2.9	0.8						
Brachidontes exustus	100.0	94.8	77.9	66.7	40.8	66.4	100.0	98.2	94.5			
Chione cancellata				33.3	5.3	2.4						
Chione grus							33.3	0.1	0.1			
Donax variabilis				66.7	14.2	5.0	33.3	0.3	0.4			
Mulinia lateralis				33.3	1.8	0.7						
Nucula proxima				33.3	1.8	0.8						
Tellina alternata	16.7	0.1	<0.1									
Trachycardium muricatum							33.3	0.1	<0.1			
Total Pelecypoda	100.0	94.9	77.9	100.0	68.1	76.2	100.0	98.7	95.1			
Crustacea												
Cirripedia				33.3	0.6	<0.1	33.3	0.1	<0.1			
Mysidacea												
Bowmaniella sp.				66.7	2.4	0.3						
Isopoda												
Ancinus depressus				33.3	1.2	0.7	33.3	0.4	0.2			
Paradella quadripunctata				33.3	0.6	0.1						
Total Isopoda				66.7	1.8	0.8	33.3	0.4	0.2			
Amphipoda												
Jassa falcata	16.7	0.1	<0.1									
Undetermined	16.7	0.1	<0.1									

Pogonias cromis - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Total Amphipoda	33.3	0.2	<0.1									
Decapoda												
Cancer irroratus	16.7	0.3	1.8									
Emerita sp.				66.7	1.8	1.5						
Heterocrypta granulata				100.0	7.7	7.4						
Hexapanopeus angustifrons							33.3	0.1	0.4			
Neopanope sayi				33.3	1.8	4.2						
Ogyrides sp.				33.3	0.6	0.6						
Ovalipes ocellatus	50.0	2.8	15.4									
Pagurus longicarpus	16.7	0.7	3.9	100.0	4.1	3.0						
Portunus gibbesii				66.7	4.1	5.2	33.3	0.3	0.3			
Trachypenaeus constrictus				33.3	1.2	0.2						
Xanthidae undetermined	16.7	0.1	0.1				33.3	0.1	1.7			
Total Decapoda	66.7	3.9	21.1	100.0	21.3	22.2	66.7	0.4	2.4			
Chordata												
Ascidiacea												
Distaplia bermudensis							33.3	0.1	2.0			
Pisces undetermined				33.3	0.6	0.2						
Number of stomachs examined:	8			3			3					
Examined stomachs with food:	6			3			3					

3.42 Sciaenops ocellatus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Decapoda												
Emerita talpoida				33.3	12.5	16.7						
Ogyrides hayi				33.3	37.5	2.8						
Penaeus sp.				33.3	12.5	13.9	50.0	50.0	47.6			
Portunus gibbesii							50.0	25.0	9.5			
Total Decapoda				66.7	62.5	33.3	50.0	75.0	57.1			
Chordata												
Pisces												
Anchoa hepsetus				33.3	25.0	46.3						
Clupeidae undetermined				33.3	12.5	20.4						
Undetermined							50.0	25.0	42.9			
Total Pisces				66.7	37.5	66.7	50.0	25.0	42.9			
Number of stomachs examined:				5			4					
Examined stomachs with food:				3			2					

