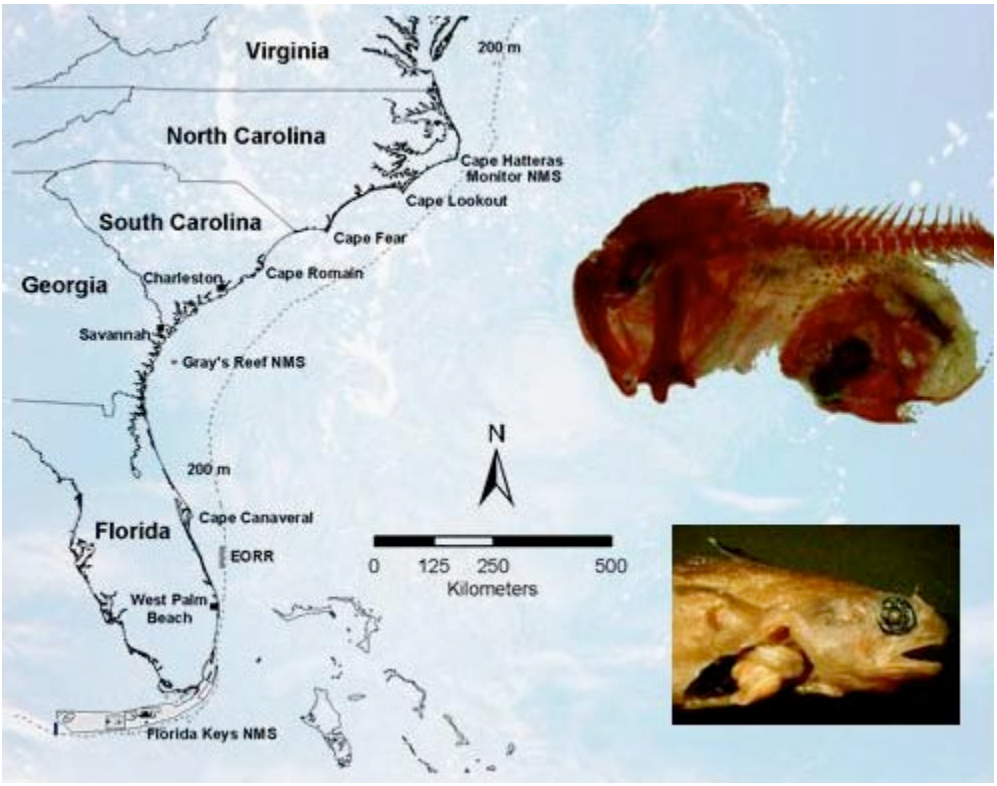

An annotated bibliography of diet studies of fish of the southeast United States and Gray's Reef National Marine Sanctuary

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Ocean and Coastal Resource Management
Marine Sanctuaries Division

February 2005

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An annotated bibliography of diet studies of fish of the southeast United States and Gray's Reef National Marine Sanctuary

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COVER

Map of southeast U.S. coast: H. Walsh
Water surface over Gray's Reef National Marine Sanctuary: K. Marancik
Cleared and stained fishes, removed from cobia stomach by J. Smith, photo by K. Marancik
Urophycis gut: J. Jenkins

SUGGESTED CITATION

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TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

One goal of Gray's Reef National Marine Sanctuary (NMS) is to protect the unique community found within the Sanctuary's boundaries. An understanding of the ecological interactions, including trophic structure, among these organisms is necessary to realize this goal. Therefore, diet information for 184 fish species was summarized from 113 published studies. Among the fish included are 84 fish species currently known to reside in Gray's Reef NMS. The locations of these studies ranged from the Atlantic Ocean off the coast of the northeast United States to northern Brazil, the Gulf of Mexico, and the Caribbean. All of the species described in this bibliography occur in the southeast United States and are, therefore, current or potential residents of Gray's Reef National Marine Sanctuary. Each entry includes the objectives, brief methods, and conclusions of the article. The bibliography is also indexed by species.

KEY WORDS

Gray's Reef National Marine Sanctuary, southeast United States, fish diet, gut contents, marine, estuarine

INTRODUCTION

An ecosystem approach to management is being adopted by the National Oceanic and Atmospheric Administration and state fishery managers (Busch et al., 2003). The ecosystem approach shifts away from traditional single species management by incorporating species interactions with their biological and physical environments (NMFS, 1999). Protection of habitat integral to the development and survival of a species during certain life stages is already being implemented through the development of the Essential Fish Habitat concept (SAFMC, 1998), the definition of Habitat Areas of Particular Concern (Dobrzynski and Johnson, 2001), and the designation of National Marine Sanctuaries (NMSA, 1972). The ecology of a system is slowly being incorporated into management plans through the development of multispecies models (e.g., multispecies virtual population models, Tsou and Collie, 2001), which use predator-prey interactions in their estimates of population and ecosystem status. In addition, Fishery Ecosystem Plans (Chesapeake Fisheries Ecosystem Plan Technical Advisory Panel, 2004), which contain information on the structure and function of an ecosystem, keep managers aware of the affects of their decisions on the ecosystem and the effect of components of the ecosystem on managed fisheries (NMFS, 1999). Each of these measures requires parameters to serve as proxies of ecosystem health (Link, 2002). Predator-prey interactions are affected by changes in ecosystem health and can be monitored relatively easily. Therefore, an important element of these ecosystem approaches is an understanding of the trophic structure of the ecosystem or sub-system in question.

Gray's Reef National Marine Sanctuary (NMS) was designated in 1981 (GRNMS, 2004). The sanctuary encompasses 56 km^2 of sand and rocky reef habitat located at the interface between the inner- and mid-shelf regions of the southeast United States continental shelf approximately 32 km east of Sapelo Island, Georgia. One of the goals of Gray's Reef NMS is to protect the unique community associated with the live bottom habitat found within the sanctuary boundaries. The Gray's Reef NMS community is a diverse group of fish, invertebrates, mammals, and sea turtles. In addition to preservation of the habitat, ecological interactions need to be monitored and maintained to meet the Sanctuary's goal. One need is an understanding of the predator-prey dynamics of fish that inhabit Gray's Reef NMS.

This bibliography was created to assist in the management of the southeast United States marine and estuarine systems, in particular Gray's Reef NMS. Fish distributions are not static; fish distributions display interannual variability (Booth et al., 2000), seasonal patterns (Bjorgo et al., 2000), and large-scale changes related to climate (Parker and Dixon, 1998). For this reason, the scope of the bibliography is fishes that inhabit the southeast U. S. continental shelf ecosystem and not simply those species that currently are reported from Gray's Reef NMS.

The following bibliography includes 113 diet studies covering 184 fish species found in the southeast U. S. Diet studies for 84 of the 181 fish species currently known to use Gray's Reef NMS are summarized. In addition, diet studies of 100 fish known to exist in the southeast U. S., but not observed at Gray's Reef NMS are also summarized. Many studies conducted outside the southeast United States were included in the interest of creating a comprehensive list of diet studies for southeastern U. S. fish species. Preference was given to studies that had gone through the peer review process, though some non-peer reviewed material was included. There

are likely more southeast U. S. fish diet studies than were covered here, but this list comprises the most often cited references.

For each study, three elements are described in the annotated bibliography: objectives, methods, and conclusions. First, the objectives of each study are listed after each citation. The methods are then described briefly, including the range of each species studied, the location of the study, the types of gear used for sampling, the size range or ontogenetic stage of fish studied, and the number of fish studied. Robins et al., (1986) was used to determine common names and the distribution of each fish species. Finally, an overview of the major conclusions of each paper is provided. If the study was not conducted within the southeast United States (Cape Hatteras, North Carolina to West Palm Beach, Florida), an explanation of why the study was included follows the conclusions. Studies that describe the diet of species found in Gray's Reef NMS are marked by an asterisk.

Figure 1: Map of the western Atlantic, Gulf of Mexico, and Caribbean showing landmarks frequently used in describing species' geographic ranges.

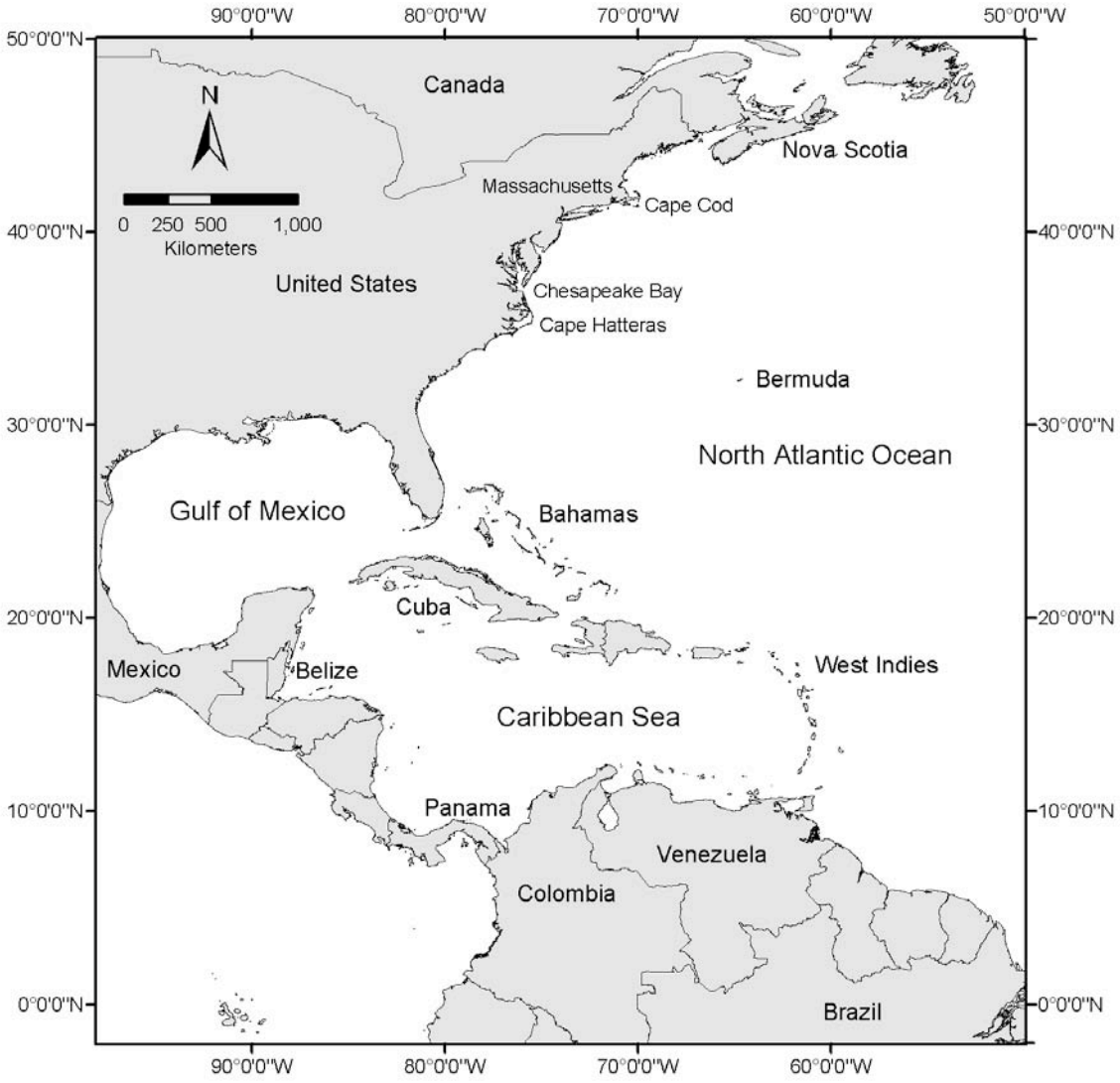
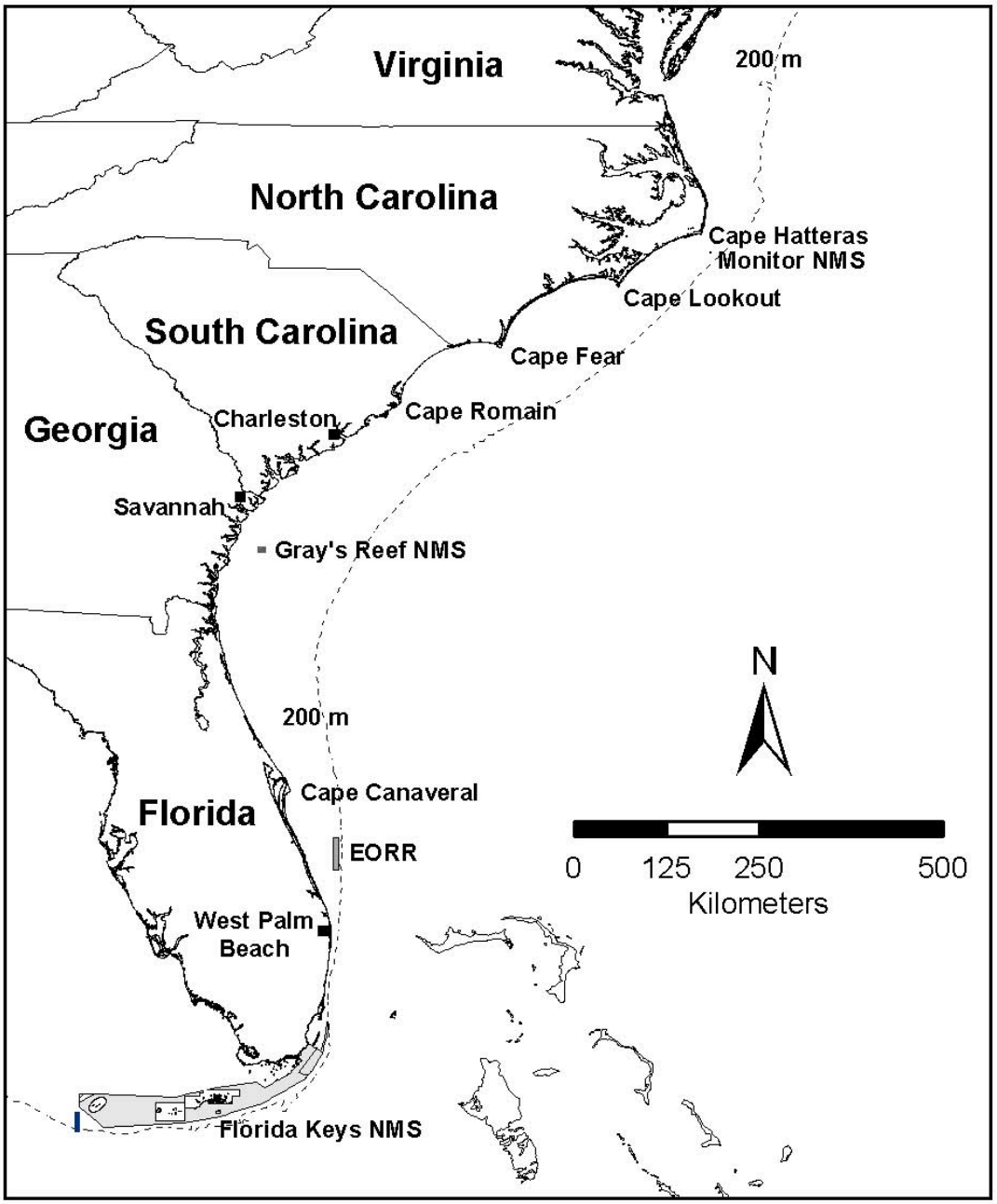


Figure 2: Map of the southeast United States showing the three National Marine Sanctuaries and five major capes of the region. (EORR is the Experimental Oculina Research Reserve).



BIBLIOGRAPHY

***1. Allen, D. M., W. S. Johnson, and V. Ogburn-Matthews. 1995. Trophic relationships and seasonal utilization of salt-marsh creeks by zooplanktivorous fishes. Environmental Biology of Fishes 42:37-50.**

The objectives of this study were to describe the seasonal patterns in abundance, distribution, and diet of adult planktivorous fishes, to relate prey consumption to prey availability, and to discuss resource partitioning among these species. Each of the species discussed occurs in the southeast U.S. Atlantic silverside, *Menidia menidia* (35-90 mm SL; n=36); rough silversides, *Membras martinica* (30-90 mm SL; n=25); bay anchovy, *Anchoa mitchelli* (30-65 mm SL; n=50); and striped anchovy, *Anchoa hepsetus* (30-105 mm SL; n=27), were sampled from the Town Creek estuary inside North Inlet, South Carolina, by surface trawl and otter trawl. Data were reported as number of prey taxa eaten and electivity index. Striped anchovy, bay anchovy, and rough silversides were most abundant during spring, summer, and fall. Atlantic silversides were most abundant in winter. The vertical distributions of these species also varied with season. During spring, bay anchovy were at the surface and bottom, striped anchovy were in low abundance and at the bottom, and Atlantic silversides and rough silversides were low in abundance and at the surface. During summer, striped anchovy and rough silverside were at the surface while bay anchovy were at the bottom. In fall, rough silversides and Atlantic silversides were at the surface. Striped anchovy were at the surface and bottom, and bay anchovy were predominantly at the bottom, though a few occurred at the surface. During winter, Atlantic silversides were on the surface and striped anchovy were at the bottom. Rough silversides had the narrowest diet and primarily ate small (< 1 mm) zooplankton such as copepods. Atlantic silversides consumed larger prey (> 1 mm) like shrimp and fish larvae. Bay and striped anchovies ate both small and large prey. Seasonal changes in diets were due to seasonal changes in prey availability. All four species of fish ate copepods, but the dominant species of copepod was different for each species of predator. Striped anchovy primarily ate *Acaria tonsa*. Bay anchovy ate *Euterpina acutifrons*, a harpacticoid copepod. Atlantic silversides ate *Pseudodiaptomus coronatus*. Rough silversides ate all three species of copepod. Therefore, these four fish avoid competition by partitioning food by size and habitat both spatially (surface vs. bottom) and temporally (season).

***2. Arnedt, M. D., J. E. Olney, and J. A. Lucy. 2001. Stomach content analysis of cobia, *Rachycentron canadum*, from lower Chesapeake Bay. Fishery Bulletin 99:665-670.**

The authors described the diet of cobia, *Rachycentron canadum,* from Chesapeake Bay and compared the Chesapeake diets to those of North Carolina and the Gulf of Mexico. Cobia (37-141 cm FL; n=114) were collected from the Chesapeake Bay by recreational fishermen. Food habits of cobia from Chesapeake Bay were more similar to fish in North Carolina than to fish from the northern Gulf of Mexico. Consumption of portunid crabs increases with fish size. This study was included to complement data on the diet of cobia from the southeast United States.

3. Baier, C. T. and J. E. Purcell. 1997. Trophic interactions of chaetognaths, larval fish, and zooplankton in the South Atlantic Bight. Marine Ecology Progress Series 146:43-53.

The objectives of this study were to quantify the trophic interaction between chaetognaths and fall/winter spawned fish larvae and to determine the direct effect of chaetognath predation on

larvae. This study was conducted off the North Carolina coast between Cape Lookout and Cape Fear. Chaetognaths fed mostly at night. Larval fish fed during the daylight hours. Copepods were the most important prey of chaetognaths. When copepods were abundant, small larvae ate microzooplankton, large larvae ate copepods in proportion to ambient conditions, and chaetognaths selectively fed on copepods at a higher level than ambient conditions. During February, when copepods were less abundant and larvae were larger, there may have been some competition for food. Chaetognaths rarely ate fish larvae. Generally, fish larvae were too large and in very low abundance compared to other potential food items.

***4. Bass, R. J. and J. W. Avault, Jr. 1975. Food habits, length-weight relationships, condition factor, and growth of juvenile red drum, *Sciaenops ocellata*, in Louisiana. Transactions of the American Fisheries Society 104:35-45.**

The objectives of this study were to investigate ontogenetic shifts in food habits of juvenile red drum, *Sciaenops ocellata* (renamed *Sciaenops ocellatus*), to compare this to availability of prey items, and to determine length-weight relationships and coefficient of condition. Red drum occur from Massachusetts to the northern Gulf of Mexico, including south Florida. Red drum (8-183 mm; n=568) were collected from the Jefferson Parish, Louisiana salt marsh by a bag seine. Data were reported as number, percent number, percent frequency, and percent volume. Red drum ate abundant prey with some, but limited selectivity. Fish 65-85 mm ate more shrimp during the day and more fish at night. Three ontogenetic phases were observed: < 15 mm fish ate zooplankton, 15-75 mm fish ate small bottom invertebrates and young of other fish, > 75 mm fish ate decapods and fish. The length-weight relationship was: Weight = -7.2052 + (4.1913)(logLength). The average coefficient of condition of red drum was 1.969. This study was included to complement data on the diet of red drum from the southeast United States.

5. Batts, B. S. 1972. Food habits of the skipjack tuna, *Katsuwonus pelamis*, in North Carolina waters. Chesapeake Science 13:193-200.

This study compared the diet of skipjack tuna, *Katsuwonus pelamis,* caught near Hatteras Inlet and those caught near Oregon Inlet, North Carolina. The geographic range of skipjack tuna extends south from southern Nova Scotia (rare north of Cape Cod) along the eastern North American coast and in the northern Gulf of Mexico to southern Brazil and worldwide in tropical oceans. Skipjack tuna (263-757 mm SL; n=193) were sampled from the shelf by recreational fishermen. Data were reported as number and percent occurrence of each prey item. The diets of fish from each inlet were similar with some variation in the dominance of fish versus mollusks. The percent volume of mollusks (gastropods and cephalopods) was highest at Oregon Inlet, while the percent volume of prey fish was highest at Hatteras Inlet.

***6. Berkeley, S. A. and E. D. Houde. 1978. Biology of two exploited species of halfbeaks, *Hemiramphus brasiliensis* and *H. balao* from southeast Florida. Bulletin of Marine Science 28:624-644.**

The objectives of this study were to determine age and growth, fecundity, size at maturity, spawning seasons, food habits, survival rate, and early life history information for two species of half beak. Both species occur along most of the east coast of the U. S., though less common north of Florida, and in the northern Gulf of Mexico. Ballyhoo, *Hemirhamphus brasiliensis* (121-280 mm FL; n=261), and Balao, *H. balao* (no length range given; n=98), were sampled from the shelf off the coast of Dade county, Florida, by commercial fishermen. Data

were reported as percent frequency. Ballyhoo likely survive to at least three years old, while balao survive to two years. Ballyhoo females are longer than males. Balao are nearly three times more fecund than ballyhoo, though they are less common in commercial catches. Ballyhoo eggs are almost certainly demersal and attach to seagrass blades. The diet of ballyhoo mostly comprised crustaceans, siphonophores, and the seagrass, *Syringodium filiforme*. There were no major differences in diet with season; although, more cladocerans were consumed in winter than during other seasons. Ballyhoo consumed more seagrass as the fish grew. Small fish (< 180 mm FL) ate decapods and copepods. Because of the low number of balao collected, only a limited amount of diet information was collected. Balao stomachs never contained seagrass, but copepods, decapods, siphonophores, and polychaetes were common food items. The mean indices of fullness were lower for balao than for ballyhoo.

***7. Boothby, R. N. and J. W. Avault, Jr. 1971. Food habits, length-weight relationship, and condition factor of the red drum (*Sciaenops ocellata*) in southeastern Louisiana. Transactions of the American Fisheries Society 100:290-295.**

The objectives of this study were to determine food habits in relation to sex, size, and season and to determine the length-weight relationship and the coefficient of condition of red drum, *Sciaenops ocellata* (renamed *S. ocellatus*), from Louisiana. Red drum occur from Massachusetts to northern Mexico including southern Florida. Red drum (25-93.2 cm SL; n=286) were sampled from the benthic habitat off the coast of Louisiana by fishermen. Data were reported as percent occurrence and percent volume. Red drum are indiscriminant feeders on shrimp, crabs, and fish. There were no apparent differences in food habits among sizes and between sexes, but there were differences among seasons. Fish (mostly *Brevoortia* spp.) were most important during winter and spring and crustaceans (mostly shrimp) were dominant from late spring through fall. Fish were present in the diet year-round and the authors concluded that fish were the most important prey item, though this counters previously published data. The length-weight relationship was higher (fish are bigger at a given size) than those published for the Atlantic, but the authors did not explain why. Overall, red drum off the coast of Louisiana were in good condition (K ranged from 1.2 to 1.7). This study was included to complement data on the diet of red drum from the southeast United States.

***8. Bortone, S. A. 1971. Studies on the biology of the sand perch, *Diplectrum formosum* (Perciformes: Serranidae). State of Florida Department of Natural Resources Technical Series No. 65. 35 p.**

The objectives of this study were to describe the distribution and habitat, associated species, length-weight relationship, age and growth, reproduction, food and feeding habits, behavior, and color patterns and changes of the sand perch. Sand perch, *Diplectrum formosum*, occur along the southeast United States from North Carolina to the Bahamas, and in the northern Gulf of Mexico to Uruguay, though absent from the West Indies. Sand perch (21-223 mm SL; n=154) were sampled from the northern Gulf of Mexico along the Florida Coast by recreational fishermen, otter trawls, hand nets, and rotenone. Data were reported as frequency of occurrence and number of organisms. Sand perch are generally found in sandy bottom habitat near rock or coral outcroppings in water < 50 m. Smaller fish (< 150 mm SL) were found farther inshore (water < 15 m) than larger fish, but may move offshore when temperatures drop. Sand perch may get as big as 300 mm, and as old as 7 years. Sand perch, like many serranids, have variable coloration patterns that change with ontogeny. Sand perch also are hermaphroditic and fairly

territorial, rarely moving from a preferred rock. Crabs and shrimp are the dominant prey of sand perch, though they also consume amphipods and fishes (flatfishes, blennies, gobies, and sea robins). There were no seasonal patterns in diet observed. This study was included to compliment diet data on sand perch from other studies.

***9. Brook, I. M. 1977. Trophic relationships in a seagrass community (*Thalassia testudinum*), in Card Sound, Florida. Fish diets in relation to macrobenthic and cryptic faunal abundance. Transactions of the American Fisheries Society 106:219-229.**

The objectives of this study were to quantify the fauna of a *Thalassia* seagrass bed in Card Sound, Florida, to examine seasonal trends in the community, to determine the dependence of fish on the benthic and cryptic fauna, and to determine seasonal and diel patterns in diet and abundance of predatory fish species. Seven of the eight fish discussed occur in the southeast United States. Silver jenny, *Eucinostomus gula* (n=443); spotfin mojarra, *Eucinostomus argenteus* (n=256); goldspotted killifish, *Floridichthys carpio* (n=231); redfin needlefish, *Strongylura notata* (n=134); pinfish, *Lagodon rhomboides* (n=70); Gulf pipefish, *Syngnathus scovelli* (n=139); and dusky pipefish, *Syngnathus floridae* (n=65), were sampled from a *Thalassia* seagrass bed in Card Sound, Florida, by drop net, seines, and a Venturi-type suction dredge. Data were reported as percent frequency and dry weight. All taxa were most abundant in May and June and least abundant in January and February. Mollusks (*Turbo castaneus*) were the most abundant organisms available as prey. Gammarid amphipods were the predominant crustaceans, and polychaetes (Syllidae, Ophiliidae, and Nereidae) were ranked third as potential prey organisms. Of the predatory fish taxa that occur in the southeast United States, the silver jenny was the most abundant. The next most abundant fish was the goldspotted killifish. Silver jenny, spotfin mojarra, pinfish, and goldspotted killifish had similar diets: copepods, polychaetes, and amphipods dominated. Goldspotted killifish ate more mollusks than the other three species. Redfin needlefish were highly piscivorous at sizes greater than 100 mm SL, while smaller fish had diets similar to the other species described. Gulf pipefish and small (< 125 mm TL) dusky pipefish ate pericaridean crustaceans and amphipods. Larger dusky pipefish (> 125 mm TL) consumed caridean shrimp and fed exclusively during the day. This study was included to compliment diet data from the southeast United States.

10. Brule, T. and L. G. Rodriguez Canche. 1993. Food habits of juvenile red groupers, *Epinephelus morio* (Valenciennes, 1928), from Campeche Bank, Yucatan, Mexico. Bulletin of Marine Science 52:772-779.

The authors described the differences in the diet of red grouper, *Epinephelus morio,* due to size range and locality differences. Red grouper range from Massachusetts, Bermuda, and the northern Gulf of Mexico to southeast Brazil. Red grouper (135-515 mm TL; n= 446) were sampled from the reef habitat by hook-and-line. Data were reported as number and Schoeners index. Crustaceans were the main food of red grouper. Larger fish (> 280 mm TL) seemed to be closer to the bottom and ate more stomatopods. All food items were benthic and most were reef associated. This study was included because of the lack of diet data for red groupers from the southeast United States.

***11. Buckel, J. A., M. J. Fogarty, and D. O. Conover. 1998. Foraging habits of bluefish, *Pomatomus saltatrix*, on the U. S. east coast continental shelf. Fishery Bulletin 97:758-775.**

The objectives of this study were to determine prey type and size selectivity patterns, foraging chronology, daily ration, and biomass of prey consumed during the autumn migration of young-of-year bluefish, *Pomatomus saltatrix,* along the shelf. Bluefish occur along most of the east coast of the U. S. and Argentina, but are absent from south Florida and northern South America. Bluefish (989 young-of-year and 275 adult) were sampled from the shelf from Cape Hatteras to Nova Scotia by Yankee trawl. Data were presented as percent frequency, percent weight, and Chesson's selectivity index. There was evidence of net feeding, but it did not seem to bias diet indices, but may bias gut fullness estimates. Bluefish selected for bay anchovy and avoided butterfish, squid, and other prey. Juvenile and adult fish took small prey throughout their size ranges, selecting for small bay anchovy at large sizes. Invertebrates (gammarid amphipods and mysids) were important prey for juveniles. Copepods were also important prey to summer-spawned bluefish in the southern New England region. The authors found little evidence of cannibalism. Bluefish fed mainly during the day or at dusk or dawn. This study was included to complement data on the diet of bluefish from the southeast United States.

***12. Bullock, L. H. and G. B. Smith. 1991. Memoirs of the *Hourglass* cruises. Seabasses (Pisces: Serranidae). Marine Research Laboratory, Florida Department of Natural Resources, St. Petersburg, Florida. Volume 8:1-243.**

The authors summarized and described the abundance, food habits, maturation, spawning, and growth of Serranidae from the west Florida shelf, many of which also occur in the southeast U. S. Mostly juvenile and adult serranids were described: yellowfin bass, *Anthias nicholsi* (71-149 mm SL; n=18); black sea bass, *Centropristis striata* (no size range or number given); bank sea bass, *Centropristis ocyurus* (11-200 mm; n=27)*;* rock sea bass, *Centropristis philadelphica* (no size range or number given)*;* sand perch, *Diplectrum formosum* (48-196 mm; n=17)*;* rock hind, *Epinephalus adscensionis* (no size range or number given)*;* graysby, *E. cruentatus* (no size range or number given)*;* speckled hind, *E. drummondhayi* (184-347 mm; n=31)*;* yellowedge grouper, *E. flavolimbatus* (66-128 mm; n=2)*;* coney, *E. fulvus* (no size range or number given)*;* red hind, *E. guttatus* (no size range or number given)*;* goliath grouper, *E. itajara* (no size range or number given)*;* red grouper, *E. morio* (18-500 mm; n=62)*;* misty grouper, *E. mystacinus* (no size range or number given)*;* warsaw grouper, *E. nigritus* (778 mm; n=1)*;* snowy grouper, *E. niveatus* (no size range or number given)*;* longtail bass, *Hemanthias leptus* (44-456 mm; n=51)*;* red barbier, *Hemanthias vivanus* (64-123 mm; n=37)*;* roughtongue bass, *Holanthias martinicensis* (48-110 mm; n=12)*;* black grouper, *Mycteroperca bonaci* (17-21 mm; n=2)*;* yellowmouth grouper, *M. interstitialis* (no size range or number given)*;* gag, *M. microlepis* (16-600 mm; n=53)*;* scamp, *M. phenax* (218-305 mm; n=2); yellowfin grouper, *M. venenosa* (no size range or number given)*;* creole-fish, *Paranthias furcifer* (no size range or number given)*;* apricot bass, *Plectranthias garrupellus* (19-61 mm; n=23)*;* whitespotted soapfish, *Rypticus maculatus* (34-192 mm; n=6)*;* school bass, *Schultzea beta* (43-95 mm; n=11)*;* pygmy sea bass, *Serraniculus pumilio* (25-62 mm; n=2 with food of 26 collected)*;* orangeback bass, *Serranus annularis* (no size range or number given)*;* tattler, *Serranus phoebe* (133-137 mm; n=4)*;* belted sandfish, *Serranus subligarius* (11-89 mm; n=12 with food of 53 collected)*;* tobaccofish, *Serranus tabacarius* (no size range or number given); and harlequin bass, *Serranus tigrinus* (no size range or number given). Yellowfin bass, red barbier, roughtongue bass, and school bass ate small crustaceans and mollusks. Longtail bass consumed copepods and fish.

Bank sea bass, sand perch, goliath grouper juveniles, apricot bass, pygmy sea bass, tattler, and whitespotted soapfish ate crustaceans; such as, copepods, small crabs, and shrimp. Rock sea bass, black sea bass, and creole-fish were generalized carnivores that principally ingested crustaceans and fish. Orangeback sea bass, belted sandfish, tobaccofish, harlequin bass, misty grouper, and gag ate small crustaceans (caridean shrimps, small crabs, and copepods) and some fish. Rock hind, graysby, yellowedge grouper, red hind, goliath grouper adults, and red grouper consumed large crustaceans and fish. Speckled hind, coney, snowy grouper, and black grouper mostly ate fish and some crustaceans. Warsaw grouper consumed large crustaceans. Yellowmouth grouper, scamp, and yellowfin grouper ate fish.

***13. Burk, S. W. 1990. Migration and diet of black sea bass (*Centropristis striata*) on an artificial and natural reef in Onslow Bay, North Carolina. MS Thesis, University of North Carolina at Wilmington, 69 p.**

The objective of this study was to compare the diet of black sea bass, *Centropristis striata,* between a natural and an artificial reef habitat. Black sea bass occur from Maine to northeastern Florida, though they reach south Florida in cold winters and in the eastern Gulf of Mexico. Black sea bass (31-210 mm SL; natural reef n=72, artificial reef n=56) were sampled from natural and artificial reefs in Onslow Bay, North Carolina, by spear, hook and line, and traps. Data were reported as percent frequency of occurrence, percent number, and percent weight. The mode of capture, time of year, and time of day did not influence prey abundance or species richness. No difference in consumption of dominant prey between the two reefs was recorded. Decapod crustaceans were the main prey group. Most prey were associated with hard substrate. The authors also said that the reef mostly provided shelter and did not appear to be the main source of food. Ultimately, sea bass are opportunistic feeders with few differences between diet at the two reefs.

***14. Campos-Davila, L., V. H. Cruz-Escalona, L. A. Abitia-Cardenas, F. Galvan-Magana, and E. F. Balart. 2002. Feeding habits of dwarf goatfish (*Upeneus parvus*: Mullidae) on the continental shelf in the Gulf of Mexico. Gulf of Mexico Science 20:60-66.**

The objectives of this study were to determine ontogenetic, seasonal patterns, and overlap in the diet of the dwarf goatfish, *Upeneus parvus*. Dwarf goatfish occur along the southeast coast of the U. S. and from Puerto Rico to Brazil, but are absent from the Bahamas. Dwarf goatfish (< 73-92 mm, 93-150 mm, > 150 mm; n= 909 with food of 1437 collected) were sampled from the coastal shelf of Alvarado, Veracruz, Mexico, by otter trawl. Data were reported as percent frequency of occurrence, percent number, and percent weight. Seasonal (wet, dry, north wind) differences in diet were probably caused by a seasonal shift in prey availability. Low values of diversity of prey and diet breadth and high values of diet overlap among size classes were observed. Dwarf goatfish were benthic carnivores, and the humpback shrimp (*Solenocera vioscai)* and the longspine swimming crab (*Portunus spinicarpus*) were the dominant prey items with some seasonal variation in total abundance. This study was included because of the lack of diet data for dwarf goatfish from the southeast United States.

***15. Carr, W. E. S. and C. A. Adams. 1972. Food habits of juvenile marine fishes: evidence of the cleaning habit in the leatherjacket, *Oligoplites saurus*, and the spottail pinfish, *Diplodus holbrooki*. Fishery Bulletin 70:1111-1120.**

The objectives of this study were to describe the diets of juvenile leatherjacket, *Oligoplites saurus*, and spottail pinfish, *Diplodus holbrooki*, and to present evidence for cleaning behavior in juveniles of these species. Both species occur along the east coast of the United States and in most of the northern Gulf of Mexico. Leatherjacket (21-101 mm SL; n=80 with food of 88 collected) and spottail pinfish (11-167 mm SL; n=205) were sampled from the Crystal River, Florida, estuary by bag seine and cast net. Data were reported as percent of total stomach contents. Free-living organisms made up a large portion of the diet of all size classes of leatherjacket. Fish smaller than 26 mm or larger than 60 mm contained very few ectoparasites (0-4%). Small fish (21-25 mm) ate free-living copepods. Leatherjackets 26-40 mm had a high percentage (56%) of ectoparasites in their diets, primarily eating calanoid copepods and a few branchiurans (*Argulus* sp.). Larger fish (61-100 mm) mostly ate mysids and small shrimp. Spottail pinfish of all sizes primarily ate free-living animals and epiphytic algae. Ectoparasites were absent from the diets of fish less than 21 mm and fish greater than 70 mm. Fish 11-25 mm were planktivorous and ate veligers, copepods, tunicate tadpole larvae, mysids, and small shrimp. Fish over 25 mm also consumed plant materials. Spottail pinfish between the sizes of 21 and 50 mm also ate a high percentage of ectoparasites (*Argulus*). This study was included to compliment diet data from other studies.

***16. Carr, W. E. S. and C. A. Adams. 1973. Food habits of juvenile marine fishes occupying seagrass beds in the estuarine zone near Crystal River, Florida. Transactions of the American Fisheries Society 102:511-560.**

The objective of this study was to describe the diet of a variety of common species in estuarine seagrass beds north of Crystal River, Florida. Each of the fish described occur along the southeast U. S. Scaled sardine, *Harengula pensacolae* (21-30 mm SL; n=28); Atlantic thread herring, *Opisthonema oglinum* (21-40 mm SL; n=56); striped anchovy, *Anchoa hepsetus* (25-50 mm SL; n=121); bay anchovy, *Anchoa mitchelli* (15-23 mm SL; n=73); inshore lizardfish, *Synodus foetens* (41-140; n=39); Atlantic needlefish, *Strongylura marina* (35-180 mm SL; n=44); halfbeak, *Hyporhamphus unifasciatus* (130-199 mm SL; n=77); permit, *Trachinotus falcatus* (15-70 mm SL; n=134); leatherjacket, *Oligoplites saurus* (21-101 mm SL; n=80); white grunt, *Haemulon plumieri* (21-40 mm SL; n=58); pigfish, *Orthopristis chrysoptera* (16-80 mm SL; n=445); silver perch, *Bairdiella chrysoura* (6-160 mm SL; n=797); spotted seatrout, *Cynoscion nebulosus* (20-130 mm SL; n=174); silver jenny, *Eucinostomus gula* (11-60 mm SL; n=306); spottail pinfish, *Diplodus holbrooki* (11-167 mm SL; n=205); pinfish, *Lagodon rhomboides* (10-110 mm SL; n=1608); clown goby, *Microgobius gulosus* (11-40 mm SL; n=30); Florida blenny, *Chasmodes saburrae* (21-60 mm SL; n=86); inland silverside, *Menidia beryllina* (11-60 mm SL; n=278); hogchoker, *Trinectes maculatus* (18-35 mm SL; n=17); southern puffer, *Sphoeroides nephelus* (6-25 mm SL; n=35), were sampled from the Crystal River, Florida, seagrass beds using a bag seine at 1 m depth. Most of these species were omnivorous due to ontogenetic shifts in diet with growth, making simple separation of species into trophic groups difficult. Detritus and veliger larvae were important for many fish as food or food for prey items. Phytoplankton was not directly important. Scaled sardine and Atlantic thread herring primarily ate veliger larvae. Scaled sardine also consumed copepods and crab megalopae in high numbers, while Atlantic thread herring ate detritus. In addition to veliger larvae, striped anchovy

ate copepods, mysids, zoea, and fish. Bay anchovy supplemented veliger larvae with copepods and eggs. Inshore lizardfish ate fish (mostly anchovies and inland silversides) almost exclusively. Small Atlantic needlefish (35-50 mm) fed on amphipods, mysids, and very small shrimp, but quickly switched to a primarily fish diet at 50 mm SL. Halfbeaks ate epiphytic algae, detritus, and seagrass in equal amounts. Small leatherjacket (21-25 mm) principally fed on free-living copepods and mysids. Leatherjacket 26-40 mm continued to eat free-living copepods but also consumed a large number of ectoparasites such as calanoid copepods. The largest leatherjacket collected (41-101 mm) ate free-living copepods, fish, mysids, and shrimp. Small permit (15-35 mm) predominantly fed on fish, shrimp, and mysids, then switched to a mostly crab and gastropod diet at 36 mm. Silver jenny primarily ate copepods at small sizes (11-30 mm), and polychaetes at larger sizes (26-60 mm). Silver jenny 26-30 mm ate copepods and polychaetes in nearly equal amounts. White grunt mostly ate copepods, detritus, mysids, and shrimp. Pigfish (16-30 mm) primarily ate copepods, shrimp, and mysids. Pigfish larger than 30 mm began eating shrimp and mysids in high numbers. The diet of larger fish (41-80 mm) was dominated by shrimp, mysids, and polychaetes. Small silver perch (6-35 mm) mostly ate copepods. Larger fish (35-160 mm) ate shrimp and fish. Spotted seatrout ate fish throughout the size range sampled. Shrimp were also frequently consumed. Small spottail pinfish ate copepods and veliger larvae. Epiphytic algae became an important part of the diet at 21 mm and remained a dominant food source into the adult stage (167 mm). Pinfish appear to go through five feeding stages throughout the juvenile stage. Small pinfish (10-20 mm) were planktivorous on copepods. Pinfish 26-30 mm were carnivorous, eating shrimp, mysids, and amphipods. Larger pinfish (36-60 mm) were herbivorous on epiphytes. Pinfish (61-80 mm) then pass through an omnivorous stage, eating epiphytes, shrimp, and fish, and then, became carnivorous on shrimp and fish as large juveniles (81-110 mm). Detritus was the primary food of the clown goby. The smallest Florida blennies (21-25 mm) ate amphipods almost exclusively. As they grew larger (25-45 mm), the blennies added detritus to their diet. Adult Florida blennies (46-60 mm) ate amphipods, detritus, and small fish. Small inland silversides (11-26 mm) ate detritus and veligers. Larger silversides (37-60 mm) continued to eat veligers, but also ate crab megalopae and copepods. Hogchoker primarily ate polychaetes. Detritus was the main source of nourishment for the southern puffer. This study was included because the diets of some of these fish have only been studied in the Gulf of Mexico.