3.43 *Chaetodipterus faber*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Cladophora laetiverens				16.7	0.2	0.1						
Gracilaria foliifera				66.7	0.9	6.4	50.0	0.1	5.6			
Hypnea musciformis				83.3	1.2	0.9	50.0	0.1	18.9			
Ulva sp.				16.7	0.2	0.2						
Total Algae				100.0	2.5	7.5	50.0	0.1	24.5			
Porifera												
Undetermined				50.0	0.7	70.0						
Cnidaria												
Hydrozoa												
Eudendrium sp.				16.7	0.2	<0.1						
Halocordyle disticha				50.0	0.7	1.7						
Obelia dichotoma				16.7	0.2	0.5						
Obelia geniculata							50.0	0.1	4.8			
Sertularia distans				66.7	0.9	0.1						
Undetermined							50.0	0.1	<0.1			
Total Hydrozoa				83.3	2.1	2.3	100.0	0.1	4.8			
Anthozoa												
Actiniaria undetermined				33.3	5.8	12.2	50.0	2.4	15.9			
Octocorallia undetermined				16.7	0.2	3.0						
Total Anthozoa				50.0	6.0	15.2	50.0	2.4	15.9			
Chelicerata												
Pycnogonida												
Anoplodactylus insignis				16.7	0.2	0.1						
Crustacea												
Isopoda												
Paracerceis caudata				16.7	1.4	0.1						
Amphipoda												
Caprella equilibra				16.7	3.2	0.1	50.0	0.3	0.4			
Caprella penantis				33.3	9.7	0.5	50.0	78.7	45.5			
Cerapus tubularis				50.0	66.4	1.1						
Erichthonius brasiliensis				33.3	0.5	<0.1						
Gammaropsis sp.				16.7	0.2	<0.1						
Jassa falcata				33.3	1.6	<0.1	50.0	16.1	6.3			
Melita appendiculata				33.3	1.6	0.2						
Stenothoe georgiana				50.0	0.9	<0.1	50.0	2.1	0.4			
Total Amphipoda				83.3	84.3	1.9	50.0	97.2	52.7			
Decapoda												
Natantia undetermined				16.7	0.2	0.1						
Bryozoa												
Anguinella palmata				16.7	0.2	<0.1						
Bugula neritina				33.3	0.5	0.7						
Schizoporella errata				16.7	0.2	<0.1						
Total Bryozoa				50.0	0.9	0.7						

Chaetodipterus faber - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Echinodermata												
Ophiuroidea undetermined				33.3	0.5	0.2						
Chordata												
Ascidiacea												
Didemnum candidum				16.7	0.2	<0.1						
Distaplia bermudensis				33.3	0.5	0.4						
Eudistoma carolinense				33.3	0.5	1.4	50.0	0.1	2.1			
Total Ascidiacea				50.0	1.2	1.8	50.0	0.1	2.1			
Number of stomachs examined:				6			2					
Examined stomachs with food:				6			2					

3.44 *Tautoga onitis*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Gelidium crinale	25.0	0.5	0.1									
Gracilaria foliifera							50.0	<0.1	2.8			
Hypnea musciformis				20.0	0.7	0.5	50.0	<0.1	0.7			
Undetermined							50.0	<0.1	0.1			
Total Algae	25.0	0.5	0.1	20.0	0.7	0.5	100.0	0.2	3.6			
Cnidaria												
Hydrozoa												
Obelia geniculata							50.0	<0.1	0.1			
Sertularia distans							50.0	<0.1	0.1			
Dynamena quadridentata				20.0	0.7	0.4						
Total Hydrozoa				20.0	0.7	0.4	50.0	0.1	0.1			
Annelida												
Polychaeta												
Hydroides dianthus	25.0	0.5	0.2									
Nereis succinea				20.0	0.7	2.4						
Nereis sp.	50.0	1.1	0.4									
Total Polychaeta	50.0	1.6	0.6									
Mollusca												
Gastropoda												
Astyris lunata							100.0	0.2	0.3			
Polinices duplicatus	25.0	1.1	0.1									
Undetermined	50.0	1.1	0.2									
Total Gastropoda	75.0	2.2	0.3				100.0	0.2	0.3			
Pelecypoda												
Brachidontes exustus	75.0	43.8	65.6	60.0	38.8	29.1	100.0	3.2	6.9			
Donax variabilis							50.0	<0.1	<0.1			