***17. Chao, L. N. and J. A. Musick. 1977. Life history, feeding habits, and functional morphology of juvenile sciaenid fish in the York River Estuary, Virginia. Fishery Bulletin 74:657-702.**

The authors describe the coexistence of seven sciaenids that share the estuarine benthos by describing: relative abundance, temporal and spatial distributions, length frequency, apparent movements, feeding habits, and morphological structures related to feeding. All seven species occur in the southeast U. S. Weakfish, *Cynoscion regalis* (67-183 mm TL; n=36); silver perch, *Bairdiella chrysoura* (57-190 mm TL; n=68); croaker, *Micropogonias undulatus* (65-199 mm TL; n=69); spot, *Leiostomus xanthurus* (14-125 mm TL; n=77); northern kingfish, *Menticirrhus saxatilis* (36.5-118 mm TL; n=20), and banded drum, *Larimus fasciatus* (14-125 mm TL; n=12), were sampled from the York River estuary by bottom trawling and bag seining. Data were reported as percent occurrence and percent volume. The coexistence of these juveniles may be due to observed differences in temporal and spatial occurrence, differences in habitat and food adaptations, and differences in abundant food resources (i.e., if *Neomysis americana* is highly

abundant, there is no need to compete). Banded drum ate crustaceans (*Neomysis americana*, cumacea, amphipods, and calanoid copepods). Weakfish and silver perch mostly ate *Anchoa mitchelli* and *Neomysis americana*. Croaker ate a wide variety of prey: fish, *Neomysis americana*, copepods, polychaetes, *Neris succinea*, amphipods, and *Pectinaria gouldii,* were most abundant. Northern kingfish mostly ate crustaceans (*Neomysis americana, Palaemonetes* spp., crustacean parts) and polychaetes. Spot primarily ate benthic prey: *Pectinaria gouldii*, polychaetes, harpacticoid copepods, *Neomysis americana*, *Glycinde solitaria*. The authors developed the hypothesis that food selection is based on morphological limitations rather than active selectivity by the different species. Morphological characters such as eye diameter, number of nasal laminae, body shape, and mouth shape, are adapted for certain types of prey, and thus, dictate what a fish can and will eat. Weakfish are adapted to fast swimming and active predation, and consumed active prey (anchovy). Banded drum are adapted for slower movements and graze on plankton.

18. Crabtree, R. E., C. Stevens, D. Snodgrass, and F. J. Stengard. 1998. Feeding habits of bonefish, *Albula vulpes*, from the waters of the Florida Keys. Fishery Bulletin 96:754-766.

The objectives of this study were to describe diet of bonefish, *Albula vulpes,* including seasonal and length-related differences and to compare diet from two areas: Florida Bay and the ocean side of the Florida Keys. Bonefish occur from New Brunswick south along the east coast of North America, but are rare north of Florida and the Bahamas. Bonefish (228-702 mm FL; n=318 with food of 385 collected) were sampled from the ocean side and Florida Bay side of the Florida Keys by hook and line, seine, and gill net. Data were reported as percent numerical abundance, percent frequency of occurrence, and percent weight. Cluster analysis grouped fish into two size classes: 260-439 mm, 400-702 mm. The two size classes differed in the consumption of xanthid, penaeid, alpheid, and *Opsanus beta*. Bonefish > 439 mm ate more decapods and teleosts than smaller fish. Prey size increased with increased predator size. Fish in the ocean selected alpheid, xanthid, *Penaeus duorarum*, and *O. beta* (in decreasing order of importance) as prey and avoided *Thor* spp. and P*ericlimenes americanus*. Fish in the bay selected xanthid, alpheid, *O. beta*, *Penaeus duorarum*, and *Callinectes* spp. (in decreasing order of importance) as prey and avoided *Thor* spp., *Hippolyte zostericola*, *Pariclimenes americanus*, and *Gobiosoma robustum*. Diet was roughly similar in other areas (from other studies) with some differences when examining at higher taxonomic resolution. This study was included due to the lack of diet data for this species in the southeast United States.

***19. Darnell, R. M. 1961. Trophic spectrum of an estuarine community, based on studies of Lake Pontchartrain, Louisiana. Ecology 42:553-568.**

The author described the use of general food categories for various fish species found in Lake Pontchartrain, Louisiana. The estuarine environment of Lake Pontchartrain was sampled to collect 15 species of fish: bay anchovy, *Anchoa mitchelli* (30-74 mm)*;* sheepshead, *Archosargus probatocephalus* (218-410 mm)*;* silver perch, *Bairdiella chrysoura* (70-143 mm)*;* crevalle jack, *Caranx hippos* (79 mm)*;* speckled seatrout, *Cynoscion nebulosus* (40-406 mm)*;* pinfish, *Lagodon rhomboides* (40-150 mm)*;* spot, *Leiostomus xanthurus* (40-203 mm)*;* inland silverside, *Menidia beryllina* (40-79 mm)*;* croaker, *Micropogonias undulatus* (10-325 mm)*;* striped mullet, *Mugil cephalus* (97-327 mm)*;* southern flounder, *Paralichthys lethostigma* (113-380 mm)*;* black drum, *Pogonias cromis* (116-218 mm)*;* red drum, *Sciaenops ocellatus* (184-625 mm)*;* Atlantic needlefish, *Strongylura marina* (357-457 mm); and hogchoker, *Trinectes maculatus* (61-74 mm).

Fish, crustaceans, and detritus were the dominant food sources in the community. This study was included because many of these fish have not been studied from the southeast U. S., and because this is one of the most cited gut content papers by other authors.

***20. DeVane, J. E., Jr. 1978. Food of king mackerel, *Scomberomorus cavalla*, in Onslow Bay, North Carolina. Transactions of the American Fisheries Society 104:583-586.**

Adult king mackerel, *Scomberomorus cavalla,* were collected to determine food habits and seasonal variability in diet. King mackerel occur in Massachusetts and the northern Gulf of Mexico to southern Brazil. King Mackerel (n=205 adults) were sampled from the shelf (coastal: 3-30 m depth) in Onslow Bay, North Carolina. Data were reported as percent occurrence and percent number. In spring and summer, king mackerel principally ate clupeids (*Brevoortia tyrannus* and *Opisthonema oglinum*) with some invertebrates (mainly squid and penaeid shrimp). In fall, when clupeids were less abundant in coastal waters, the diet of king mackerel became more diverse, but still mainly consumed fish.

***21. Dixon, R. L. 1975. Evidence for mesopelagic feeding by the vermilion snapper, *Rhomboplites aurorubens*. Journal of the Elisha Mitchell Scientific Society 91:240-242.**

The objectives of this study were to describe the diet of vermilion snapper, *Rhomboplites aurorubens,* and place it within a trophic structure of the outer continental shelf. Vermilion snapper occur along the southeast United States and in the northern Gulf of Mexico to southeast Brazil. Vermilion snapper (281-568 mm TL; n=17) were sampled from the deep water pelagic environment of Onslow Bay, North Carolina by the hook and line recreational fishermen. Data were reported as number and percent frequency of occurrence. Vermilion snapper primarily fed on small mesopelagic organisms and did not substantially compete with bottom foragers.

22. Dodrill, J., C. S. Manooch, III, and A. B. Manooch. 1993. Food and feeding behavior of adult snowy grouper, *Epinephelus niveatus* (Valenciennes) (Pisces: Serranidae), collected off the central North Carolina coast with ecological notes on major food groups. Brimleyana 19:101-135.

The objectives of this study were to identify food habits of snowy grouper, *Epinephelus niveatus*, to evaluate their contribution to grouper diet, and to compare the snowy grouper diet to sympatric species. Snowy grouper occurs along the east coast of the U. S. south of Massachusetts, from the northern Gulf of Mexico to southeast Brazil, and in the eastern Pacific. Snowy grouper (335-1100 mm TL, n=254) were sampled from the deep shelf edge and upper slope (137-238 m) of North Carolina, by recreational fishermen. Data were reported as number and volume. Mostly crustaceans were consumed. Snowy grouper probably ate irregularly (high number of empty stomachs). Sympatric species had a more diverse diet. Snowy grouper are ambush predators and probably do not move much to feed.

***23. Donaldson, P. L. and I. E. Clavijo. 1994. Diet of round scad (*Decapterus punctatus*) on a natural and an artificial reef in Onslow Bay, North Carolina. Bulletin of Marine Science 55:501-509.**

The objectives of this study were to describe the diet of round scad, *Decapterus punctatus,* on natural and artificial reefs in Onslow Bay, North Carolina, and to determine the importance of various food types. This species occurs along the east coast of North America (Nova Scotia south) and the Gulf of Mexico to southeast Brazil. Round scad (46-151 mm SL;

n=185) were sampled from natural and artificial reefs by spearing, hook and line, and gill nets. Data were reported as percent frequency. Round scad fed predominantly on holozooplankton on both reef types. The authors did not examine differences due to the size of the predator.

24. Dragovich, A. 1970. The food of skipjack and yellowfin tunas in the Atlantic Ocean. Fishery Bulletin 68:445-460.

The author examined the diet of yellowfin tuna, *Thunnus albacares,* and skipjack tuna, *Katsuwonus pelamis,* quantitatively in relation to geographic areas, the size of the tunas, the distance from land, and the time of day. In addition, comparisons were made between the diets of the two species. Both species occur along the entire eastern U. S. (though skipjack tuna are rare north of Cape Cod, Massachusetts) and Gulf of Mexico and occur worldwide in the tropics. Skipjack (22-81 cm FL; n=1060) and yellowfin tuna (40-155 cm FL; n=611) were sampled from the upper pelagic region of the Atlantic ocean coasts of South America, Africa, the U. S., and the Bahamas by perse seine, long line, and trolling live bait (both fishery dependent and independent sampling). Data were reported as percent frequency and percent volume. In the north Atlantic and southwest Atlantic both tunas mostly ate fish (mainly scombrids); while in the southeast Atlantic both ate a higher number of crustaceans (decapods, stomatopods, and amphipods) than fish (Scombridae, Carangidae, Dactylopteridae, and Chaetodontidae) or mollusks (mostly squid; not higher in percent volume). This study and previous studies have found that juvenile scombrids are common prey of adult tunas. The tunas in this study fed early and late in the day (more empty stomachs and lower stomach volume in mid-day). The two species ate many of the same prey, but fish from each species found in the same area consumed different prey. The consumption of crustaceans tended to decease as the size of skipjack increased. However, the occurrence of fish in the diet increased with increased fish size for both species.

25. Duarte, L. O. and C. B. Garcia. 1999a. Diet of the lane snapper, *Lutjanus synagris* (Lutjanidae), in the Gulf of Salamanca, Colombia. Caribbean Journal of Science 35:54-63.

The objectives of this study were to determine daily and seasonal variation in diet, prey importance, prey size, and prey diversity by predator size for the lane snapper, *Lutjanus synagris*. Lane snapper occur along the southeast U. S. and the northern Gulf of Mexico to southeast Brazil. Lane snapper (105-335 mm SL; n=128) were sampled from the Colombia shelf (12-105 m depth) by bottom trawls. Crustaceans and teleost fishes were most important, larger fish ate larger prey (fish > 320 mm, frequently had empty stomachs.) This study was included because no diet studies of this species have been conducted in the southeast United States.

***26. Duarte, L. O. and C. B. Garcia. 1999b. Diet of the mutton snapper, *Lutjanus analis* (Cuvier) from the Gulf of Salamanca, Colombia, Caribbean Sea. Bulletin of Marine Science 65:453-465.**

The objectives of this study were to quantify and qualify the diet, prey importance, size of prey, and daily and temporal variations in the diet of the mutton snapper, *Lutjanus analis*. Mutton snapper occur along most of the east coast of the U. S. south of Massachusetts and in the northern Gulf of Mexico to Brazil. Mutton snapper (210-460 mm SL; n=110 with food of 128 collected) were sampled from the coastal shelf of Colombia by bottom trawls. The data were reported as percent weight, percent frequency of occurrence, percent number, and geometric index of importance. All fish 85-210 mm SL had empty stomachs. Reptantians, perciformes, stomatopods, and natantians were the dominant prey (in descending order). There was no

difference in prey with predator size; however, prey weight increased with an increase in predator size. Snappers prey on a wide range of food sources. This study was included due to the lack of diet data from the southeast United States.

27. Eggleston, D. B., J. J. Grover, and R. N. Lipcius. 1988. Ontogenetic diet shifts in Nassau grouper: Trophic linkages and predatory impact. Bulletin of Marine Science 63:111-126.

The objectives of this study were to describe the size specific diet of Nassau grouper, *Epinephelus striatus*; the impact of predators on nocturnal crabs found on patch reefs; and the relationship between grouper and crab density. Nassau grouper occur in North Carolina, Bermuda, and the northern Gulf of Mexico to Brazil. Nassau grouper (< 20 cm, 20-29 cm, and > 30 cm; n=68) were sampled from natural and artificial reefs of the Bahamas by spearing. An ontogenetic shift in diet from crustaceans to fish was observed. Increased grouper densities coincided with decreased crab densities. This study was included because no studies of Nassau grouper diet have been conducted on fish from the southeast United States.

***28. Eggold, B. T. and P. J. Motta. 1992. Ontogenetic dietary shifts and morphological correlates in striped mullet, *Mugil cephalus*. Environmental Biology of Fishes 34:139-158.**

The authors investigated ontogenetic diet shifts of striped mullet, *Mugil cephalus,* to determine if diet differences are correlated with changes in feeding location, feeding behavior, or feeding morphology. Striped mullet occur along most of the east coast of North America, but are absent from the Bahamas and most of the West Indies and Caribbean. Striped mullet (20- > 100 mm; n=200) were sampled from the Cross Bayou, Florida, estuary by bag seine, mullet cast net, and bagless seine. Data were reported as percent composition and Czechamowski Quantitative Index. A greater diversity of food items was found in larger fish (> 100 mm SL) than in smaller fish (< 40 mm SL), likely caused by foraging deeper in the sand (surface vs 5 mm deep). As the fish grew, the diversity of prey found in the stomach became increasingly similar to that of the sediment. Small fish (20-30 mm) ate small amounts of sand and large amounts of organic matter, algae, and *Diploneis* sp. (diatom). At 30-40 mm, striped mullet ate more sand and less organic matter and diatoms. Fish $\geq$ 40 mm ate more sand particles and a wider variety of diatoms and other food particles. The ontogenetic shift did not appear to be related to a shift in habitat, because all the fish were collected from roughly the same place. Detritus may be important as food. The mullet's feeding behavior changed from surface browsing to grazing deeper in the sediments. Gill raker length changed with size. The rakers on the first arch are longest in small fish (< 40 mm SL), which increases prey retention in filter feeders. The 2-4 rakers are longest in larger fish (> 50 mm SL); this may help explain the differences in diet with size. This study was included to complement data on the diet of striped mullet from the southeast United States.

29. Fay, C. W., R. J. Neves, and G. B. Pardue. 1983. Species profiles: life histories and environmental requirements of coastal fish and invertebrates (Mid Atlantic) – Atlantic silverside. U. S. Fish and Wildlife Service Division of Biological Services, RWS/OBS-82/11.10 U. S. Army Corps of Engineers TR EL-82-4. 15 p.

The authors described the life history and environmental requirements of the Atlantic silverside, *Menidia menidia*. Atlantic silversides occur from the Gulf of St. Lawrence to northeast Florida. Silversides were sampled from the mid-Atlantic shelf by various means.

Sliversides feed in schools, often following the tidal ebb and flow near gravel and sand bars, open beaches, tidal creeks, river mouths, and flooded zones of marsh vegetation. Silverside ate a variety of small crustaceans (mysids, amphipods, and calanoid copepods), squid, insects, algae, and diatoms. This study was included because no studies of Atlantic silversides have been conducted in the southeast United States.

***30. Finucane, J. H., C. B. Grimes, and S. P. Naughton. 1990. Diets of young king and Spanish mackerel off the southeast United States. Northeast Gulf Science 11:145-153.**

The objectives of this study were to describe the diet of Spanish, *Scomberomorus maculatus*, and king mackerel, *S. cavalla*; compare diets between the Gulf of Mexico and southeast U. S.; and measure mutual resource use by the two scombrid species and the extent of diet similarity for each species among areas. Spanish mackerel (larval/postlarval: 2.8-22 mm SL; n=307; juvenile: 9-42 cm SL; n=489) and king mackerel (larval/postlarval: 2.9-13.3 mm SL; n=95; juvenile: 9-73 cm SL; n=508) were sampled from the Gulf of Mexico and southeast U. S. shelves by bongo nets, trawls, and trap nets. Data were reported as percent number, percent occurrence, Horn/Morisita's Index, and diet breadth. King mackerel ate a wider variety of prey than Spanish mackerel. Diet overlap between the two was small. Spanish mackerel ate more invertebrates than king mackerel. Atlantic and Gulf of Mexico fish ate similar food though at different proportions. Both species were principally piscivores. Both mackerels as juveniles ate a greater diversity of prey in the Gulf than in the Atlantic. No comparisons were made between size classes within each species.

***31. Fitzhugh, G. R., L. B. Crowder, and J. P. Monaghan. 1996. Mechanisms contributing to variable growth in juvenile southern flounder (*Paralichthys lethostigma*). Canadian Journal of Fisheries and Aquatic Sciences 53:1964-1973.**

The objectives of this study were to examine factors effecting growth rate variability in southern flounder, *Paralichthys lethostigma,* including daily growth rates and the relationship between growth and the onset of piscivory. Southern flounder occur from North Carolina to Texas, but are absent from south Florida. Southern flounder (< 101-400 mm TL; n=1573) were sampled from the Pamlico and Core sounds, North Carolina, by otter trawl. Data were reported as number of prey items per size class, weight, and number of stomachs with prey type. Based on otolith measurements, daily growth rates ranged from 0.35 to 1.5 mm per day until approximately 75-100 mm when the growth trajectory branched. The variability in growth rate coincided with the onset of piscivory. Small flounder had a higher frequency of stomachs with food, which principally contained mysidacea. Southern flounder become piscivorous at about 70 mm. Larger fish (> 90 mm) had a higher frequency of empty stomachs and increased occurrence of fish prey. Female growth was faster and more variable than the growth of males.

***32. Francis, Jr., A. W. 2002. Ontogeny of morphological asymmetry in paralichthyid fishes and its consequences for feeding performance and ecology. PhD dissertation, Florida Institute of Technology, Melbourne, Florida 210 p.**

The objectives of this study were to describe patterns in resource use, ontogenetic changes in feeding morphology, ecology among developmental stages, and correlations between feeding biomechanics and feeding ecology of Gulf flounder, *Paralichthys albigutta*. Gulf flounder occur from North Carolina to Texas including south Florida and the Bahamas. Gulf flounder (20-79 mm and 181-240 mm; n=32) were sampled from the benthos of Sebastian Inlet

(channel from Atlantic to Indian River Lagoon, Tampa Bay) with an ichthyoplankton net, seine, and hook and line. Data were reported as percent composition. Small fish (< 60 mm) ate crustaceans (*Callinectes* spp. and mysids) almost exclusively. Larger fish (180-240 mm) ate fish almost exclusively. This study was included due to the limited amount of diet data for Gulf flounder from the southeast United States.

***33. Franks, J. S. and K. E. VanderKooy. 2000. Feeding habits of juvenile lane snapper *Lutjanus synagris* from Mississippi coastal waters, with comments on the diet of Gray Snapper *Lutjanus griseus*. Gulf and Caribbean Research 12:11-17.**

The objective of this study was to describe the diets of lane snapper, *Lutjanus synagris*, and gray snapper, *L. griseus*. Both species occur along the southeast United States coast and in the northern Gulf of Mexico to southeast Brazil. Lane snapper (63.7-86.5 mm SL; n=53 with food of 94 collected) and gray snapper (71.2-151.1 mm SL; n=12 with food of 16 collected) were sampled from the mouths of the East Pascagoula River and Bayou Cassotte in Mississippi coastal waters by otter trawl. Data were reported as percent numeric abundance, percent weight, percent frequency of occurrence, index of relative importance, percent index of relative importance, Morisita index of overlap, and Horn's index of overlap. The two species were predominantly macrobenthic and demersal feeders; although, gray snapper also may use the water column community as food. Juvenile lane snapper primarily ate decapods (*Latreutes parvulus* and unidentifiable shrimp). Juvenile gray snapper consumed decapods (shrimp) and fish (*Anchoa* sp.). Amphipods were also of moderate importance for both species. There was high dietary overlap of lane snapper diet between sampling sites, between seasons, and between size groups. This study was included to compliment diet data for lane and gray snappers from other studies.

***34. Gallagher, M. L., J. J Luczkovich, and E. J. Stellwag. 2001. Characterization of the utlrastructure of the gastrointestinal tract mucosa, stomach contents and liver enzyme activity of the pinfish during development. Journal of Fish Biology 58:1704-1713.**

The objective of this study was to describe the diet and physiology of digestion during pinfish, *Lagodon rhomboides,* and development. Pinfish occur from Massachusetts through the southeast United States, and from the northern Gulf of Mexico to the Florida Keys and Yucatan. Pinfish (26-152 mm SL; n=63) were sampled from the Core Sound estuary, North Carolina. Small pinfish (26-39 mm) were carnivorous, eating small and planktonic organisms. Gastric glands develop at approximately 30 mm, coinciding with an increase in plant material in the diet. Large pinfish (> 80 mm) were omnivorous, consuming animal and plant materials and detritus. Larger fish had a relatively smaller stomach capacity than smaller fish. An orderly progression in diet from primarily carnivorous to primarily herbivorous was observed with growth. The types of gastric cells (e.g. mucus secreting cells and lipid absorbing cells) and liver enzyme activity also changed as the fish grew from carnivorous young to herbivorous adults.

***35 Grimes, C. B. 1979. Diet and feeding ecology of the vermilion snapper, *Rhomboplites aurorubens* (Cuvier) from North Carolina and South Carolina waters. Bulletin of Marine Science 29:53-61.**

This study examined the diet relative to fish size, season, depth, and prey type to determine the trophic category appropriate for vermilion snapper, *Rhomboplites aurorubens*. Vermilion snapper occur along the southeast United States and the northern Gulf of Mexico to southeast Brazil. Vermilion snapper (< 100 mm, 100-175 mm, and > 175 mm; n=353) were

sampled from the shelf and shelf break by the recreational hook and line fishery and a fishery independent trawling survey. The smallest juveniles (< 100 mm TL) principally ate copepods; intermediate juveniles (100-174 mm TL) primarily ate fish scales, and adults (> 175 mm TL) mostly ate squid and small pelagic crustaceans (including copepods). Vermilion snapper appear to actually eat fish scales and not act as a cleaner fish based on the lack of ectoparasites identified in the fish stomachs. There was a subtle seasonal change in diet (shifts in the proportion of taxa consumed) and differences due to inshore/offshore habitat (i.e., more pelagic crustaceans consumed offshore than inshore). Vermilion snapper fed on pelagic, planktonic, and epibenthic prey, while most other snapper consume benthic prey. The authors hypothesize that vermilion snapper feed at night, as most of their prey were nocturnal.

***36. Hales, L. S. 1987. Distribution, abundance, reproduction, food habits, age, and growth of round scad, *Decapterus punctatus*, in the South Atlantic Bight. Fishery Bulletin 85:251-268.**

The author examined the seasonal distribution, abundance, reproduction, diet, age, and growth of round scad, *Decapterus punctatus.* Round scad occur along most of the east coast of North America and from the Gulf of Mexico to southeast Brazil. Round scad (juveniles and adults 39-189 mm FL; n=457) were sampled from the shelf and upper slope regions from Cape Fear, North Carolina, to Cape Canaveral, Florida, by random sampling at discrete depths. Data were reported as percent number, percent volume, percent frequency of occurrence, and index of relative importance. Most fish were caught in water 9-92 m deep during spring and summer. In the summer, fish were caught in waters 92-110 m. Round scad do not have seasonal migrations; although, more were found over reefs than sand in winter. Adult fish were more common at the surface. Among juveniles, size increased with depth from 27 m to 110 m (though smallest fish collected were found at 111-184 m in summer 1975). Round scad were serial spawners from March through August. Round scad mature at smaller sizes than do other species of *Decapterus*, and grew fast; most of their size was achieved in the first year. Small fish (39-89 mm) ate copepods. Medium-sized fish (90-139 mm) ate some small fish, but mostly copepods. Large fish (140-189 mm) ate a greater variety of prey, including larger items such as chaetognaths.

***37. Hansen, D. J. 1969. Food, growth, migration, reproduction, and abundance of pinfish, *Lagodon rhomboides*, and Atlantic croaker, *Micropogon undulatus*, near Pensacola, Florida. 1963-65. Fishery Bulletin 68:135-146.**

The author investigated the seasonal and annual changes in food, growth, migration, reproduction, and abundance at two stations for pinfish, *Lagodon rhomboides,* and Atlantic croaker, *Micropogon undulatus* (renamed *Micropogonias undulatus*). Pinfish (13-152 mm SL; n=3577) of the lower estuary and seagrass beds of Pensacola, Florida, and croaker (14-173 mm SL; n=2520) of the upper estuary and mud/oyster beds of the estuary were sampled by trawl. Data were reported as percent volume. For pinfish, the type of food varied with season and fish size, but not by station. Pinfish ate more vegetation in late spring and early summer and less in late fall. In fall, most pinfish over 90 mm SL left the estuary, and the amount of food in pinfish stomachs decreased. This coincided with the spawning season. Croaker > 75 mm SL mostly ate fish. Croaker appeared first and in greatest abundance in areas of low salinity. They moved to areas of higher salinity as they grew and appeared in the lower estuary in late spring. All croaker left the estuary by November and did not return to the estuary as adults. Growth of both species

varied from year to year. This study was included to complement data on the diets of Atlantic croaker and pinfish from the southeast United States.

***38. Hastings, R. W. 1973. Biology of the pygmy seabass, *Serraniculus pumilio* (Pisces: Serranidae). Fishery Bulletin 71:235-242.**

The author provided a synopsis of information scattered in the literature and new data on habitat, behavior, distribution, reproduction, development, growth, food habits, and predation of pygmy seabass, *Serraniculus pumilio*. Pygmy seabass occur along the southeast U. S. coast and from the northern Gulf of Mexico to northern South America, but are absent from the Bahamas and West Indies. Pygmy seabass (15.8-54.1 mm SL; n=31) were sampled from sand near structure (large shell, coral, rock) in Choctawhatchee Bay, St. Andrew Bay, Apalachicola Bay, and Alligator Harbor, Florida. Data were reported as percent frequency. Pygmy seabass habitats are areas of moderate depth (10-70 m) on the shelf, but move offshore to warmer water in winter. The seabass were most common over sand or shell bottom near irregularities like coral or rock. Recruitment of populations on the jetties resulted from immigration of adults, not young. These seabass were territorial and synchronous hermaphrodites. Larger second year fish may remain offshore in deeper water. Pygmy seabass were indiscriminate carnivores that seem to prefer small crustaceans (amphipods, isopods, copepods); though, crabs and shrimp were also common prey.

***39. Hastings, P. A. and S. A. Bortone. 1980. Observations on the life history of the belted sandfish, *Serranus subligarius* (Serranidae). Environmental Biology of Fishes 5:365-374.**

The authors described the life history of belted sandfish, *Serranus subligarius,* which occurs from North Carolina to Florida (rare in the Florida Keys) and in the northern Gulf of Mexico. Belted sandfish (< 40-94.6 mm SL; n=158 with food of 181 collected) were sampled from inshore jetties and limestone reef off the northern Florida Gulf coast by hand nets, plastic bags, and spears while skin or SCUBA diving. Data were reported as percent occurrence, percent number, and percent weight. Belted sandfish were rarely observed over sand bottom > 1 m from solid substrate. Age and growth characters were similar to other synchronously hermaphroditic serranids. Belted sandfish primarily ate benthic crustaceans (ostracods, copepods, gammaridean amphipods, and caprellidean amphipods) and some fish (one incidence of cannibalism). First year individuals consumed planktonic copepods, but the majority of their diet came from benthic organisms. This study was included due to the lack of diet data for fish from the southeast United States.

***40. Hayse, J. W. 1990. Feeding habits, age, growth, and reproduction of Atlantic spadefish *Chaetodipterus faber* (Pisces: Ephippidae) in South Carolina. Fishery Bulletin 88:67-83.**

The objectives of this study were to examine the stomach contents of Atlantic spadefish, *Chaetodipterus faber,* to determine if collection mode biases diet studies, ontogenetic and habitat differences in diet, spawning period, sex ratios, and age at maturity. Atlantic spadefish occur from Massachusetts south and in the northern Gulf of Mexico to southeast Brazil. Young-of-year spadefish were sampled from South Carolina estuaries and the coastal shelf. Adult fish were collected from artificial reefs and jetties. Sampling gear included dip nets, stop nets, seine, trawls, spears, and hook and line. A total of 177 fish (60-472 mm TL) were collected. Data were reported as percent frequency, percent volume, Index of Relative Importance, and a

modified index of relative importance (=%F%V). Fish from hook-and-line samples had different diets than other collection methods with a bias toward cannonball jellies. The diets of fish collected in estuary samples (young-of-year) were dominated by hydroids. Fish collected from coastal waters predominantly ate the anthozoan, *Renilla reniformis*, and amphipods. The diet of fish collected from the reef/jetty was dominated by hydroids. Data showed a strong relationship between otolith radius and the length of the fish, a decrease in growth rate with age, and close agreement between back-calculated lengths and observed lengths at age. All age 1 females and older were mature. Spadefish spawn offshore from late spring through early fall. Juveniles move to estuaries. In fall, young-of-year fish move to shallow offshore areas with the age one individuals.

***41. Henwood, T., P. Johnson, and R. Heard. 1978. Feeding habits and food of the longspined porgy, *Stenotomus caprinus* Bean. Northeast Gulf Science 2:133-137.**

The authors characterized major food items and feeding patterns of longspined porgy, *Stenotomus caprinus*. Longspined porgy occur from North Carolina to Georgia and the Gulf of Mexico from Florida to the Yucatan. Longspined porgy (23-145 mm; n=301) were sampled from the shelf offshore of Mississippi, Alabama, and Florida by otter trawl. Data were reported as frequency of occurrence and percent frequency. When feeding, longspined porgy showed little affinity for bottom type. Most feeding occurred during daylight hours. The only differences in food between large and small individuals were in size of prey. Longspined porgy are browsers, primarily preying on small polychaetes and crustaceans. The mouth and teeth were designed for nipping and crushing substrate. Longspined porgy are not likely to be major predators of other fish, though fish are occasionally consumed. Echinoderms, sipunculids, and nemerteans were frequently consumed. Parasitic worms in the stomach and lower digestive tract were common. This study was included due to the lack of diet data for this species in the southeast United States.

***42. Hettler, W. F. 1989. Food habits of juveniles of spotted seatrout and gray snapper in western Florida Bay. Bulletin of Marine Science 44:155-162.**

The objectives of this study were to describe the diet and habitat type and ontogenetic changes in juvenile gray snapper, *Lutjanus griseus,* and spotted seatrout, *Cynoscion nebulosus*. Both species occur along the east coast of the U. S. and Gulf of Mexico. Gray snapper (<30-250 mm SL; n= 215) and spotted seatrout (< 30-250 mm SL; n=144) were sampled from shallow seagrass, deep bank channels, and mangrove prop root habitat along west Florida Bay by trawl and rotenone. Data were reported as percent frequency of occurrence. Habitat type influenced available prey and, thus, diet. Seagrass beds were the most important feeding habitat. Spotted seatrout mostly ate small crustaceans at small sizes (< 50 mm SL) and increased fish consumption with size (> 50 mm SL). Gray snapper ate penaeid shrimp. This study was included because studies of gray snapper from the southeast United States have not been published.

43. Horvath, M. L., C. B. Grimes, G. R. Huntsman. 1990. Growth, mortality, reproduction and feeding of knobbed porgy, *Calamus nodosus*, along the southeastern United States coast. Bulletin of Marine Science 46:677-687.

The authors reported on age, growth, mortality, reproduction, diet, and size of knobbed porgy, *Calamus nodosus,* in North and South Carolina. Knobbed porgy occur from North

Carolina to southern Florida and the entire Gulf of Mexico. Knobbed porgy (adults; n=70) were sampled from the reef habitat by the recreational hook and line fishery plus some independent hook and line sampling and trawling. Data were reported as percent frequency of occurrence. Knobbed porgy were protogynous hermaphrodites, and the majority of fish were female. The largest and oldest fish were 17 years old. Annual growth from age 6-10 was 13 mm, and only decreased slightly from age 11-16 (12 mm). Knobbed porgy use strong jaws and pharyngeal teeth to eat invertebrates. Identification of prey was difficult, but mollusks, crabs, and polychaetes dominated stomach contents.

***44. Houde, E. D. and J. A. Lovdal. 1984. Seasonality of occurrence, foods and food preferences of ichthyoplankton in Biscayne Bay, Florida. Estuarine, Coastal and Shelf Science 18:403-419.**

The objectives of this study were to determine the kind, abundance, and seasonality of ichthyoplankton in Biscayne Bay, Florida, to describe the food preference of these ichthyoplankton, and to determine seasonal trends in prey abundance. The twelve species discussed in this study occur in the southeast United States. Bay anchovy, *Anchoa mitchelli* (2.2-17.4 mm SL; n=253 with food of 666 collected); scaled sardine, *Harengula jaguana* (3.7-13.1 mm SL; n=29 with food of 82 collected); Atlantic thread herring, *Opisthonema oglinum* (3.5-19.1 mm SL; n=111 with food of 257 collected); yellowfin menhaden, *Brevoortia smithi* (n=4 with food of 20 collected); unidentified Clupeidae (n=14 with food of 33 collected); Gobiidae (1.3-6.3 mm SL; n=172 with food of 525 collected); spotted dragonet, *Callionymus* (*Diplogrammus*) *pauciradiatus* (1-3.5 mm SL; n=504 with food of 770 collected); pigfish, *Orthopristis chrysoptera* (2.1-7.7 mm SL; n=104 with food of 242 collected); lined sole, *Achirus lineatus* (1.5-3.1 mm SL; n=32 with food of 48 collected); sea bream, *Archosargus rhomboidalis* (1.5-3.7 mm SL; n=77 with food of 184 collected); spotted seatrout, *Cynoscion nebulosus* (1.6-4.3 mm SL; n=58 with food of 74 collected); and Blenniidae (2.5-7.3 mm SL; n=55 with food of 130 collected) were sampled from the Biscayne Bay, Florida, estuary by a bongo frame fitted with 333 μm and 35 μm mesh nets. Data were reported as number, percent number, and index of relative importance. Ichthyoplankton densities were lowest when the water temperature was low and highest during rising temperatures and salinities. All the taxa examined were most abundant during spring and summer; except pigfish, which were more abundant during fall and winter. The abundance of zooplankton prey was fairly consistent throughout the year. Only tintinnid abundance declined sharply in winter. Samples collected in the 35 μm mesh net contained more fish larvae, particularly yolk-sac larvae, than samples collected with the 333 μm mesh net. Copepods of all stages were the dominant food of the larval fish; however, selection for the copepodite and adult stages was apparent. Tintinnids, bivalve veligers, gastropod veligers, and the dinoflagellate, *Prorocentrum micans*, were also common prey for all taxa. There were no seasonal patterns in the prey eaten by the larvae. Lined sole ate more mollusk veligers than other taxa; although, mollusk veligers were preferred by all taxa. Gobies and the bay anchovy ate more tintinnids than the other fish taxa. Prey size increased as larval fish size increased, but all larvae continued to eat small prey as they grew. This study was included to complement diet data from the southeast United States.

45. Huh, S-H. and C. L. Kitting. 1985. Trophic relationships among concentrated populations of small fishes in seagrass meadows. Journal of Experimental Marine Biology and Ecology 92:29-43.

The objectives of this study were to determine the seasonality of prey availability, seasonal changes in food habits of common fish, and experimental depletion of food and dietary shifts by common fish. The species discussed occur in the southeast United States, Gulf of Mexico, and Caribbean. Darter goby, *Gobionellus boleosoma* (size not reported); pinfish, *Lagodon rhomboides* (26-60 mm SL); code goby, *Gobiosoma robustum* (6-40 mm SL); and Gulf pipefish, *Syngnathus scovelli* (31-120 mm SL), were sampled from seagrass beds in Redfish Bay, Texas, by throwing cages and push nets. Amphipods (*Elasmopus levis, Cymadusa compta*, and *Ampelisca abdita*) were the dominant organisms in the sediment. Annelids and mollusks were also important in the community. Most of the potential prey community occurred in highest abundance during spring, lowest in summer, and increased in late fall and winter. Copepods, on the other hand, were abundant in summer and low during spring. Algae and diatoms were present year round. Darter goby and pinfish diets changed with season and food availability. In spring, darter gobies were carnivorous, eating amphipods. During summer, they began eating epiphytic filamentous algae, diatom chains, and detritus. During late fall, diatom chains, particularly *Biddulphia pulchella,* continued to dominate. During winter, darter gobies became carnivorous again, eating copepods and amphipods. Benthic prey (amphipods and polychaetes) dominated the pinfish diet during spring. During summer, pinfish switched to epiphytic filamentous algae, drift algae, diatoms, and seagrass pieces. During fall, pinfish began eating more amphipods, and benthic prey in addition to plants. The code goby (11-20 mm SL) changed diet with season and food availability, but were carnivorous during all seasons. Code goby were only abundant during late fall and early winter, when food was fairly abundant. During spring and fall, amphipods were the common prey. During winter, copepods became important. During summer, code goby ate amphipods, copepods, and polychaetes. Larger code gobies (> 20 mm) ate amphipods year round. The Gulf pipefish was most common during late fall and winter. There were no changes in diet with season. Pipefish (31-70 mm) ate copepods year round. Amphipods were less important in smaller fish, but the larger pipefish (71-120 mm) relied heavily on amphipods. Diet overlap was highest during spring when food was abundant and all fish were carnivorous. The least overlap was in summer when food was sparse. Pinfish and darter gobies turned toward plants as food, and code goby and Gulf pipefish became less abundant. In cage experiments, concentrated fish were more likely to shift diet to other prey types and amphipod depletion was higher than in control cages. This study was included because of the lack of diet data for some of these species in the southeast United States.

***46. Kjelson, M. A., D. S. Peters, G. W. Thayer, and G. N. Johnson. 1975. The general feeding ecology of postlarval fish in the Newport River estuary. Fishery Bulletin 73:137-144.**

The authors described food preferences, feeding intensity and chronology, evacuation rates, and daily ration of three common estuarine fish: Atlantic menhaden, *Brevoortia tyrannus;* pinfish, *Lagodon rhomboides*; and spot, *Leiostomus xanthurus*. All three species occur along the eastern U. S. coast and Gulf of Mexico. Atlantic menhaden (25-32 mm TL; n=120), pinfish (16-20 mm TL; n=120), and spot (17-24 mm TL; n=120) were sampled from the Newport River estuary, North Carolina, by seine, dip net, channel net, and bongo net. Data were reported as percent number. Copepods (*Centropages*, *Temora*, *Acartia*, and Harpacticoida) made up ~99%

of the diet of each species. The reliance on copepods may be because copepods were the only food item of appropriate size present in abundance. All three species ate during the day particularly between dawn and noon. The estimated gut capacity for 30 mm lab reared menhaden was 72 copepods, for 21 mm lab reared spot was 44 copepods, and for 18 mm lab reared pinfish was 37 copepods. The number of copepods found in the guts of wild caught spot and pinfish supported these estimates. Wild caught menhaden, on the other hand, only contained an average of five copepods per fish. Menhaden lost 68% of their gut contents when collected in bongo nets. Stress of capture may not be the only thing causing regurgitation; handling stress also caused loss of gut contents in menhaden.

***47. Knapp, E. B. 1951. Food habits of the sergeantfish, *Rachycentron canadus*. Copeia 1951:101-102.**

The author described food of cobia, *Rachycentron canadus* (renamed *R. canadum*). Cobia occur from Massachusetts to Argentina and are nearly worldwide in warm waters. Cobia (adult; n=29) were sampled from the shelf off the coast of Port Aransas, Texas. Data were reported as number and percent occurrence. Cobia is a voracious predator that fed both at the bottom and the surface. They are generalist carnivores with a wide variety of prey items (predominantly, *Squilla* spp., eels, shrimps, and crabs). This study was included to complement data on the diet of *R. canadum* from the southeast United States.

***48. Larson, E. T. and A. L. Shanks. 1996. Consumption of marine snow by two species of juvenile mullet and its contribution to their growth. Marine Ecology Progress Series 130:19-28.**

The objectives of this study were to determine the reliance of two species of mullet on marine snow for nutrition. White mullet, *Mugil curema,* and striped mullet, *M. cephalus,* both occur along the east coast of the U. S. White mullet (mean SL=20 mm; n=10) and striped mullet (mean offshore SL=18 mm, mean Charleston harbor SL=23 mm; n=20) were sampled from offshore and estuarine areas of South Carolina by neuston net and Cobb trawl. Data were reported as number. The study mainly concentrated on laboratory experiments testing the consumption of marine snow by both species of mullet. A diet of limited *Artemia* and unlimited marine snow caused the least amount of weight loss (compared to only *Artemia*, only marine snow, and unfed). Striped mullet assimilated about half the organic matter and amino acids contained in marine snow. These results were compared with field caught fish, which ate a combination of amorphous material and small crustaceans.

***49. Lewis, V. P. and D. S. Peters. 1994. Diet of juvenile and adult Atlantic menhaden in estuarine and coastal habitats. Transactions of the American Fisheries Society 123:803-810.**

The objectives of this study were to describe the diet of Atlantic menhaden, *Brevoortia tyrannus,* throughout its range; differences between fish from estuarine and coastal habitats; the carbohydrate, humic compound, and ash content of amorphous matter, and to discuss the origin of amorphous matter. Atlantic menhaden occur along the entire east coast of North America. Menhaden (56-298 mm FL; n=39) were sampled from estuarine creeks and coastal water from Massachusetts to Georgia by cast net (estuarine) and purse seine (commercial, coastal). Amorphous matter made up ~80% of the gut contents, phytoplankton made up 17%, and zooplankton made up 1%. Through carbohydrate, humic compound, and ash content

estimations, the authors concluded that amorphous matter was not consumed as living organisms and was not the residue of fragile dinoflagellates. This means that the trophic link between primary producers and fisheries species are uncertain. The stomachs of estuarine fish contained more amorphous matter than those from coastal habitat; however, amorphous matter was dominant, and phytoplankton was second in importance.