Tautoga onitis - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Musculus lateralis	25.0	0.5	0.1									
Total Pelecypoda	100.0	44.3	65.7	60.0	38.8	29.1	100.0	3.2	6.9			
Chelicerata												
Pycnogonida												
Tanystylum orbiculare							50.0	<0.1	0.1			
Crustacea												
Cirripedia												
Balanus improvisus				20.0	49.0	37.7						
Isopoda												
Erichsonella filiformis.							100.0	0.1	0.6			
Paracerceis caudata							50.0	<0.1	0.1			
Paradella quadripunctata				20.0	1.4	0.3						
Total Isopoda				20.0	1.4	0.3	100.0	0.2	0.7			
Amphipoda												
Caprella equilibra							50.0	0.3	0.4			
Caprella penantis	75.0	10.3	2.6				100.0	80.1	66.9			
Cerapus tubularis	25.0	1.1	0.4									
Corophium lacustre							50.0	0.1	<0.1			
Corophium sp.				20.0	0.7	0.1						
Elasmopus levis	25.0	3.2	0.3				50.0	<0.1	<0.1			
Erichthonius brasiliensis	50.0	3.2	0.4				50.0	<0.1	<0.1			
Gammaropsis sp.	75.0	25.9	5.0									
Jassa falcata							100.0	13.8	10.6			
Lembos smithi	25.0	1.1	0.2									
Melita dentata	25.0	1.1	0.2									
Parhyale hawaiensis				40.0	2.0	0.2						
Stenothoe georgiana							100.0	1.4	0.6			
Sunampithoe sp.	25.0	0.5	0.8									
Total Amphipoda	100.0	46.5	9.9	40.0	2.7	0.3	100.0	95.8	78.6			
Decapoda												
Hexapanopeus angustifrons				40.0	3.4	14.0						
Libinia dubia	25.0	1.1	6.0									
Panopeus herbstii	25.0	1.6	16.1	20.0	0.7	4.4						
Reptantia undetermined							50.0	<0.1	0.6			
Xanthidae undetermined							50.0	0.1	5.6			
Total Decapoda	50.0	2.7	22.1	60.0	4.1	18.4	100.0	0.2	6.1			
Bryozoa												
Bugula neritina	25.0	0.5	0.4									
Bugula turrita	25.0	0.5	0.4									
Crisia sp.	25.0	0.5	0.2									
Membranipora tenuis	25.0	0.5	0.1									
Thalamoporella gothica				60.0	2.0	10.9	50.0	<0.1	1.5			
Total Bryozoa	25.0	2.2	1.1	60.0	2.0	10.9	50.0	<0.1	1.5			

Tautoga onitis - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Chordata												
Ascidiacea												
Eudistoma carolinense							50.0	<0.1	2.0			
Number of stomachs examined:	4			6			4					
Examined stomachs with food:	4			5			2					

3.45 *Astroscopus y-graecum*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Decapoda												
Lysmata wurdemanni				100.0	50.0	89.5						
Chordata												
Pisces												
Undetermined				100.0	50.0	10.5						
Number of stomachs examined:				1								
Examined stomachs with food:				1								

3.46 *Hypleurochilus geminatus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Algae												
Algae A	30.0	0.6	0.9									
Hypnea musciformis	10.0	0.2	2.4									
Total Algae	30.0	0.8	3.3									
Protozoa												
Foraminifera										14.3	2.9	1.1
Cnidaria												
Hydrozoa												
Clytia fragilis				48.0	8.0	5.3						
Clytia sp.				8.0	1.3	0.3						
Dynamena cornicina				4.0	0.7	0.1	8.0	0.8	14.6			
Eudendrium sp.				4.0	0.7	0.2						
Halecium dysymmetrum				4.0	0.7	1.0						
Halecium tenellum				20.0	3.4	4.1						
Obelia dichotoma				16.0	2.7	5.1						

Hypleurochilus geminatus - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Obelia geniculata	40.0	0.8	6.4				56.0	5.5	22.9	78.6	15.9	45.0
Sertularia distens	20.0	0.4	0.2	8.0	1.3	1.9	4.0	0.4	2.6			
Undetermined medusae							32.0	10.9	8.5			
Undetermined				24.0	4.0	28.7						
Total Hydrozoa	40.0	1.2	6.6	80.0	22.8	47.6	76.0	17.6	48.6	78.6	15.9	45.0
Annelida												
Polychaeta												
Arabella iricolor							4.0	0.4	1.0			
Hydroides dianthus	30.0	1.6	1.8	4.0	0.7	0.1	12.0	1.6	5.3			
Nereis sp.	10.0	0.2	0.6									
Sabellaria vulgaris	30.0	1.2	2.1	8.0	1.3	0.5				14.3	5.8	4.4
Total Polychaeta	50.0	3.0	4.5	12.0	2.0	0.6	12.0	1.9	6.3	14.3	5.8	4.4
Mollusca												
Gastropoda												
Astyris lunata							4.0	0.4	0.2			
Pelecypoda												
Brachidontes exustus	20.0	0.4	0.6	56.0	32.2	8.3	52.0	16.0	12.4	14.3	2.9	4.9
Donax variabilis	10.0	0.4	0.1									
Musculus lateralis	10.0	0.4	1.5									
Petricola pholadiformis										7.1	1.4	0.5
Total Pelecypoda	30.0	1.2	2.2	56.0	32.2	8.3	52.0	16.0	12.4	21.4	4.3	5.5
Chelicerata												
Pycnogonida												
Anoplodactylus insignis							4.0	0.4	2.2			
Crustacea												
Copepoda	10.0	0.2	0.1							28.6	14.5	2.2
Ostracoda										7.1	1.4	0.5
Cumacea							4.0	0.4	0.2			
Cirripedia												
Cypris larvae							12.0	1.2	0.5			
Undetermined	20.0	1.2	0.9				16.0	26.6	6.3	14.3	4.3	3.3
Isopoda												
Erichsonella filiformis							8.0	0.8	0.3			
Jaeropsis coralicola				8.0	1.3	0.2						
Paradella quadripunctata				4.0	15.4	4.4	20.0	11.3	8.0	28.6	21.7	13.2
Sphaeroma quadridentatum				4.0	1.3	2.2						
Undetermined							4.0	0.4	0.3			
Total Isopoda				12.0	18.1	6.9	32.0	12.5	8.7	28.6	21.7	13.2
Amphipoda												
Ampithoe valida	10.0	0.2	0.1									
Caprella equilibra	50.0	2.8	2.3				8.0	1.9	1.9	7.1	1.4	1.1
Caprella penantis	80.0	62.2	56.1									
Corophium acherusicum	10.0	0.2	0.1									
Corophium lacustre	10.0	0.2	0.1							7.1	1.4	0.5
Corophium sp.				4.0	0.7	0.1						