50. Ley, J. A., C. L. Montague, and C. C. McIvor. 1994. Food habits of mangrove fishes: a comparison along estuarine gradients in northeastern Florida Bay. Bulletin of Marine Science 54:881-899.

The objectives of this study were to determine if fish diet varied along a salinity gradient and if upstream, lower salinity habitats provided lower quality food than the downstream, higher salinity habitats. Goldspotted killifish, *Floridichthys carpio*; redfin needlefish, *Strongylura notata*; and Gulf killifish, *Fundulus grandis*, occur in the southeast United States; although, they are most abundant in southern Florida, the Gulf of Mexico, and parts of the Caribbean. Goldspotted killifish (3-7.7 cm TL; n=305), Gulf killifish (4.2-13.8 cm TL; n=219), and redfin needlefish (9.5-42.0 cm TL; n=201) were sampled from the northeastern Florida Bay by rotenone and block nets. Data were reported as percent frequency and percent composition. Dietary overlap was common, with amphipods the most common prey of all species. Fish parts and algae were also common. Goldspotted killifish consumed filamentous green algae and benthic invertebrates (amphipods, copepods, ostracods, and mollusks), but most of their stomach content was unrecognizable material. The Gulf killifish was piscivorous (killifish and anchovies), but also ate insects from the water's surface and small crabs, *Rhithropanopeus harrissi*, from the bottom. Redfin needlefish mostly ate fish and insects. The diets of Gulf killifish and redfin needlefish varied among sites, but not in a gradient pattern. These two species consumed more insects during the dry season than during the wet season. The goldspotted killifish diet did change systematically along the gradient. More algae, a lower quality food, were consumed upstream, while more benthic invertebrates (copepods, ostracods, and nematodes), higher quality foods, were consumed downstream. Omnivory, broad dietary overlap, and the ability to exploit temporary peaks in prey abundance, were observed in all fish examined and are characteristic of euryhaline estuarine fishes. The authors concluded that during the dry season and in low salinity areas, high quality prey (amphipods) became less abundant and fish species had to switch to less desirable, lower quality prey (algae). This study was included because of the lack of diet data for some of these species from the southeast United States.

***51. Lindquist, D. G., L. B. Cahoon, I. E. Clavijo, M. H. Posey, S. K. Bolden, L. A. Pike, S. W. Burk, and P. A. Cardullo. 1994. Reef fish stomach contents and prey abundance on reef and sand substrata associated with adjacent artificial and natural reefs in Onslow Bay, North Carolina. Bulletin of Marine Science 55:308-218.**

The objectives of this study were to compare the diets of three reef fish and to compare what is eaten to what is available in both sand and reef habitats. Cubbyu, *Equetus umbrosus;* black seabass, *Centropristis striata;* and scup, *Stenotomus chrysops,* occur on the southeast U. S. continental shelf. Cubbyu (63-165 mm SL; n=43), black seabass (47-209 mm SL; n=128), and scup (53-170 mm SL; n=94) were sampled from the shelf and reef habitats by spearing, hook and line, and trapping. The data were reported as percent dry weight, percent occurrence, and percent number. In general, sand and reef associated prey were eaten more than planktonic prey.

Cubbyu ate more sand associated prey (in natural reef), seabass and scup ate prey from each habitat equally. There may have been some differences in sand versus reef associated prey consumption between natural and artificial reefs, but prey associated with sand habitat was an important source of food.

***52. Llanso, R. J., S. S. Bell, and F. E. Vose. 1998. Food habits of red drum and spotted seatrout in a restored mangrove impoundment. Estuaries 21:294-306.**

The objectives of this paper were to determine whether a restored (previously impounded) mangrove was accessible to red drum, *Sciaenops ocellatus,* and spotted sea trout, *Cynoscion nebulosus,* by comparing concentrations between the restored and a natural mangrove and by examining the use of benthic prey by the two species in the two mangroves. Red drum and spotted seatrout both occur along most of the east coast of the United States including south Florida and the northern Gulf of Mexico. Red drum (19-590 mm; n=263) and spotted seatrout (40-320 mm; n=147) were sampled from the restored and natural mangrove estuaries near Tampa Bay, Florida, by various sampling gear. Data were reported as weight, number, biological index value, index of relative importance, and Jacob's electivity index. More fish of both species were found at the restored site than at the natural site. Prey abundance patterns were similar at the two sites. Red drum selected for microcrustaceans (amphipods) disproportionate to availability. Sea trout generally ate in proportion to availability; although, small fish (< 200 mm) occasionally selected for palaemonids. Overall, both species have flexible diets with no strong selection or avoidance. Restored mangroves provided valuable prey to estuarine dependent fishes. This study was included due to the limited data for these species from the southeast United States.

53. Luczkovich, J. J., G. P. Ward, J. C. Johnson, R. R. Christian, D. Baird, H. Neckles, and W. M. Rizzo. 2002. Determining the trophic guilds of fishes and macroinvertebrates in a seagrass food web. Estuaries 25:1143-1163.

The authors' objectives were to define and describe the food web of a seagrass bed near St. Mark's National Wildlife Refuge in Florida. Data collected for this study was combined with published data and analyzed by hierarchical clustering and correspondence analysis to define trophic guilds. Six trophic guilds were defined: suspension feeders (gastropods, bivalves, polychaetes, mysids, calanoid copepods, tanaeids, amphipods, and foraminifera), suspension feeding fish (tonguefish, seahorses, pinfish, spot, silversides, small red drum, anchovies, pipefish, hake, sea robins, small flounder, large flounder, needlefish, large red drum), predator-scavenger invertebrates (the predatory gastropods *Bystcoptypus spiratus*, *Natica* sp., and *Urosalpinx perrugata*), herbivores (herbivorous amphipods, shrimps, polychaetes, gastropods), omnivores (omnivorous crabs, shrimp, and polychaetes), and detritivores (detritivorous amphipods, shrimps, harpacticoid copepods, isopods, crabs, polychaetes, gastropods, and echinoderms). This study was included due to the limited data for seahorses, pipefish, and tonguefish from the southeast United States.

54. Manooch, III, C. S. 1973. Food habits of yearlings and adult striped bass, *Morone saxatilis* (Walbaum), from Albemarle Sound, North Carolina. Chesapeake Science 14:73-86.

This study described the diet of striped bass, *Morone saxatilis*, in Albemarle Sound, particularly the effects of fish size, season, specific area of collection, food size, and the

possibility of cannibalism. Striped bass are found from the St. Lawrence River to northern Florida (St. Johns River) and in the northern Gulf of Mexico from west Florida to Louisiana. They were also introduced to the Pacific coast of the U. S. and elsewhere. Striped bass (125-714 mm TL; n=1094) were sampled from predominantly fresh and brackish-salt water by experimental gill nets, balloon trawls, and by the commercial and recreational fisheries. Data were reported as number, percent number, volume, percent volume, frequency, percent frequency, and total length. Little evidence was found for cannibalism among east coast fish. Differences were found in the diets of small fish (125-304 mm TL; preying on soft-rayed fish) versus large fish (305-714 mm TL; preying on spiny-rayed fish); freshwater inhabitants (eating clupeids) versus salt-water inhabitants (eating spiny-rayed fish, anchovy, and crustaceans); and summer/fall caught fish (which ate fish; predominantly *Brevoortia tyrannus* and *Alosa aestivalis*) versus winter/spring caught fish (which consumed clupeids, but the importance of amphipods and blue crabs increased during these seasons).

***55. Manooch, III, C. S. 1977. Foods of the red porgy, *Pagrus pagrus* Lineaus (Pisces: Sparidae), from North Carolina and South Carolina. Bulletin of Marine Science 27:776-787.**

The objectives of this study were to describe the diet of red porgy, *Pagrus pagrus,* and to compare season, geographic area, size, and proximity to bottom effects on diet in North and South Carolina. Red porgy occur from New York and the northern Gulf of Mexico to Argentina as well as the east Atlantic. Red porgy (juveniles: 46-202 mm TL; adults: 202-625 mm TL; n=779) were sampled from the pelagic and benthic shelf environment (23-120 m water depth) by the recreational fishery. Data were reported as number, percent frequency, and percent occurrence. Invertebrates remained the main food source with minor shifts in specific taxa consumed with season. More fish were eaten inshore than offshore, but invertebrates (crabs in particular) were the main prey across the shelf. There were few differences among geographic area; although, more echinoderms were eaten than crabs in the Cape Fear region, and fish were slightly more piscivorous in this region. Small juveniles (46-64 mm) ate amphipods and copepods, unlike the large juveniles (130-162 mm) and adults (202-625 mm). Adults ate more fish than either size class of juvenile. Red porgy consumed predominantly benthic food.

***56. Manooch, III, C. S. and M. Haimovici. 1983. Foods of greater amberjack, *Seriola dumerili*, and almaco jack, *Seriola rivoliana* (Pisces: Carangidae), from the South Atlantic Bight. Journal of the Elisha Mitchell Scientific Society 99:1-9.**

The objectives of this study were to identify the food and compare the diets of two carangids: greater amberjack, *Seriola dumerili,* and almaco jack, *S. rivoliana*. Both species occur along the east coast of the U. S. south of Massachusetts to northern South America. Greater amberjack (397-1386 mm TL; n=81) and almaco jack (276-1094 mm TL; n=49) were sampled from the North Carolina, South Carolina, Georgia, and Florida shelves by the recreational fishery. Data were reported as percent number, percent volume, percent frequency, and index of relative importance. Both species had a similar diet consisting mostly of fish and crustaceans (greater amberjack: clupeids, bothids, serranids, balistids, sparids, penaeids, and *Sicyonia* sp.; almaco jack: serranids, clupeids, synodontids, scombrids, balistids, portunids, and penaeids); however, almaco jack ate more non-bottom associated prey (such as portunid crabs) than greater amberjack.

57. Manooch, III, C. S. and D. L. Mason. 1983. Comparative food studies of yellowfin tuna, *Thunnus albacares*, and blackfin tuna, *Thunnus atlanticus* (Pisces: Scombridae) from the southeastern and Gulf coasts of the United States. Brimleyana 9:33-52.

The objectives of this study were to compare the diet between the two tunas and among different size classes. Yellowfin tuna, *Thunnus albacares,* and blackfin tuna, *T. atlanticus,* occur along most of the North American east coast and the northern Gulf of Mexico to south Brazil. Yellowfin tuna (501- > 1100 mm FL; n=206) and blackfin tuna (< 500-1100 mm FL; n=98) were sampled from the shelf waters of North Carolina, South Carolina, Georgia, east and west Florida, Mississippi to Louisiana, and south Texas by recreational fishermen. More clupeids and diogenid crabs were found in blackfin tuna and more scombrids and squid in yellowfin tuna. No differences were found in the consumption of fish or crustaceans with yellowfin tuna size. Size of prey increased while surface feeding decreased with blackfin tuna size. Both species were aggressive predators on large fast prey. In addition, the tunas used their gill apparatus to strain small plankton from surface waters to supplement their diet.

***58. Manooch, III, C. S., D. L. Mason, and R. S. Nelson. 1983. Food and gastrointestinal parasites of dolphin, *Coryphaena hippurus*, collected along the southeastern and Gulf coasts of the United States. NOAA Technical Memorandum NMFS-SEFC-124. 36 p.**

The objectives of this study were to describe the diet of dolphin, *Coryphaena hippurus,* in relation to fish size, area of collection, and season, and to examine parasitic infestations. Dolphin occur from Nova Scotia to southeast Brazil and are worldwide in tropical waters. Dolphin (250-1530 mm FL; n= 2219 with food of 2632 collected) were sampled from the shelf from North Carolina to Texas by recreational hook and line fishermen. Data were reported as percent number, percent volume, percent frequency of occurrence, and index of relative importance. Dolphin ate mostly fish, and invertebrates (squid, paper nautilus, small crustaceans) were of secondary importance. Invertebrates were eaten only by smaller individuals. Prey size increased with predator size. Large dolphin (900-1100 mm FL) ate small dolphin (< 900 mm FL). More dolphin were collected in summer (there was also more effort), and few fish were collected in winter. The summer diet was the most diverse. Invertebrate prey were more common in fall than spring or summer. Feeding was associated with sargassum. Parasites increased in number with increased host size.

***59. Manooch, III, C. S., D. L. Mason, and R. S. Nelson. 1985. Foods of little tunny, *Euthynnus alletteratus*, collected along the southeastern and Gulf coasts of the United States. Bulletin of the Japanese Society of Scientific Fisheries 51:1207-1218.**

The objectives of this study were to identify the relation between diet and fish size, geographical area of collection, and season of little tunny, *Euthynnus alletteratus,* and to compare this data with Spanish mackerel, *Scomberomorus maculatus,* and king mackerel, *S. cavalla*. Little tunny occur along the entire east coast of the United States south of Massachusetts, in the northern Gulf of Mexico to Brazil, and in the east Atlantic. Little tunny (172-885 mm FL; n=2134) were sampled off the coasts of the southeast U. S. and northern Gulf of Mexico by recreational fishermen. Data were reported as percent number, percent volume, percent frequency, and index of relative importance. Fish was the most abundant prey in all size classes. Larger (> 500 mm FL) little tunny ate slightly more and larger fish than smaller (< 500 mm FL) individuals. Crustaceans ranked higher (IRI) than fish in spring and winter. Fish were the most abundant prey (by percent) in all seasons except winter. Type and percent of prey items

changed with region generally alternating between clupeids (South Carolina, south Florida, eastern Gulf of Mexico, Texas) and crustaceans (North Carolina, east central Florida, Louisiana, Mississippi) as the highest ranking prey. Diet of adult little tunny was more similar to *S. cavalla* than to *S. maculatus*.

***60. Matheson III, R. H., G. R. Huntsman, and C. S. Manooch, III. 1986. Age, growth, mortality, food and reproduction of the scamp, *Mycteroperca phenax*, collected off North Carolina and South Carolina. Bulletin of Marine Science 38:300-312.**

The authors discussed the age and growth, mortality estimates, age at recruitment, yield per recruit, status of the fishery, spawning, and foods of scamp, *Mycteroperca phenax,* in North and South Carolina. Scamp occur along the east coast of the United States and in the northern Gulf of Mexico to Venezuela. Scamp (adult; n=326) were sampled from between Cape Hatteras, North Carolina and Georgia by the recreational and commercial fisheries. Data were reported as percent number, percent volume, percent frequency of occurrence, and index of relative importance. Scamp appeared to grow throughout their lives; the oldest fish caught in this study was 21 years and 893 mm FL. Annual instantaneous mortality rates ranged from 0.29-0.91; samples from commercial catches had mortality rates on the high end of that range, while samples from headboats were on the low end. Estimated age at recruitment was 4-6 years, and the maximum yield per recruit was 600 g. Of the 91 fish that contained food in their stomachs, most were piscivorous (unidentifiable remains, *Decapterus punctatus*, *Haemulon aurolineatum*, serranids, and *Rhomboplites aurorubens*). Some crustaceans (penaeids, *Solenocera* sp., natantians, *Ovalipea* sp., and *Portunus* sp.) and *Octopus* sp. were found, but were of low importance (low IRI).

***61. Merriner, J. V. 1975. Food habits of the weakfish, *Cynoscion regalis*, in North Carolina waters. Chesapeake Science 16:74-76.**

The objectives of this study were to describe the diet of weakfish, *Cynoscion regalis,* and to compare the diet among sampling gear and age classes within a gear type. Weakfish occur all along the east coast of the United States. Weakfish (age 0, 1, and 2; n=817) were sampled from Pamlico Sound and the coast near Morehead City, North Carolina, by trawling, seines, pound nets, and gill nets. Data were reported as percent occurrence, percent number, and percent volume. Weakfish ate penaeid shrimp, mysids, and small fish (*Anchoa* spp., *Opisthonema oglinum*, and *Brevoortia tyrannus*), with an increasing incidence of clupeids as they grew. Cannibalism was observed, though this likely occurs more when other prey is limited. Diet changed with changes in geographic area, reflecting a shift in the abundant prey taxa with region.

62. Mobley, K. B. and W. Fleeger. 1999. Diet of *Scartella cristata*: an artificial habitat-associated blenny (Pisces: Blenniidae). Vie et Milieu 49:221-228.

The objectives of this study were to describe the diet of the molly miller, *Scartella cristata,* in relation to ontogenetic changes, time of day, and sex. Molly miller occur along the southeast United States, the northern Gulf of Mexico to Brazil, and the eastern Atlantic. Molly miller (19-78 mm SL; n= 62) were sampled from rock jetties in the upper subtidal zone near Destin and Panama City, Florida, by snorkel with hand nets. Data were reported as frequency of occurrence, total gut content biomass, and percent prey biomass. Adults of both sexes ingested the same total amount of food. Males may have been absent at night because they were guarding a nest. Smaller fish (< 30 mm SL) ate more and larger invertebrates (mysids, isopods, barnacles,

tanaids, and bivalves). Plant intake increased with size, so that the largest fish (> 60 mm SL) had diets consisting primarily of algae and organic matter. If preferred prey became less available, the molly miller compensated with other lesser prey options. This study was included because Molly miller have only been studied outside the southeast United States.

***63. Moran, D. 1988. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico) – Red Snapper. U. S. Fish and Wildlife Service Division of Biological Services, Report 82(11.83). U. S. Army Corps of Engineers TR EL-82-4. 19 p.**

The author described the life history and environmental requirements of red snapper, *Lutjanus campechanus*. Red snapper occur from North Carolina to the Florida Keys and around the Gulf of Mexico to the Yucatan. Red snapper were sampled from sand, shelf, and muddy bottom next to reefs in the Gulf of Mexico. Small zooplankton were important prey for fish up to 150 mm FL, but larger prey enter the diet at ~100 mm FL. Shrimp were the main food source of red snapper. This study was included because of the lack of diet data for red snapper in the southeast United States.

***64. Moriniere, E. C. de la, B. J. A. Pollux, I. Nagelkerken, M. A. Hemminga, A. H. L. Huiskes, and G. van der Velde. 2003. Ontogenetic dietary changes of coral reef fishes in the mangrove-seagrass-reef continuum: Stable isotopes and gut-content analysis. Marine Ecology Progress Series 246:279-289.**

The objectives of this study were to compare the feeding habits of several species in a marine bay to the adjacent coral reef; to compare stable isotopes from fish muscle and potential prey; to determine whether the separation of juveniles in nursery habitats from their adult subpopulation on the coral reef can be confirmed from fish diets and stable isotope ratios, and to determine if ontogenetic changes in resource use and trophic level occur in these reef fish species. The study species were french grunt, *Haemulon flavolineatum,* bluestriped grunt, *H. sciurus,* schoolmaster, *Lutjanus apodus,* gray snapper, *L. griseus*, and yellowtail snapper, *Ocyurus chrysurus*, all of which occur along the southeast U. S. coast. French grunt (2-18 cm; n=81), bluestriped grunt (4-29 cm; n=80), schoolmaster (5-28 cm; n=79), gray snapper (6-28 cm; n=22), and yellowtail snapper (3-27 cm; n=76) were sampled from mangrove, seagrass bay, and coral reef habitat in Spanish Water Bay, Curacao, Netherlands Antilles by seine, Antillean fish trap, and rotenone. Data were reported as average percent volume. The ranking of ^{13}C isotopes was seagrass, algae, and mangrove leaves. Primary producers were lower in ^{15}N than zooplankton and invertebrates. Bay individuals were richer in ^{13}C than were the reef individuals. Zoobenthivorous and piscivorous fishes were higher in ^{15}N than herbivores. Haemulids and lutjanids primarily ate decapod crabs and fish. The diet of fish from bay samples shifted from small crustaceans to decapod and fish with increasing size. Overall, carbon isotopes discriminated between biota from the mangrove, seagrass, and coral reef habitats, while higher nitrogen levels indicated higher trophic levels. This study was included because of the lack of diet data for some of these species from the southeast United States.

***65. Motta, P. J., K. B. Clifton, P. Hernandez, B. T. Eggold, S. D. Giordano, and R. Wilcox. 1995. Feeding relationships among nine species of seagrass fishes of Tampa Bay, Florida. Bulletin of Marine Science 56:185-200.**

The objectives of this study were to examine the diet, dietary diversity, and dietary overlap of nine seagrass residents and discuss their use of seagrass as foraging habitat. Each of the nine species was found in the southeast United States and northern Gulf of Mexico. Striped burrfish, *Chilomycterus schoepfi* (119-210 mm SL; n=30); goldspotted killifish, *Floridichthys carpio* (46-87 mm SL; n=30); pinfish, *Lagodon rhomboides* (123-159 mm SL; n=30); silver jenny, *Eucinostomus gula* (64-89 mm SL; n=30); longnose killifish, *Fundulus similis* (73-114 mm SL; n=30); scaled sardine, *Harengula jaguana* (82-122 mm SL; n=30); Gulf pipefish, *Syngnathus scovelli* (91-149 mm SL; n=30); striped anchovy, *Anchoa hepsetus* (86-100 mm SL; n=30); and hardhead catfish, *Arius felis* (280-377 mm SL; n=30), were sampled from seagrass beds in Boca Ciega Bay, Florida, by beach seine, monofilament gill net, and otter trawl. Data were reported as percent number, percent wet weight, percent guts containing taxa, index of relative importance, diversity, and Horn's index of niche overlap. Goldspotted killifish, scaled sardine, and striped anchovy had similar diets (overlap values between 0.735 and 0.796) due to the high abundance of copepods in the stomach of each species. Goldspotted killifish also ate ostracods, eggs, gastropods, and amphipods. The diet of scaled sardine also included cypris larvae, cladocerans, trematodes, amphipods, bivalves, and eggs. Striped anchovy consumed bivalves and shrimp, but copepods were of much greater importance in their diet. These three species had the most diverse diets of the species examined (H'=1.55-1.87). Striped burrfish, longnose killifish, and silver jenny also had similar diets; although, with less diet overlap than the previous group (values between 0.333 and 0.490). Striped burrfish primarily consumed gastropods, but also ate bivalves, barnacles, and crabs. Longnose killifish predominantly ate bivalves. Silver jenny ate polychaetes, bivalves, cumaceans, amphipods, and gastropods. Differences in the most abundant prey species for each predator species resulted in lower overlap values. The diets of hardhead catfish, Gulf pipefish, and pinfish differed from one another and from all other species (overlap values ranged from 0.006-0.287). Hardhead catfish ate crabs, tunicates, and fish. Gulf pipefish primarily ate amphipods, and secondarily ate shrimp and cypris larvae. Pinfish ate algae and tunicates. This study was included due to the lack of diet data for some of these species from the southeast United States.

***66. Mullaney, M. D., Jr. and L. D. Gale. 1996. Ecomorphological relationship in ontogeny: Anatomy and diet in Gag, *Mycteroperca microlepis*. Copeia 1996:167-180.**

The objectives of this study were to describe the ontogenetic shifts in the diet of gag, *Mycteroperca microlepis,* and the degree of association between shifts in food habits to shifts in feeding morphology, including gill raker, mouth size, and dental ontogeny. Gag occur along most of the east coast of the U. S. and the entire Gulf of Mexico to Brazil, but are absent from the West Indies. Larval and juvenile gag (10-157 mm SL; n=200) were sampled from the estuary and oyster beds of Charleston Harbor, South Carolina, by otter trawl and open-topped habitat trays. Data were reported as percent volume, percent number, percent occurrence, and index of relative importance. Fish < 20 mm ate neritic calanoid copepods and gammaridean amphipods. Gag shift from planktivory to epibenthic predation (decapods and fish) at around the time of settlement and transformation. Prey size increased as the mouth size of gag increased. As fish settle and transform, the size and type of prey shifts, teeth morphology changes, and gill

rakers number and length decreases. There was also an ontogenetic shift in the mode of tooth attachment. These changes may be correlated to a shift from planktivory to piscivory.

***67. Naughton, S. P. and C. H. Saloman. 1981. Stomach contents of juveniles of king mackerel (*Scomberomorus cavalla*) and Spanish mackerel (*S. maculatus*). Northeast Gulf Science 5:71-74.**

The objectives of this study were to determine common prey of juvenile king mackerel, *Scomberomorus cavalla,* and Spanish mackerel, *S. maculatus,* and to compare these data to published data on larger individuals. These species occur all along the eastern U. S. coast (though Spanish mackerel are rare north of Chesapeake Bay) and in the Gulf of Mexico. King mackerel (117-432 mm FL; n=139) and Spanish mackerel (103-309 mm FL; n=244) were sampled from the pelagic environment near Cape Canaveral, Florida, and Galveston Bay, Texas, by trawl. Data were reported as relative frequency and percent volume. King and Spanish mackerels ate mostly fish (squid were present but not dominant). The diet of Spanish mackerel differed between regions (Cape Canaveral versus Galveston Bay). Larger mackerel from other studies principally ate clupeids. Juveniles from this study mostly ate *Anchoa* spp. (which were smaller than the clupeids eaten by larger fish).

***68. Naughton, S. P. and C. H. Saloman. 1984. Food of bluefish (*Pomatomus saltatrix*) from the U.S. south Atlantic and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFC-150. 37 p.**

The objectives of this study were to examine bluefish, *Pomatomus saltatrix,* diet from the southeast U. S. and Gulf of Mexico and to examine the differences in area, size of bluefish, and season. Bluefish occur from Nova Scotia south along the U. S. east coast and Bermuda to Argentina, but are rare or absent between south Florida and northern South America. Bluefish (0-999 mm FL; n=1549 with food of 4841 collected) were sampled from the North Carolina, South Carolina, Florida, and Louisiana shelves by the recreational hook and line fishery. Data were reported as percent frequency of occurrence and percent volume. Bluefish primarily ate fish, some crabs, shrimp, squid, gastropods, and seagrass (importance of which varied by area). Food of bluefish varied by area; Gulf of Mexico bluefish consumed a greater diversity of fish and were more general in prey selection than southeast Atlantic bluefish. Within and among areas, the prey eaten varied with size of predator. Small fish (0-399 mm FL) ate more invertebrates than large fish (600-999 mm FL). Small bluefish outnumbered medium (400-599 mm FL) and large fish, except in Louisiana where medium bluefish dominated. The dominant fish and invertebrate prey changed with season, but there were only minor changes in prey among years. Bluefish ate mostly schooling prey. Cannibalism has only been seen from South Carolina north (this study and others). Bluefish may not be strictly pelagic predators as sand has been found in guts of fish in the Gulf of Mexico. Seasonal, area, and yearly variation in diet may be due to local abundance, seasonal availability of prey, and changes in prey selection with predator size.

***69. Odum, W. E. and E. J. Heald. 1972. Trophic analyses of an estuarine mangrove community. Bulletin of Marine Science 22:671-738.**

The objectives of this study were to summarize the food habits of fish and invertebrates from the North River mangrove system and to estimate the relative importance of each species based on abundance data. Thirty-nine of the forty-three fish species discussed occur in the

southeast United States. Tarpon, *Megalops atlantica* (16-273 mm SL collected in previous studies); ladyfish, *Elops saurus* (19-38 mm and 223-346 mm; n=14 with food of 34 collected); scaled sardine, *Harengula pensacolae* (16-96 mm SL; n=54 with food of 67 collected); bay anchovy *Anchoa mitchelli* (<25-62 mm SL; n=44); inshore lizardfish, *Synodus foetens* (112 mm and 189 mm plus data from previous studies; n=0 with food of 2 collected); sea catfish, *Arius felis* (52-331 mm SL; n=76); gafftopsail catfish, *Bagre marinus* (262-445 mm; n=5 with food of 8 collected); American eel, *Anguilla rostrata* (181-472 mm SL; n=4 with food of 12 collected); marsh killifish, *Fundulus confluentus* (n=16); Gulf killifish, *Fundulus grandis* (29-68 mm SL; n=27); sheepshead minnow, *Cyprinodon variegatus* (10-53 mm SL; n=44); goldspotted killifish, *Floridichthys carpio* (14-59 mm SL; n=81); rainwater killifish, *Lucania parva* (< 20 mm-37 mm SL; n=122); sailfin molly, *Poecilia latipinna* (29-54 mm; n=224); snook, *Centropomus undecimalis* (< 56 mm, < 100 mm, 230-851 mm from previous studies); jewfish, *Epinephelus itajara* (191 mm and 232 mm, plus data from previous studies; n=2); gray snapper, *Lutjanus griseus* (95-254 mm SL; n=96 with food of 112 collected); crevelle jack, *Caranx hippos* (147-241 mm SL; n=6 with food of 22 collected); leatherjacket, *Oligoplites saurus* (29 mm, plus data from previous studies; n=1 with food of 24 collected); silver jenny, *Eucinostomus gula* (19-70 mm SL; n=112); spotfin mojarra, *Eucinostomus argenteus* (9-63 mm SL; n=113 with food of 135 collected); striped mojarra, *Diapterus plumieri* (35-172 mm SL; n=12 with food of 14 collected); red drum, *Sciaenops ocellatus* (6-403 mm SL; n=56); spotted seatrout, *Cynoscion nebulosus* (68-382 mm SL; n=32 with food of 35 collected); silver perch, *Bairdiella chrysura* (9-17 mm SL and 127-181 mm SL; n=48); pinfish, *Lagodon rhomboides* (39-61 mm SL; n=12); sheepshead, *Archosargus probatocephalus* (48-267 mm SL; n=114 with food of 121 collected); crested goby, *Lophogobius cyprinoides* (24-73 mm SL; n=154 with food of 174 collected); code goby, *Gobiosoma robustum* (7-35 mm SL; n=72); clown goby, *Microgobius gulosus* (18-32 mm SL; n=18); frillfin goby, *Bathygobius soporator* (38-86 mm SL; n=6 with food of 11 collected); great barracuda, *Sphyraena barracuda* (135-369 mm SL; n=6); striped mullet, *Mugil cephalus* (data from previous study); inland silversides, *Menidia beryllina* (12-65 mm SL; n=144 with food of 351 collected); hogchoker, *Trinectes maculatus* (14-110 mm SL; n=2 with food of 8 collected); lined sole, *Achirus lineatus* (32-74 mm SL; n=2 with food of 6 collected); skilletfish, *Gobiesox strumosus* (10-32 mm SL; n=18); Gulf toadfish, *Opsanus beta* (18-135 mm SL; n=12), were sampled from the North River, Florida, mangrove system by bag seines, throw nets, dip nets, lift nets, various traps and pound nets, trammel nets, set lines, hook and line, fish poisons, roller beam trawl, standard plankton nets, Van Veen grabs, and an Ockelman dredge. Data were reported as percent composition. Food of tarpon was not determined in this study. In previous studies, tarpon were planktivores, mostly eating cyclopoid copepods at small sizes (16-45 mm SL). At larger sizes (19-273 mm SL), tarpon were carnivorous, mainly consuming *Gambusia*, ostracods, *Palaemonetes*, *Fundulus heteroclitus*, and *Mugil cephalus*. Small ladyfish (19-38 mm) ate copepods and crab zoea. Larger ladyfish, 223-346 mm, ate caridean shrimp and small fish (*Poecilia latipinna*, *Eucinostomus gula*, *Menidia beryllina*, and *Anchoa hepsetus*). Scaled sardine (16-30 mm SL) consumed planktonic copepods, zoeae, nauplii, and a few fish larvae; larger fish (64-96 mm) ate amphipods. Small bay anchovy (< 25 mm SL) ate microzooplankton (copepods, copepodites, nauplii). Larger anchovies (31-62 mm SL) ate mysids, amphipods, harpacticoid copepods, isopods, chironomid larvae. Zooplankton is scarce in this system which may explain the reliance on benthic organisms; most other studies showed bay anchovy as zooplankton feeders. Only two inshore lizardfish were collected for this study and both had empty guts. Previous studies have shown inshore lizardfish to eat small fish, crabs, shrimp, and

worms. Small sea catfish (52-74 mm SL) ate amphipods, mysids, chironomid larvae, isopods, and small crabs. Larger catfish (205-331 mm SL) ate *Rhithropanopeus harrisii*, amphipods, mysids, and fishes. Gafftopsail catfish ate small *Callinectes sapidus* (40-50 mm carapace width) and unidentified fish. American eel appear to be nocturnal feeders, which eat *Rhithropanopeus harrisii*, *Palaemonetes intermedius*, *Alpheus heterochaelis*, and *Lophogobius cyprinoides*. Marsh killifish ate chironomid larvae and amphipods. Gulf killifish (29-45 mm) ate amphipods, isopods, small specimens of *Rhithropanopeus harrisii* (2-4 mm CW), chironomid larvae, terrestrial insects, small snails, and filamentous algae. Larger killifish (> 45 mm) ate fishes, larger specimens of *R. harrisii* (up to 12 mm CW), and *Gambusia affinis*. Sheepshead minnow (15-53 mm) ate detritus and algae. However, smaller fish (10-15 mm) ate a few harpacticoid copepods and small amphipods. Goldspotted killifish primarily ate detritus (21%), small amphipods (18%), and unrecognizable material (17%). Small rainwater killifish (< 20 mm) ate planktonic copepods. Rainwater killifish, 21-37 mm, ate amphipods, chironomid larvae, mysids, ostracods. Sailfin molly mostly ate vascular plant detritus (conglomerates and root material), unrecognizable particles, and inorganic particles. Food of snook was not determined in this study; however, in previous studies, small snook (<56 mm) ate small crustaceans. Juveniles ate fish (*Gambusia*) and caridean shrimp. Adults (230-851 mm) ate *Eucinostomus* sp., *Mugil cephalus*, *Lagodon rhomboides*, *Anchoa* spp., *Poecilia latimpinna*, *Menidia beryllina*, and *Gambusia affinis*, caridean and penaeid shrimp, crabs, and crayfish. Jewfish ate *Penaeus duorarum* and *Rhithropanopeus harrisii*. Gray snapper ate fishes (*Lophogobius cyprinoides*, *Microgobius gulosus*, *Anchoa hepsetus*, *A. mitchilli*, *Gambusia affinis*, *Poecilia latipinna*, *Fundulus grandis*, and *Anguilla rostrata*) during the day. *Rhithropanopeus harrisii*, *Alpheus heterochaelis*, and *Palaemonetes* sp. were also common prey. During the night, gray snapper ate crustaceans (*Rhithropanopeus harrisii* and *Alpheus heterchaelis*) and some fishes. Crevelle jack ate penaeid shrimp, but the authors regard these data as inconclusive (only six fish contained food and all were captured in traps). Only one leatherjacket was collected with food. This specimen contained larval fish (5 mm) and three young *Palaemonetes* sp. These results are similar to other studies, which found *Alpheus heterochaelis*, *Penaeus duorarum*, and larval fishes as common prey. During the dry season (January to May), silver jenny primarily ate harpacticoid copepods and amphipods. During the wet season (June to December), copepods were replaced by chironomid larvae. In contrast to most previous work on the biology of spotfin mojarra and silver jenny, the diet and habitat of the two species were identical. Small *Eucinostomus* sp. (probably spotfin mojarra) ate planktonic organisms (larval copepods, nauplii, and zoeae) at the smallest sizes (9-13 mm) and ate more small amphipods and chironomid larvae at slightly larger sizes (16-19 mm). Larger fish (19-63 mm), ate amphipods and harpacticoid copepods during the dry season and chironomid larvae and amphipods during the wet season. There was no difference in diet among size groups of striped mojarra, which primarily ate mysids and amphipods. Larval red drum (6-8 mm) ate copepods (*Acartia* sp.). At 10 mm, red drum began eating more crab zoeae and other larval fish. Fish 34-42 mm ate mysids, amphipods, and *Palaemonetes intermedius*. Adults (308-403 mm) ate *Rhithropanopeus harrisii* and some chironomids and mangrove bark. Spotted seatrout ate *Anchoa mitchilli*, *Eucinostomus gula*, and caridean shrimp. Juveniles (68-112 mm) from a near by bay contained mysids, amphipods, chironomid larvae, carideans, and small fishes. Larval silver perch (9-17 mm) ate copepods and larval fish. Larger fish (127-181 mm) ate *Anchoa mitchilli* and mysids. Pinfish ate animal prey only (*Brachiodontes exustus*, mysids, amphipods, and *Congeria leucophaeata*); however, fish from a nearby bay also contained some algae and vascular plants, crustaceans, and

mollusks. During the dry season, sheepshead mainly ate *Brachidontes exustus* and hydrozoans. During the wet season, sheepshead ate *Congeria leucophaeata*, *Brachidontes exustus*, and *Rhithropanopeus harrisii*. Crested gobies had a very diverse diet that consisted mainly of amphipods and plant detritus (leaf parenchyma, root material, bark). Crested gobies over 60 mm ate more small crabs and caridean shrimp than smaller individuals. Small code goby (7-15 mm) ate harpacticoid copepods, juvenile mysids, cumaceans, and pennate diatoms. Larger code goby (15-35 mm) primarily ate amphipods (42%). The only seasonal pattern in code goby was the occurrence of cladocerans and chironomid larvae between August and December and the occurrence of cumaceans during December to August. The diet of clown gobies was similar to that of code gobies: amphipods, harpacticoid copepods, chironomid larvae, and cumaceans. Frillfin gobies were only collected during the dry season and consumed *Palaemonetes intermedius*, chironomids, and amphipods. Great barracuda were not considered important to the trophic structure of the North River system, but the six collected primarily ate fish (*Eucinostomus gula*, *Menidia berryllina*, and *Archosargus probatocephalus*). Striped mullet were studied in a similar Florida system and consumed benthic diatoms, filamentous algae, vascular plant detritus, and inorganic sediment particles. Small inland silversides (12-16 mm) fed during the day on planktonic copepod stages, some crustacean larvae, and eggs. The diet of larger fish (31-65 mm) differed between day and night. In the dry season, inland silversides ate terrestrial insects and harpacticoid copepods during the day, and ate amphipods and mysids at night. During the wet season, fish ate chrionomid larvae and terrestrial insects during the day, and ate mysids, amphihpods, and chironomid larvae at night. Only two specimens each of hogchoker and lined sole were collected with food in their stomachs. Both species ate amphipods, mysids, chironomid larvae, *Nereis pelagica*, and foraminifera. The skilletfish ate amphipods, isopods, and chironomid larvae. Small gulf toadfish (18-60 mm) ate amphipods, chironomid larvae, mysids, isopods, and fishes. Larger toadfish (60-135 mm) ate *Palaemonetes* sp., *Rhithropanopeus harrisii*, *Alpheus heterochaelis*, mussels, fish remains, and mangrove bark.

***70. Overstreet, R. M. and R. W. Heard. 1978. Food of the red drum, *Sciaenops ocellatus*, from Mississippi Sound. Gulf Research Reports 6:131-135.**

The authors described the diet of red drum, *Sciaenops ocellatus*, which occur from Massachusetts to northern Mexico including south Florida. Red drum (190-780 mm SL; n= 107) were sampled from areas near barrier islands and in open water adjacent to marsh grass in Mississippi and Sapelo Island, Georgia, by hook and line and gill net. Data were reported as percent occurrence. Red drum ate more fish and larger crustaceans at larger sizes. Polychaetes and echinoderms also were important prey. Red drum from this study ate more species of decapods than previously reported. Similar results were found in the fish collected from Sapelo Island and Mississippi Sound, but Sapelo Island fish preyed more on echinoderms and were generally larger (430-1020 mm).

***71. Overstreet, R. M. and R. W. Heard. 1982. Food contents of six commercial fishes from Mississippi Sound. Gulf Research Reports 7:137-149.**

The objective of this study was to describe the diet of six fish (five from the southeast U. S.) in Mississippi Sound. Spotted seatrout, *Cynoscion nebulosus*, silver seatrout, *C. nothus*, black drum, *Pogonias cromis*, sheepshead, *Archosargus probatocephalus*, and southern flounder, *Paralichthys lethostigma,* occur in the southeast U.S. Spotted seatrout (73-532 mm SL; n=340 with food of 373 collected), silver seatrout (197-324 mm SL; n=12 with food of 25 collected),

black drum (n=15), sheepshead (145-449 mm SL; n=125 with food of 142 collected), and southern flounder (125-410 mm SL; n=97 with food of 212 collected) were sampled from the Mississippi Sound by trammel nets, trawl, and hook and line. Data were reported as percent occurrence. The diet varied by species of fish, length of fish, season, specific location, and abundance of prey. Silver seatrout and spotted seatrout had similar diets, consisting mostly of penaeid shrimps, *Anchoa mitchilli*, and *Brevoortia patronus*. Due to the low numbers of black drum collected, it is difficult to say what prey items dominated the diet of black drum; however, crustaceans were the most common prey taxa among the 15 fish caught. Sheepshead had the most diverse diet (113 species) consisting primarily of molluscs and plants in smaller fish (145-350 mm SL) and crustaceans, polychaetes, molluscs, and fishes in larger fish (353-449 mm SL). The proximity to barrier islands influenced the diet of sheepshead as a greater diversity of prey were consumed by fish collected near barrier islands than in estuaries. Southern flounder primarily ate fishes (*Anchoa mitchilli*) and penaeid shrimps, with only minor shift in frequency of ingestion throughout the year. This study was included because of the limited data for some species from studies conducted in the southeast United States.

***72. Pike, L.A. and D. G. Lindquist. 1994. Feeding ecology of spottail pinfish (*Diplodus holbrooki*) from an artificial and natural reef in Onslow Bay, North Carolina. Bulletin of Marine Science 55:363-374.**

The objective of this study was to describe the diet of spottail pinfish, *Diplodus holbrooki,* between natural and artificial reefs and to determine if diet changes with size or season. Spottail pinfish are found from Chesapeake Bay to northern Florida, and from the Florida Keys to the northwest Gulf of Mexico. Spottail pinfish (60-160 mm SL; n=96) were sampled from the natural and artificial reefs in Onslow Bay, North Carolina by SCUBA. Spottail pinfish ate planktonic invertebrates in spring and ate algae and attached invertebrates in summer and fall. Individuals 60-110 mm ate more benthic prey than larger fish (111-160 mm SL). The differences between natural and artificial reefs were minimal.