Hypleurochilus geminatus - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Erichthonius brasiliensis	20.0	1.2	0.6				36.0	16.0	8.4			
Gammaropsis sp.	30.0	2.2	1.5				4.0	0.4	0.2			
Jassa falcata	90.0	18.2	17.9	8.0	1.3	0.1	12.0	2.3	1.3	14.3	2.9	2.7
Lembos websteri	10.0	0.8	0.5									
Stenothoe georgiana	70.0	3.6	2.2							7.1	1.4	0.5
Undetermined				8.0	1.3	0.1						
Total Amphipoda	90.0	91.6	81.4	16.0	3.4	0.3	48.0	20.7	11.8	28.6	7.2	4.9
Decapoda												
Reptantia undetermined										7.1	1.4	1.1
Bryozoa												
Aeverrillia setigera				8.0	1.3	1.4						
Anguinella palmata	10.0	0.2	0.2	12.0	2.0	3.9						
Bugula neritina	10.0	0.2	0.4	12.0	2.0	0.4				28.6	5.8	5.5
Crisia sp.	20.0	0.4	0.2	24.0	4.0	5.6				35.7	7.2	3.8
Thalamoporella gothica							4.0	0.4	0.6			
Total Bryozoa	30.0	0.8	0.8	28.0	9.4	11.4	4.0	0.4	0.6	64.3	13.0	9.3
Chordata												
Ascidiacea												
Didemnum condidum				32.0	5.4	6.9						
Distaplia bermudensis							8.0	1.9	2.2	7.1	7.2	9.3
Eudistoma carolinense				40.0	6.7	17.3						
Total Ascidiacea				56.0	12.1	24.3	8.0	1.9	2.2	7.1	7.2	9.3
Number of stomachs examined:	10			25			25			16		
Examined stomachs with food:	10			25			25			14		

3.47 *Hypsoblennius hentzi*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Protozoa												
Foraminifera							4.0	0.2	0.1			
Cnidaria												
Hydrozoa												
Clytia cylindrica				12.5	2.9	3.0						
Dynamena cornicina							4.0	0.2	0.5			
Obelia geniculata							16.0	0.9	4.8	50.0	16.7	10.0
Sertularia distans							4.0	0.2	0.6			
Undetermined				12.5	2.9	3.0						
Total Hydrozoa				25.0	5.7	5.9	20.0	1.4	5.9	50.0	16.7	10.0
Annelida												
Polychaeta												
Hydroides dianthus	50.0	12.4	7.0	12.5	2.9	11.8	4.0	0.2	0.4			

Hypsoblennius hentzi - continued:

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Nereis succinea	10.0	0.7	1.4	12.5	2.9	2.2						
Sabellaria vulgaris	50.0	3.6	3.5	37.5	11.4	37.8				50.0	16.7	10.0
Undetermined				12.5	2.9	0.7						
Total Polychaeta	70.0	16.8	12.5	62.5	20.0	52.6	4.0	0.2	0.4	50.0	16.7	10.0
Mollusca												
Pelecypoda												
Brachidontes exustus	10.0	0.7	0.7				24.0	2.7	2.3			
Undetermined												
Crustacea												
Ostracoda	10.0	1.5	0.7									
Cirripedia												
Cypris larvae							4.0	0.2	0.1			
Undetermined	70.0	28.5	30.6	25.0	57.1	37.0	68.0	48.8	36.4			
Isopoda												
Erichsonella filiformis	10.0	0.7	0.7				8.0	0.5	0.9			
Paracerceis caudata				25.0	8.6	2.2						
Paradella quadripunctata	20.0	2.9	6.2				40.0	3.9	8.8	50.0	66.7	80.0
Total Isopoda	20.0	3.6	6.9	25.0	8.6	2.2	40.0	4.4	9.7	50.0	66.7	80.0
Amphipoda												
Caprella equilibra	30.0	9.5	8.3				32.0	4.4	5.0			
Caprella penantis	30.0	6.6	10.4				48.0	19.9	23.6			
Caprellidae undetermined				12.5	2.9	0.7						
Cerapus tubularis							20.0	1.4	1.1			
Corophium lacustre	20.0	8.0	7.6									
Erichthonius brasiliensis	30.0	2.2	2.1				36.0	5.3	4.7			
Gammaropsis sp.	40.0	5.1	5.5				12.0	0.9	0.6			
Jassa falcata	70.0	10.2	9.0				28.0	5.0	3.9			
Stenothoe georgiana	30.0	6.6	4.9				28.0	2.3	1.5			
Undetermined				12.5	2.9	0.7						
Total Amphipoda	90.0	48.2	47.9	12.5	5.7	1.5	72.0	39.2	40.5			
Decapoda												
Xanthidae undetermined							4.0	0.2	0.2			
Bryozoa												
Bugula neritina	100.0	0.7	0.7				20.0	1.1	1.9			
Chordata												
Ascidiacea												
Distaplia bermudensis							12.0	1.4	2.4			
Number of stomachs examined:	10			9			25			2		
Examined stomachs with food:	10			8			25			2		

3.48 *Gobiosoma ginsburgi*

Prey	Spring			Summer			Fall			Winter		
	F	N	V	F	N	V	F	N	V	F	N	V
Protozoa												
Foraminifera				4.0	1.1	1.5						
Cnidaria												
Hydrozoa												
Obelia geniculata										4.0	1.2	1.3
Annelida												
Polychaeta												
Hydroides dianthus	8.3	2.7	2.3				4.0	0.9	1.9			
Sabellaria vulgaris				16.0	7.5	13.2	4.0	0.9	1.9	28.0	8.2	18.7
Undetermined				4.0	1.1	2.9						
Total Polychaeta	8.3	2.7	2.3	20.0	8.5	16.2	8.0	1.7	3.9	28.0	8.2	18.7
Mollusca												
Pelecypoda												
Brachidontes exustus	8.3	2.7	4.5	16.0	6.4	7.3	48.0	31.3	31.1	4.0	1.2	2.7
Diplodonta punctata							4.0	1.7	1.9			
Donax variabilis							4.0	0.9	1.0			
Musculus lateralis										4.0	1.2	1.3
Petricola pholadiformis							8.0	2.6	1.9			
Undetermined	8.3	2.7	2.3	16.0	5.4	7.3						
Total Pelecypoda	16.7	5.4	6.8	32.0	11.7	14.7	48.0	36.5	35.9	8.0	2.3	3.9
Crustacea												
Copepoda				24.0	50.5	23.5	16.0	5.2	3.9	16.0	29.4	6.7
Ostracoda				8.0	3.2	2.9	24.0	17.4	7.8			
Cirripedia												
Cypris larvae				4.0	1.1	1.5						
Undetermined							4.0	0.9	1.0			
Isopoda												
Erichsonella filiformis				4.0	1.1	1.5	16.0	3.5	3.9	28.0	9.4	9.3
Idoteidae undetermined										4.0	1.2	1.3
Paracerceis caudata				4.0	1.1	1.5						
Paradella quadripunctata							16.0	5.2	5.8	20.0	5.9	9.3
Undetermined				8.0	3.2	4.4						
Total Isopoda				16.0	5.3	7.3	28.0	8.7	9.7	40.0	16.5	19.7
Amphipoda												
Ampithoe valida							4.0	0.9	2.9			
Caprella equilibra				4.0	1.1	1.5	4.0	0.9	1.0	8.0	7.1	2.7
Caprella penantis	25.0	16.2	20.4				4.0	5.2	7.8			
Cerapus tubularis							4.0	1.7	2.9	4.0	1.2	1.3
Corophium acherusicum				4.0	1.1	2.9						
Corophium lacustre				4.0	1.1	2.9	4.0	0.9	1.0	4.0	1.2	1.3
Corophium sp.	8.3	5.4	2.3	8.0	2.1	2.9						
Elasmopus levis							4.0	0.9	1.0			
Erichthonius brasiliensis	25.0	8.1	6.8				16.0	6.9	5.8	8.0	2.3	2.7
Gammaropsis sp.				4.0	1.1	2.9				4.0	1.2	4.0
Gammarus sp.	25.0	21.6	29.5							8.0	3.5	4.0