***73. Pitts, P. A. 1991. Comparative use of food and space by three Bahamian butterflyfishes. Bulletin of Marine Science 48:749-756.**

The objectives of this study were to compare the use of space and diet (at a local scale) by three species of Chaetodontidae. Foureye butterflyfish, *Chaetodon capistratus*, banded butterflyfish, *C. striatus*, and spotfin butterflyfish, *C. ocellatus,* all occur along most of the east coast of the U. S. and northern Gulf of Mexico to Brazil. Foureye butterflyfish (mean SL=92 mm; n=33), banded butterflyfish (mean SL=121.7 mm; n=31), and spotfin butterflyfish (mean SL=136.3 mm; n=31) were sampled from reef habitat near Grand Bahama Island by pole spearing. Data were reported as percent frequency of occurrence, percent dry weight, and rank index. Foureye butterflyfish were predominantly found on the reef crest and least on the patch reef. Banded butterflyfish were found in highest abundance on the reef crest, but the patch reef was frequently used. Spotfin butterflyfish were found in the annularis zone of the reef face. Thus, foureye and banded butterflyfish used similar habitats, which differed from the habitat of spotfin butterflyfish. There was considerable overlap in diet among the three species, but banded and spotfin butterflyfish fed selectively on coral polyps and sabellid and terebellid polychaetes, while foureye butterflyfish fed on coral polyps and gorgonian polyps almost exclusively. Therefore, evidence suggests resource partitioning among these three species of butterfly fish. This study was included due to the lack of diet studies from the southeast United States.

74. Poole, J. C. 1964. Feeding habits of the summer flounder in Great South Bay. New York Fish and Game Journal 11:28-34.

The objective of this study was to examine the hypothesis that a change in the feeding behavior if summer flounder, *Paralichthys dentatus,* causes the reduced late summer catch by commercial and sport fishermen by comparing feeding habits with catch statistics of the sport fishery. Summer flounder occur throughout the east coast of the U. S. from Maine to northern Florida. Summer flounder (20-70 cm; 1-3 years old; n=1210) were sampled from waters in Great South Bay, New York, by fishery independent trawling. Data were reported as number, weight, percent number, and percent weight. Summer flounder were carnivorous, feeding primarily on sand shrimp (*Cragon septemspinosa*) and winter flounder (*Pseudopleuronectes americanus).* Feeding did not fluctuate throughout the season, but catch rates and catch per unit effort did. Thus, feeding behavior is not likely a controlling factor in flounder catch rates. This study was included to complement data on the diet of summer flounder from the southeast United States.

***75. Powell, A. B. and F. J. Schwartz. 1979. Food of *Paralichthys dentatus* and *P. lethostigma* (Pisces: Bothidae) in North Carolina estuaries. Estuaries 2:276-279.**

The objectives of this study were to compare the diets of two flounder species and to examine ontogenetic and seasonal trends in the prey. Summer flounder, *Paralichthys dentatus,* and southern flounder, *P. lethostigma,* both occur along the southeast U. S. coast, but are absent from south Florida. Summer flounder extend farther north (Maine to north Florida) and Southern flounder extend farther south (to Texas). Summer flounder (100-200 mm TL; n=353 with food of 564 collected) and southern flounder (100-200 mm TL; n=234 with food of 440 collected) were sampled from the Pamlico Sound estuary by otter trawl. Data were reported as percent occurrence and volume. Southern flounder stomachs primarily contained fish (followed by mysids). Summer flounder stomachs contained mysids (followed by fish); although, southern flounder occur in areas with higher concentrations of *Neomysis americana* than summer flounder. Juveniles of both species ate less in winter and food consumption increased with increasing temperature.

***76. Richards, S. W., J. M. Mann, and J. A. Walker. 1979. Comparison of spawning seasons, age, growth rates, and food of two sympatric species of searobins, *Prionotus carolinus* and *Prionotus evolans*, from Long Island Sound. Estuaries 2:255-268.**

The objectives of this study were to describe the seasonal abundance, spawning, age, growth, and food of two species of searobin. Northern searobin, *Prionotus carolinus,* and striped searobin, *P. evolans,* both occur along the U. S. east coast from Nova Scotia to Florida, though striped searobin are rare north of Cape Cod, Massachusetts. Northern searobin (3-40 cm; n=960) and striped searobin (3-40 cm; n=791) were sampled from Long Island Sound by trawls, seines, and gill nets. Data were reported as number and percent number. The abundance of both species increased from May to June. The spawning season was June, July, and early August. By the end of the first growing season, striped searobin were slightly longer and obviously heavier than the northern searobin. Both species principally ate crustaceans (amphipods, *Crangon septemspinosus*, *Neomysis americana*). The two species may be able to cohabitate in a similar niche by partitioning food based on size. Striped searobin grew faster and consumed larger prey (primarily *Crangon septemspinosus* and other crabs) while northern searobin were smaller and

consumed smaller sized prey (primarily amphipods). This study was included because no diet studies of northern searobin have been conducted in the southeast United States.

***77. Roelofs, E. W. 1954. Food studies of young sciaenid fishes, *Micropogon undulatus* and *Leiostomus xanthurus* from North Carolina. Copeia 1954:151-153.**

The objectives of this study were to describe the diet of young spot, *Leiostomus xanthurus,* and croaker, *Micropogonias undulatus,* and examine direct predation of these two species on commercially important shrimp species. Croaker and spot occur along the entire east coast of the U. S. from Massachusetts south through the northern Gulf of Mexico. Spot (63.5-153 mm; n=73) and croaker (63.5-153 mm; n=159) were sampled from North Carolina estuaries. Data were reported as percent of fish in which prey items were found. Factors other than availability resulted in differences in the diet of the two species. Croaker ate more infaunal prey organisms (annelids); spot ate more epifaunal organisms (copepods). The gill arches of the spot were much more efficient straining mechanisms, which may explain the difference in diet. Locality, season, and fish size did not make a difference. No commercial shrimp species were found in the stomachs of the fish examined.

78. Rooker, J. R. 1995. Feeding ecology of the schoolmaster snapper, *Lutjanus apodus* (Walbaum), from southwestern Puerto Rico. Bulletin of Marine Science 56:881-894.

The author described the diet, ontogenetic patterns in feeding, and importance of diel feeding periodicity, habitat, and season of the schoolmaster snapper, *Lutjanus apodus*. Schoolmaster snapper occur along the east coast of the United States and the northern Gulf of Mexico to Brazil. Schoolmaster (39-345 mm FL; n=449) were sampled from mangroves (shoreline and mangrove key) and coral reefs (inshore shallow, inshore moderate, and offshore moderate to shelf edge) using spears. Data were reported as percent composition by weight, percent composition by number, percent frequency, and index of relative importance. Smaller fish ($\leq$ 70 mm) were more common in mangroves; larger fish (> 70 mm) were more common in reefs. The shift from mangrove to reef occurred gradually in the 100-190 mm size range. The majority of the diet was made up of amphipods, crabs, fishes, shrimp, and stomatopods with some shift with size. Gape height and width increased with increased fish size, maybe playing a role in the ontogenetic shift in prey. There were some differences in prey consumption among the five different habitats sampled. Piscivory was highest in the mangrove key and coral reef habitats. Consumption of shrimp was higher in shallow reefs than elsewhere. Seasonal differences in diet were also found in the larger size classes. During late summer, fall, and winter, fish were the dominant prey taxa. During spring and summer, crab and stomatopod increased. The author observed an ontogenetic shift in feeding time with small fish feeding around midday and larger fish feeding continuously, with peak activity during crepuscular and night periods.

***79. Rose, C. D. and Hassler, W. W. 1974. Food habits and sex ratios of dolphin, *Coryphaena hippurus*, captured in the western Atlantic Ocean off Hatteras, North Carolina. Transactions of the American Fisheries Society 103:94-100.**

The authors described the food habits and sex ratios of dolphin, *Coryphaena hippurus,* and examined interrelationships among size, trophic requirements, schooling behavior, and sex ratios. Dolphin occur from Nova Scotia to southeast Brazil and are worldwide in tropical waters. Dolphin (450-1275 mm; n=396) were sampled from the open shelf water and tide line off the

coast of Hatteras, North Carolina, by the recreational hook and line fishery. Data were reported as frequency of occurrence, abundance, weight, and percent weight. Prey size and predator size were positively correlated. Most fish (61%) > 800 mm were males. Most small fish (450-600 mm) were females and were found along tide lines. Currently, no data to address the hypothesis that dolphin are nonselective feeders is available. The authors observed cannibalism of adults on young-of-year. The tide-line was important to young and small female fish both nutritionally, by feeding on the fauna associated with sargassum, and for protection provided by the sargassum. During 1963 few tide lines were encountered and the occurrence of females with empty guts increased. Male fish, which grow faster, likely have a more voracious appetite than females and leave the tide-line in search of larger prey. Hence, the abundance of young and female fish in the tide line (with sargassum) and abundance of males in the large fish populations in the open ocean.

80. Ross, J. L. 1982. Feeding habits of the gray tilefish, *Caulolatilus microps* (Goode and Bean, 1887) from North Carolina and South Carolina waters. Bulletin of Marine Science 32:448-454.

The objectives of this study were to discuss the diet of gray tilefish, *Caulolatilus microps,* and describe the relationship with the shelf edge demersal fish community. Gray tilefish occur from North Carolina to south Florida and the Gulf of Mexico. Gray tilefish (400-780 mm TL; n=92) were sampled from the North and South Carolina shelf, 70-236 m deep water, by fishery dependent and independent hook and line fishing. Data were reported as percent frequency and percent volume. Gray tilefish selected for larger prey as the fish grew. Gray tilefish fed on slow-moving benthic items, but also consumed more motile items such as juvenile *Centropristis* spp., *Leptochela bermudensis*, and portunid crabs. Although a reef-associated species, gray tilefish were collected over diverse bottom types. However, gray tilefish were restricted to a narrow belt of warm Florida current water off the southeastern United States.

***81. Ross, J. L., J. S. Pavela, and M. E. Chittenden, Jr. 1989. Food habits of the rock sea bass, *Centropristis philadelphica*, in the western Gulf of Mexico. Northeast Gulf Science 10:139-152.**

The objectives of this study were to describe the diet of rock sea bass, *Centropristis philadelphica,* and to examine ontogenetic, diurnal, seasonal, and bathymetric variations in their diet. Rock sea bass occur along the east coast of the U. S. from North Carolina to Florida and in the northern Gulf of Mexico. Rock sea bass (< 75-224 mm SL; age 0-IV; n=1200) were sampled from inshore and offshore pelagic environments over mud and sand in the Gulf of Texas by shrimp trawlers. Data were reported as percent frequency, percent number, and percent volume. Small fish (< 75 mm) ate mysids, natantian decapods, and shrimp. Medium sized fish (75-149 mm) ate more brachyurans and fewer mysids, but otherwise their diets were similar. Large fish (150-224 mm) mostly ate crabs. Fish also were important to the diet, and consumption shifted from larval to larger fish with size. Shrimp were important at all sizes. Rock sea bass ate during the day and night; although, at night they seemed to shift to larger but fewer prey. The importance of individual taxa was different between inshore and offshore fish. Shrimp and mysids were eaten inshore; sicyonids were more important offshore. This study was included due to the low sample size for this species in other studies from the southeast United States.

***82. Ross, S. T. 1977. Patterns of resource partitioning in sea robins (Pisces: Triglidae). Copeia 1977:561-571.**

The objective of this paper was to examine resource partitioning of eight species of Triglidae by location, time, prey size, and prey type. Bighead searobin, *Prionotus tribulus* (adults; n=13); leopard searobin, *P. scitulus* (adult; n=35); bandtail searobin, *P. ophryas* (n=33); bluespotted searobin, *P. roseus* (n=238); spiny searobin, *P. alatus* (n=78); barred searobin, *P. martis* (n=27); blackwing searobin, *P. salmonicolor* (n=84); and horned searobin, *Bellator militaris* (n=183), were sampled from demersal shelf habitat of the west Florida shelf by trawl. Data were reported as percent occurrence, number, and percent volume. The basic mouth shape of each species was similar; thus, it was believed that the difference in food use was related to location of the sea robins, type or size of prey, or diel period of feeding. In summary, triglids segregated by location: offshore or inshore. In areas where they overlapped, the triglids partitioned food based on prey size. The scitulus group (*P. scitulus, B. militaris, P. martis*, and *P. roseus*) typically ate prey individuals under 10 mm. The tribulus groups (*P. tribulus, P. alatus, P. ophryas*, and *P. salmonicolor*) ate prey individuals larger than 10 mm. Both groups relied heavily on small crustaceans, polychaetes, and lancelets. Time of day was not a factor. This is a common pattern. This study was included because each of these species occurs in the southeast United States, but food habits have not been studied there.

***83. Ross, S. T. 1978. Trophic ontogeny of the leopard searobin, *Prionotus scitulus* (Pisces: Triglidae). Fishery Bulletin 76:225-234.**

The objectives of this study were to describe the ontogenetic changes in prey use for leopard searobin, *Prionotus scitulus,* in relation to morphology and development of jaw size, intestinal length, growth, reproduction, and distribution. Leopard searobin occur from Virginia to south Florida and in the north and east Gulf of Mexico. Leopard searobin (21-140 mm; n=469) were sampled from the Tampa Bay estuary and the mouth of the estuary (5-7 m depth) by trawl. Data were reported as number, percent number, volume, and percent volume. Juveniles (< 90 mm) ate planktonic and epifaunal prey (crustacean larvae, cumaceans, copepods, mysids, and gammarid amphipods). Adults (> 90 mm) ate infaunal prey (lancelets and polychaetes). Consumption increased with fish growth, initially through a rapid rise in the number of small prey consumed then switching, at 90 mm, to fewer, larger prey. This shift was not biased by seasonal availability and was preceded by rapid growth of the jaw and intestine. In addition, the shift was to larger prey types, and only rarely did fish select for larger individuals of a single prey taxon. This study was included due to the lack of diet data from the southeast United States.

***84. Ross, S. T. 1983. Memoirs of the *Hourglass* cruises. Searobins (Pisces: Triglidae). Marine Research Laboratory, Florida Department of Natural Resources, St. Petersburg, Florida. Volume 6:1-76.**

The author described the abundance, food habits, maturation, spawning, and growth of eight species of Triglidae. Each species occurs along the southeast U. S. Leopard searobin, *Prionotus scitulus* (75-175 mm; n=75); bighead searobin, *P. tribulus* (> 100 mm; n=13); barred searobin, *P. martis* (45-165 mm; n=28); bandtail searobin, *P. ophryas* (65-185 mm; n=27); bluespotted searobin, *P. roseus* (60-190 mm; n=141); blackwing searobin, *P. salmonicolor* (155-195 mm; n=22); spiny searobin, *P. alatus* (45-155 mm; n=20); and horned searobin, *Bellator militaris* (25-105mm; n=54), were sampled from the west Florida shelf from Tampa to Fort

Myers. All fish primarily consumed crustaceans (brachyurans, gammerid amphipods, natantians, mysids), but showed ontogenetic changes in diet. Feeding time varied from mornings to diurnal. This study was included due to the lack of diet data for triglids in the southeast United States.

***85. Ross, S. W. 1989. Diet of the banded drum in North Carolina. Transactions of the American Fisheries Society 118:680-686.**

The author described the diet of banded drum, *Larimus fasciatus*. Banded drum occur from Massachusetts to Texas except for southern Florida. Banded drum (19-182 mm SL; n=1024) were sampled from the North Carolina coast by trawl. Banded drum mostly ate crustaceans (mysids, calanoid copepods, sergestids). Larger fish (> 140 mm SL) ate larger prey, such as *Acetes americanus*. Smaller fish (< 140 mm SL) primarily consumed *Neomysis americana*. Banded drum ate more during summer and fall, and less during winter and spring. Banded drum fed in the water column on plankton at low light levels.

***86. Ross, S. W. and M. L. Moser. 1995. Life history of juvenile gag, *Mycteroperca microlepis*, in North Carolina estuaries. Bulletin of Marine Science 56:222-237.**

The objective of this study was to describe the life history of juvenile gag, *Mycteroperca microlepis,* including diet. Gag grouper occur along the east coast of the U. S. south of Massachusetts and in the Gulf of Mexico to Brazil, but are absent from the West Indies. Juvenile gag (n=246) were sampled from North Carolina estuaries and shelf habitats by seining, trawling, and dive surveys. Data were reported as percent volume. Gag use a wide range of habitat during the course of their lives. The authors observed higher food diversity in spring and early summer, least in late summer. In estuaries, the diet was mainly caridean and penaeid shrimp. Larger juvenile gag (> 67 mm) ate carideans, fish, and penaeids. The smallest (< 67 mm SL) gag ate copepods, carideans, and amphipods.

***87. Saloman, C. H. and S. P. Naughton. 1983a. Food of king mackerel, *Scomberomorus cavalla*, from the southeastern United States including the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFC-126. 22 p.**

The authors compared the food of king mackerel, *Scomberomorus cavalla*, among areas, seasons, and sizes. King mackerel (0-1599 mm FL; n=6977) were sampled from the shelf off the coast of North Carolina, South Carolina, Georgia, Florida, Louisiana, and Texas by recreational fishermen and fishery independent gill netting and seining. Data were reported as percent frequency of occurrence and percent volume. Fish, particularly schooling species, were the most important prey type. The important families differed by location. Clupeids were the only family found in all seven sampling location (North Carolina, South Carolina, north Florida, south Florida, west Florida, east Florida, Louisiana, Texas). Fish from the Gulf of Mexico showed seasonal variation in important prey fish family. Small fish (0-999 mm FL) ate more squid and shrimp. Squid, shrimp, and engraulids declined in importance as predator size increased.

***88. Saloman, C. H. and S. P. Naughton. 1983b. Food of Spanish mackerel, *Scomberomorus maculatus*, from the Gulf of Mexico and southeastern seaboard of the United States. NOAA Technical Memorandum NMFS-SEFC-128. 22p.**

The objectives of this paper were to compare the diets of Spanish mackerel, *Scomberomorus maculatus,* among five locations along the southeast United States (2 Atlantic, 3 Gulf of Mexico) and to examine variation in area of capture, size of predator, year, season, and

type of gear. Spanish mackerel (50-749 mm FL; n=2517 with food of 6933 collected) were sampled from the shelf off the coasts of North Carolina, South Carolina, Florida, Louisiana, and Texas by the recreational hook and line, gill net, and beach seine fisheries. Data were reported as percent frequency of occurrence and percent volume. Fish (particularly schooling species) were the most important prey type, but differed by area. *Anchoa* spp., *Sardinella aurita*, and *Chloroscombrus chrysurus* were consumed in all areas. *Anchoa* spp. were more important when predators were small (< 500 mm FL). Crustaceans and mollusks were important in larger mackerel (> 500 mm FL). Dominant prey differed by year. Gear differences due to regurgitation and starvation were more common in nets than with hook and line. Hook and line was more likely to catch fish actively feeding (less time for digestion). The large number of empty stomachs implies quick digestion or regurgitation.

***89. Schmidt, T. W. 1989. Food habits, length-weight relationship and condition factor of young great barracuda, *Sphyraena barracuda* (Walbaum), from Florida Bay, Everglades National Park, Florida. Bulletin of Marine Science 44:163-170.**

The objectives of this study were to describe quantitatively the feeding habits and length-weight relationship and condition factors of great barracuda, *Sphyraena barracuda*. Great barracuda occur from Massachusetts to southeast Brazil and are nearly worldwide in warm waters. Barracuda (juvenile 36-350 mm TL; n=50; adult: 350-441 mm TL; n=6 with food of 13 collected) were sampled from a Florida Bay, Everglades National Park seagrass bed by otter trawl and haul seine. Data were reported as percent number, percent volume, percent frequency, and index of relative importance. While most adults captured had empty stomachs, great barracuda ate fish almost exclusively, particularly Cyprinodontidae. The mean coefficient of condition value was 0.497 with a range of 0.245-1.945, SD = 0.18. There was a clear difference in size of prey between juveniles and adults (adults > 350 mm ate larger prey), but no significant differences among size classes of juvenile. This study was included because of the lack of diet studies on great barracuda in the southeast United States.

***90. Sedberry, G. R. 1985. Food and feeding of the tomtate, *Haemulon aurolineatum* (Pisces, Haemulidae) in the South Atlantic Bight. Fishery Bulletin 83:461-466.**

The objectives of this study were to determine foraging habitat of tomtate, *Haemulon aurolineatum,* and to relate feeding behavior to existing knowledge of the ecology of hard bottom areas in the southeast United States. Tomtate occur along the east coast of the United States and in the northern Gulf of Mexico to Brazil. Tomtate (1-200 mm SL; n=95 with food of 154) were sampled from hard bottom on the inner-, mid-, and outer-shelf off the coasts of South Carolina and Georgia by trawl, trapping, and hook and line. Data were reported as percent frequency, percent number, percent volume, and Ivlev's index of electivity. Tomtate were nocturnal predators in sand and pelagic habitats. Tomtate were generalist invertivores, which mainly ate decapods, amphipods, polychaetes, and copepods. Thus, tomtate is a reef-related, not reef-dependent, species.