Gobiosoma ginsburgi - continued:

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Jassa falcata	8.3	2.7	2.3	4.0	1.1	2.9	8.0	2.6	2.9	44.0	15.3	21.3
Lembos websteri							32.0	7.8	10.7	4.0	1.2	1.3
Lysianopsis alba	8.3	2.7	2.3				4.0	0.9	1.0			
Melita appendiculata	16.7	8.1	4.5	4.0	2.1	2.9	4.0	0.9	1.0	20.0	5.9	8.0
Microdeutopus sp.	8.3	2.7	2.3									
Paracaprella tenuis	8.3	2.7	2.3									
Stenothoe georgiana	8.3	8.1	6.8							12.0	3.5	4.0
Undetermined	25.0	10.8	9.1	8.0	5.4	5.9						
Total Amphipoda	100.0	89.2	88.6	28.0	14.9	25.0	60.0	29.6	37.8	76.0	42.3	50.0
Decapoda												
Pontonia domestica				4.0	1.1	1.5						
Reptantia megalope				4.0	1.1	1.5						
Reptantia undetermined				4.0	1.1	2.9						
Total Decapoda				12.0	3.2	5.9						
Undetermined Crustacea				4.0	1.1	1.5						
Bryozoa												
Anguinella palmata	8.3	2.7	2.3									
Number of stomachs examined:	22			25			25			25		
Examined stomachs with food:	12			25			25			25		

3.49 *Scomberomorus cavalla*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Chordata												
Pisces												
Anchoa hepsetus				100.0	100.0	100.0						
Number of stomachs examined:				1								
Examined stomachs with food:				1								

3.50 Scomberomorus maculatus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Chordata												
Pisces												
Anchoa hepsetus				4.0	3.3	2.5	50.0	33.3	35.6			
Chloroscombrus chrysurus				8.0	10.0	3.8						
Membras martinica							50.0	66.7	64.4			
Opisthonema oglinum				92.0	86.7	93.7						
Total Pisces				100.0	100.0	100.0	100.0	100.0	100.0			
Number of stomachs examined:	1			25			2					
Examined stomachs with food:	0			25			2					

3.51 Peprilus alepidotus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Gastropoda undetermined	11.1	10.0	16.7									
Chordata												
Pisces undetermined	100.0	90.0	83.3									
Number of stomachs examined:	28			1			2					
Examined stomachs with food:	9			0			0					

3.52 Paralichthys dentatus

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Crustacea												
Mysidacea												
Neomysis americana	10.0	98.2	66.7									
Decapoda												
Ovalipes ocellatus	100.0	1.8	33.3									
Number of stomachs examined:	1											
Examined stomachs with food:	1											

3.53 *Paralichthys lethostigma*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Chordata												
Pisces												
Menticirrhus sp.							100.0	100.0	100.0			
Number of stomachs examined:	3			2			3			1		
Examined stomachs with food:	0			0			1			0		

3.54 *Monacanthus hispidus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Gastropoda												
Epitonium sp.							100.0	1.0	0.7			
Pelecypoda												
Brachidontes exustus							100.0	1.9	1.4			
Tellina sp.							100.0	1.0	2.0			
Total Pelecypoda							100.0	2.9	3.4			
Crustacea												
Isopoda												
Paradella quadripunctata							100.0	1.9	1.0			
Amphipoda												
Caprella equilibra							100.0	50.0	52.2			
Cerapus tubularis							100.0	1.9	1.0			
Jassa falcata							100.0	7.8	2.7			
Melita appendiculata							100.0	11.7	4.1			
Stenothoe georgiana							100.0	21.6	7.5			
Total Amphipoda							100.0	93.1	67.6			
Chordata												
Ascidiacea												
Distaplia bermudensis							100.0	1.0	27.3			
Number of stomachs examined:							1					
Examined stomachs with food:							1					

3.55 *Sphoeroides maculatus*

Prey	Spring F	Spring N	Spring V	Summer F	Summer N	Summer V	Fall F	Fall N	Fall V	Winter F	Winter N	Winter V
Mollusca												
Pelecypoda												
Brachidontes exustus							100.0	95.1	96.8			
Crustacea												
Cirripedia							100.0	3.3	0.2			
Decapoda												
Penaeus sp.							100.0	1.6	3.0			
Reptantia undetermined				100.0	100.0	100.0						
Number of stomachs examined:				1			1					
Examined stomachs with food:				1			1					

Appendix 4. Number and weight (kg) of species captured in blue crab traps around the north jetty rocks. Each set represents 15 traps set for 12-hr periods.

SEASON	SPECIES	CHANNEL SIDE Day Set No.	CHANNEL SIDE Day Set Weight	CHANNEL SIDE Night Set No.	CHANNEL SIDE Night Set Weight	EXPOSED SIDE Day Set No.	EXPOSED SIDE Day Set Weight	EXPOSED SIDE Night Set No.	EXPOSED SIDE Night Set Weight	TOTALS No.	TOTALS Weight
Spring	Menippe mercenaria	19	5.25	78	17.93	30	7.24	112	33.35	239	83.77
"	Conger oceanicus	1	1.55	14	9.51*			5	4.77	20	15.83*
"	Opsanus tau			3	1.35*	2	0.45*			5	1.80*
"	Centropristis striata	2	0.90			2	0.35			4	1.25
"	Libinia emarginata	2	0.02							2	0.02
"	Portunos spinimanus	2	0.10							2	0.10
"	Portunus sp.			1	0.15			1	0.10	2	0.25
"	Libinia dubia	1	0.02							1	0.02
"	Callinectes sapidus	1	0.25							1	0.25
"	Tautoga onitus	1	0.18							1	0.18
"	Diplodus holbrooki	1	0.74							1	0.74
Summer	Centropristis striata	7	1.14	7	0.70	25	8.05	27	5.75	66	15.64
"	Menippe mercenaria	4	0.88	11	2.35	8	1.60	36	8.30	59	13.13
"	Lagodon rhomboides	23	1.94	7	0.60	13	1.12	2	0.20	45	3.86
"	Opsanus tau	6	1.35	13	9.35	3	0.90	7	2.60	29	14.20
"	Conger oceanicus			3	3.20			4	4.60	7	7.80
"	Diplodus holbrooki	1	0.02	6	0.07					7	0.09
"	Pagurus sp.			2	----					2	----
"	Libinia dubia	1	----							1	----
"	Portunus gibbesii	1	----							1	----
Fall	Opsanus tau	5	1.7	20	9.25	3	1.8	16	8.60	44	21.35
"	Diplodus holbrooki	5	0.45	3	0.30	21	1.55	2	0.15	31	2.45
"	Conger oceanicus			20	24.00			7	8.30	27	32.30
"	Centropristis striata	20	3.33	4	1.55					24	4.88
"	Menippe merceneria			2	0.20*			14	5.95	16	6.15*
"	Lagodon rhomboides	5	0.70			1	0.15			6	0.85
"	Octopus vulgaris	2	2.70			1	2.20	1	0.50	4	5.40
"	Orthopristis chrysoptera	1	0.15							1	0.15
Winter	Conger oceanicus			19	23.40			7	7.50	26	30.90
"	Callinectes sapidus			18	2.85					18	2.85
"	Libinia sp.			1	0.10			3	0.25*	4	0.35
"	Cancer irroratus			1	0.03					1	0.03
"	Archosargus probatocephalus	1	0.25							1	0.25
"	Hippocampus erectus	1	<.01							1	<.01
"	Opsanus tau							1	0.45	1	0.45

* subtotal only - one or more specimens not weighed
-- weight not taken

END
FILMED
FEB. 1988
DTIC