***91. Sedberry, G. R. 1987. Feeding habits of sheepshead, *Archosargus probatocephalus*, in offshore reef habitats of the southeastern continental shelf. Northeast Gulf Science 9:29-37.**

The objectives of this study were to describe the diet of sheepshead, *Archosargus probatocephalus,* and to relate diet to the ecology of the live bottom reef. Sheepshead occur along the east coast of the U. S. and from the northern Gulf of Mexico to Brazil but are absent

from the West Indies and Bahamas. Sheepshead (n=31 with food of 42 collected) were sampled from live bottom reef on the inner- (16-22 m) and mid-shelf (23-37 m) off the coasts of South Carolina, Georgia, and Florida by trawl and spearing. Data were reported as percent frequency, percent number, and percent volume. Sheepshead mostly ate sessile or tubicolous forms of prey firmly attached to the substrate. Larger fish (> 350 mm SL) ate larger attached pelecypods. Amphipods and barnacles were eaten by both size groups. Smaller fish (< 350 mm SL) ate more bryozoans and gastropods than larger fish. Sheepshead in areas lacking benthic algae (South Carolina, Georgia, and Florida) are omnivorous; eating more plants inshore and more sessile invertebrates offshore. Sheepshead may contribute to the high diversity on the reef due to heavy feeding on live bottom sessile invertebrates and reducing the abundance of competitively superior species.

***92. Sedberry, G. R. 1988. Food and feeding of black sea bass, *Centropristis striata*, in live bottom habitats in the South Atlantic Bight. Journal of the Elisha Mitchell Scientific Society 104:35-50.**

The author described the feeding habits of black sea bass, *Centropristis striata,* to determine the importance of reef habitat as a source of food. Black sea bass occur from Maine to northeast Florida and in the eastern Gulf of Mexico and reaches the extreme southern parts of Florida in cold winters. Black sea bass (50- > 250 mm SL; n=313) were sampled from live bottom reef on the inner-, mid-, and outer-shelf of South Carolina, Georgia, and Florida by trawling, trapping, hook and line, and vertical longline. Data were reported as percent frequency, percent number, percent volume, and Ivlev's index of electivity. Black sea bass selected for motile epifaunal amphipods. There was a high degree of diet overlap with southern porgy, *Stenotomus aculeatus,* and a lesser degree of overlap with pinfish, *Lagodon rhomboides*, and sheepshead, *Archosargus probatocephalus*. Black sea bass were dependent on the reef for food. Prey size and use of fish in diet increased with increased predator size. Black sea bass were most abundant on the inner-shelf.

***93. Sedberry, G. R. 1990. Feeding habits of whitebone porgy, *Calamus leucosteus* (teleostei: Sparidae), associated with hard bottom reefs off the southeastern United States. Fishery Bulletin 87:935-944.**

The objectives of this study were to describe the food habits of whitebone porgy, *Calamus leucosteus*, to determine the importance of hard bottom reef habitat, and measure the diet overlap between porgy and other abundant sparids. Whitebone porgy occur from North Carolina to southern Florida and the entire Gulf of Mexico. Whitebone porgy (99-315 mm SL; n=219) were sampled from hard bottom across the shelf in South Carolina and Georgia by trawl, trapping, and hook and line. Data were reported as percent frequency, percent number, percent volume, and Ivlev's index of electivity. Unlike other sparids, whitebone porgy go through slight changes in feeding with increased size. Anthozoans and barnacles were dominant in the diet of fish < 151 mm SL. Fish were important prey in fish < 250 mm SL, while echinoderms were important prey of fish > 250 mm SL. Whitebone porgy diet was similar to red porgy, *Pagrus pargrus,* and sheepshead, *Archosargus probatocephalus*, but different from pinfish, *Lagodon rhomboides,* and southern porgy, *Stenotomus aculeatus*. The preferred prey of whitebone porgy was motile, sand-dwelling animals. No dependency on reef/hard bottom habitats was observed.

***94. Sedberry, G. R. and N. Cuellar. 1993. Planktonic and benthic feeding by the reef-associated vermilion snapper, *Rhomboplites aurorubens* (Teleostei, Lutjanidae). Fishery Bulletin 91:699-709.**

The objectives of this study were to evaluate the dependence of vermilion snapper, *Rhomboplites aurorubens,* on hard-bottom benthos, sand-bottom infauna, demersal zooplankton, holozooplankton, and nekton as food, and to describe differences in feeding habits with size. Vermilion snapper occur along the southeast U. S. coast and the northern Gulf of Mexico to southeast Brazil. Vermilion snapper (1-170 mm SL; n=255) were sampled from hard bottom on the inner-shelf (16-22 m depth), mid-shelf (23-37 m depth), and outer-shelf (46-69 m depth) of South Carolina and Georgia by trawl, traps, and hook and line. Data were reported as percent frequency, percent number, percent volume, and Ivlev's index of electivity. Vermilion snapper were more common on the mid and outer-shelf than the inner-shelf. Food was found in stomachs of fish collected during day and night; however, most full stomachs were collected at night. Vermilion snapper ate planktonic and nektonic organisms; more small crustaceans at small sizes and more fish, squid, and cumaceans in addition to crustaceans at larger sizes. Snapper selected for crustaceans in the water column in higher proportions than occur in the water column. Snapper may be important in transferring energy from benthic sand habitat and the water column to the reef in the form of feces. Vermilion snapper were associated with reefs, but this association was not a trophic dependence.

***95. Sikora, M. H., R. W. Heard, and M. D. Dahlberg. 1972. The occurrence and food habits of two species of hake, *Urophycis regius* and *U. floridanus* in Georgia estuaries. Transactions of the American Fisheries Society 101:513-525.**

The objectives of this study were to gain life history and ecology/bioenergentics information for spotted hake, *Urophycis regia,* and southern hake, *U. floridanus* (renamed *U. floridana*). Both species occur from North Carolina to southern Florida and throughout most of the Gulf of Mexico. Spotted hake also occur north of Cape Hatteras, North Carolina. Juvenile spotted hake (50-224 mm TL; n=2683) and juvenile southern hake (56-206 mm TL; n=470) were sampled from estuaries with varying bottom type (sand, mud, shell) between Sapelo and St. Catherines Sounds, Georgia, by trawling. Data were reported as frequency, percent frequency of occurrence, and dry weight. Juvenile hake were present in the estuaries during cold months (February – April). Rough growth rate estimates for spotted hake were 17 mm per month and for southern hake were 25 mm per month. Crustaceans (amphipods, cumaceans, mysidaceans, and macrurans) and fish were the most important prey items by number and percent frequency, while mollusks were the most important by biomass/dry weight.

***96. Smith, J. W. 1995. Life history of cobia, *Rachycentron canadum* (Osteichthys: Rachycentridae), in North Carolina waters. Brimleyana 23:1-23.**

The objectives of this study were to describe the age and size composition, distribution, reproduction, and diet of recreationally caught cobia, *Rachycentron canadum.* Cobia (39-142 cm FL; n=101 with food of 140 collected used for diet study) were sampled from the shelf off the coast of Carteret County, North Carolina, by recreational fishermen. Data were reported as percent frequency of occurrence, percent number, percent mass, and index of relative importance. Females were larger than males (maximum female length of 1420 mm FL; maximum male length of 1360 mm FL), but Von Bertalanffy growth estimates were higher for males (0.37) than females (0.24). Cobia were sexually mature at 2 years for both sexes (females

800 mm FL; males 600-650 mm FL). Adult cobia occur off North Carolina from March (offshore over reefs and rocky outcroppings) till late July and early August (in estuaries and inlets). Juvenile cobia also occurred in North Carolina sounds from May to mid-September). *Callinectes sapidus* (blue crab) and fish (blackcheek tonguefish, smooth dogfish, pipefish) were the dominant prey overall. As cobia grow, their diet shifts from penaeid shrimp and teleost fish (dominant in cobia < 9 kg) to decapod crabs (dominant in cobia > 9 kg). North Carolina sounds and inlet areas may be feeding grounds for females before and after spawning.

97. Smith, J. W. and J. V. Merriner. 1985. Food habits and feeding behavior of the cownose ray, *Rhinoptera bonasus*, in lower Chesapeake Bay. Estuaries 8:305-310.

The authors provided observations on cownose ray, *Rhinoptera bonasus,* feeding behavior. Cownose rays occur from southern New England to north Florida and the entire Gulf of Mexico, then migrate to Trinidad, Venezuela, and Brazil. Cownose rays (43-99 cm DW; n=68) were sampled from demersal grass beds of the lower York River, Virginia, using a 91 m gill net, a commercial pound net, haul seines, otter trawls, and rods and reels. Data were reported as percent number, percent volume, percent frequency, and index of relative importance. Cownose rays mostly ate bivalves. As they got larger (85-99 cm DW), clams (primarily the soft shell clam, *Mya arenaria*) became more important.

***98. Sogard, S. M. 1984. Utilization of meiofauna as a good source by a grassbed fish, the spotted dragonet *Callionymus pauciradiatus*. Marine Ecology Progress Series 17:183-191.**

The objectives of this study were to assess the feeding ecology of the spotted dragonet, *Callionymus pauciradiatus* (renamed *Diplogrammus pauciradiatus*), by quantifying the diet, comparing the diet composition to available food, and determining the rate of gastric evacuation. Spotted dragonets are found along the southeast United States and in the Caribbean from the Bahamas to Colombia. Spotted dragonet (5-35 mm SL; n=113) were sampled from the seagrass beds of Biscayne Bay, Florida, by push net. Data were reported as frequency of occurrence and percent number. Spotted dragonet ate meiofauna within the size range of 0.2-1.0 mm, primarily harpacticoid copepods. The diet of this species was similar throughout the year. Food was spread evenly among the foregut, midgut, and hindgut during the day, suggesting that feeding occurred throughout the day. During the night, food was compressed in the hindgut, implying that gut evacuation is slowed during the night. Larger fish ate larger copepods, but did not exclude smaller prey. Harpacticoid copepods were common in the meiofaunal community, third in abundance. Harpacticoids, ostracods, and mites were positively selected for by dragonets. Due to the high abundance and fast turnover rates of copepods, dragonets are not likely to be limited by food. This study was included due to the lack of diet data from spotted dragonet in the southeast United States.

***99. Steimle, F. W. and L. Ogren. 1982. Food of fish collected on artificial reefs in the New York Bight and off Charleston, South Carolina. Marine Fisheries Review 44:49-53.**

The objectives of this study were to determine whether artificial reefs are, or can be, important providers of forage for fish and to determine whether fish collected on artificial reefs primarily eat attached or encrusting epifauna. Of the eleven species of fish sampled for this study, nine are common off the southeast U. S. coast. Red hake, *Urophycis chuss* (n=31); rock sea bass, *Centropristis philadelphica* (n=8); black sea bass, *C. striata* (n=59); sheepshead, *Archosargus probatocephalus* (n=3); pinfish, *Lagodon rhomboides* (n=3); scup, *Stenotomus*

chrysops (n=3); northern kingfish, *Menticirrhus saxatilis* (n=23); tautog, *Tautoga onitis* (n=57); and winter flounder, *Pseudopleuronectes americanus* (n=3), were sampled from artificial reefs off the coasts of Charleston, South Carolina, Monmouth Beach, New Jersey, and Atlantic Beach, New York, by hook and line and spearing. Data were reported as percent stomach volume and percent intestine volume. The authors found little evidence of reliance on reef dependent flora and fauna as food. Encrusting and attached epifauna were seldom found in the stomachs of the fish studied. Tautog and sheepshead seemed to use reef fauna the most, feeding primarily on tunicates and barnacles (*Mytilus*). Most of the food of other fish was probably from adjacent, non-reef sediments.

***100. Stickney, R. R. 1976. Food habits of Georgia estuarine fishes. 2. *Symphurus plagiusa* (Pleuronectiformes: Cynoglossidae). Transactions of the American Fisheries Society 105:202-207.**

The objectives of this study were to describe the diet of blackcheek tonguefish, *Symphurus plagiusa,* in relation to location of capture (river or sound), season of the year, and standard length groups, and to compare this data to other Georgia fish. Blackcheek tonguefish occur along the east coast of the U. S., south of New York, and in the northern Gulf of Mexico to Panama. Blackcheek tonguefish (60-150 mm SL; n=588) were sampled from Georgia estuarine rivers and sounds by otter trawl. Data were reported as percent fish containing a food item. Some of the most common prey organisms (*Neomysis americana* and *Squilla* sp.) were uncommon in blackcheek tonguefish stomachs and occurred only seasonally. Postlarval fish (< 60 mm) ate algae. Fish 60-90 mm ate amphipods, decapod megalopae, and zoea. Larger crustaceans became important in fish > 100 mm. The diversity of prey was highest in fish 101-150 mm. Blackcheek tonguefish ate directly from the sediment; thus, ingesting sand, for all size classes, during all seasons, and in all locations (estuarine rivers and sounds). Feeding was non-directed; thus, senses other than vision were used, or food selection is not as precise as in other flatfishes. The physical size of the mouth was more limiting on what blackcheek tonguefish ate than selectivity.

***101. Stickney, R. R., G. L. Taylor, and R. W. Heard, III. 1974. Food habits of Georgia estuarine fishes I. Four species of flounder (Pleuronectiformes: Bothidae). Fishery Bulletin 72:515-525.**

The authors provide a general description of what four common estuarine flatfish species eat with some comparisons among sizes, seasons, and location. All four species are common in the southeast United States. Fringed flounder, *Etropus crossotus* (41-100 mm; n=421); bay whiff, *Citharichthys spilopterus* (50-150 mm; n=210); ocellated flounder, *Ancyclopsetta quadrocellata* (25-200 mm; n=217); and windowpane, *Scopthalmus aquosus* (25-175 mm; n=105), were sampled from Wassaw Sound, Ossabaw Sound, St. Catherines Sound, and Sapelo Sound, Georgia, by otter trawl. Data were presented as percent number. Fringed flounder diet differed from the others, mainly feeding on smaller organisms like the copepod *Pseudodiaptomus coronatus*, due to the smaller mouth size of this flounder. Fringed flounder fed during the day and polychaete consumption increased with increasing fish size. Ocellated flounder ate the mysid, *Neomysis americana*. Prey diversity increased with increasing fish size, with *Trachypenaeus constrictus* important in the 150-175 mm range and a variety of food ingested at larger sizes. Bay whiff were not collected in winter. Their food seems similar to ocellated flounder with *N. americana* the main prey item and *T. constrictus* becoming important

at larger sizes (125 mm). The highest abundance of windowpane were collected in spring and at small sizes. These fish ate *N. americana* almost exclusively with very little change in diet with size or season. The authors believe the small size of *P. coronatus* made it difficult for the larger mouthed fishes to retain after ingestions (flushed out of the operculum).

***102. Stickney, R. R., G. L. Taylor, and D. B. White. 1975. Food habits of five species of young southeastern United States estuarine sciaenidae. Chesapeake Science 16:104-114.**

The authors described the diets of five common sciaenids in estuaries of the southeast U. S., from stations in the more riverine sections of the estuary to stations in the sound. These species are all found in the southeast U. S. Silver perch, *Bairdiella chrysoura* (30-149 mm SL; n=183)*;* weakfish, *Cynoscion regalis* (30-169 mm SL; n=120)*;* spot, *Leiostomus xanthurus* (50-149 mm SL; n=122)*;* croaker, *Micropogonias undulatus* (< 39-200 mm SL; n=194), and star drum, *Stellifer lanceolatus* (40-119 mm SL; n=184), were sampled from estuaries between Georgetown, South Carolina, and Jacksonville, Florida, by otter trawl. All five fish fed mostly on mysids (*Neomysis americana*) and copepods (*Pseudodiaptomus coronatus*). Weakfish were the only substantial predators of fish. For all but spot, who ate copepods throughout the size ranges studied, prey size increased with predator size. Food habits changed little from the riverine study area to the sound.

***103. Stoner, A. W. 1979. Species specific predation on amphipod crustacea by pinfish (*Lagodon rhomboides*): mediation by macrophyte standing crop. Marine Biology 55:201-207.**

The author tested the hypothesis that prey selectivity in pinfish, *Lagodon rhomboides*, is mediated by seagrass biomass. Pinfish (16-80 mm SL; n=400 at each of three sites) were sampled from seagrass beds of Apalachee Bay, Florida (with varying degrees of cover). Data were reported as number and percent number. Species consumed by pinfish varied among study sites (presumable the result of macrophyte cover). The relative frequency of prey items in pinfish stomachs differed from the abundance of prey implying that pinfish select for certain species. Where vegetation was sparse, amphipods were eaten in proportion to their abundance. Size of prey did not seem to affect selectivity, so there must be a behavioral mechanism in selecting certain amphipods. Thus, physical structure of a habitat is important to the population and community dynamics of its inhabitants. The author also warns against categorizing prey into broad taxonomic groups. This study was included to complement data on the diet of pinfish from the southeast United States.

***104. Stoner, A. W. 1980. Feeding ecology of *Lagodon rhomboides* (Pisces: Sparidae): variation and functional responses. Fishery Bulletin 78:337-352.**

The objectives of this study were to explain the ontogenetic, spatial, and temporal variations in food habits of pinfish, *Lagodon rhomboides,* based on predator morphology, food abundance, and habitat complexity. Pinfish (11-160 mm SL; n=2174) were sampled from three Apalachee Bay, Florida, seagrass beds (macrophyte covering: 9, 141, > 200 g dry wt./m^2) by otter trawl. Data were reported as percent dry weight. An ontogenetic shift from planktivore (< 16 mm) to carnivore (16-35 mm) to omnivore (36-80 mm) to herbivore (> 80 mm) was observed. For all stages, food availability effected the diversity and selectivity of prey consumed. Prey availability and consumption differed between the less vegetated area, where pinfish took food from the water column, and the more vegetated areas, where pinfish mostly took benthic prey.

There were some discrepancies between this study and previously published data. These discrepancies may be explained by differences in geographic region and the type of seagrass cover. The life history strategy of pinfish may be adapted to seasonal patterns of productivity and abundance of prey. The author defends the hypothesis that morphology dictates diet (type of teeth prevent pinfish from eating plants till 35 mm). This study was included to complement data on the diet of pinfish from the southeast United States.

***105. Stoner A. W. and R. J. Livingston. 1984. Ontogenetic patterns in diet and feeding morphology in sympatric sparid fishes from seagrass meadows. Copeia 1984:174-187.**

The objectives of this study were to examine the relationship between ontogenetic and feeding patterns (morphology versus flexible) and to support the "ontogenetic trophic unit" concept over the functional ecological units used in most modeling efforts. Pinfish, *Lagodon rhomboides,* and spottail pinfish, *Diplodus holbrooki,* occur along the southeast U. S. coast and northern Gulf of Mexico. Pinfish (11-121 mm SL; n=2174) and spottail pinfish (11-121 mm SL; n=1315) were sampled from a seagrass meadow in Apalachee Bay, Florida, by trawl. Data were reported as percent dry weight. Both fish were most active during the day and appeared to be visual predators. There was little evidence of dietary overlap. There are two prevailing hypotheses on the importance of morphology on diet: morphological constraints dictate diet (Choa and Musick, 1977) and diet is flexible and independent of jaw morphology (Liem, 1980). This study provided evidence for the morphological constraint hypothesis with differences in teeth shapes, mouth size, and fin anatomy explaining the feeding patterns in the two fish. However, the authors also observed a high degree of feeding flexibility within ontogenetic stages indicating that jaw morphology may not fully dictate diet. This study was included to complement data on the diet of spottail pinfish from the southeast United States.

***106. Sutter, F. C., R. S. Waller, and T. D. McIlwain. 1986. Species profiles: Life histories and environmental requirements of coastal fish and invertebrates (Gulf of Mexico) – Black Drum. U. S. Fish and Wildlife Service Biological Report 82 (11.51). U. S. Army Corps of Engineers TR EL-82-4. 11 9.**

The authors described the life history and environmental requirements of black drum, *Pogonias cromis*. Black drum occur from Nova Scotia to northern Mexico and from southern Brazil to Argentina. Black drum (8-50 cm TL) were sampled from shallow bottom habitat in the Gulf of Mexico. Black drum generally fed off the bottom on crustaceans; although, occasionally ventured to the surface for menhaden. Young fish (8-20 cm TL) ate small fish, copepods, polychaetes, and amphipods. Larger fish (> 20 cm TL) relied more heavily on mollusks and larger crustaceans (crabs and shrimp). This study was included because of the lack of southeast United States studies on black drum.

***107. Sutter, F. C. and T. D. McIlwain. 1987a. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico) – Sand seatrout and silver seatrout. U. S. Fish and Wildlife Service Division of Biological Services, Report 82(11.10). U. S. Army Corps of Engineers TR EL-82-4. 16 p.**

The authors described the life history and environmental requirements of sand seatrout, *Cynoscion arenarius*, and silver seatrout, *Cynoscion nothus*, of the Gulf of Mexico. Sand seatrout do not occur in the southeast United States and are not discussed further. Silver seatrout occur from Maryland to northeastern Florida and throughout the Gulf of Mexico. Silver seatrout

(26-175 mm SL) were sampled from shallow shelf areas of the Gulf of Mexico. The diet of silver seatrout shifts from shrimp and mysids to fish and shrimp at 50-76 mm. This study was included due to the limited amount of data for silver seatrout from the southeast United States.

***108. Sutter, F. C. and T. D. McIlwain. 1987b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico) – Pigfish. U. S. Fish and Wildlife Service Division of Biological Services, Report 82(11.71). U. S. Army Corps of Engineers TR EL-82-4. 11 p.**

The authors described the life history and environmental requirements of pigfish, *Orthopristis chrysoptera*. Pigfish occur along most of the east coast of the U. S. and parts of Mexico. Pigfish (16-80 mm SL) were sampled from the west Florida shelf. Pigfish diet shifted from planktivore to benthic carnivore around 50 mm. This study was included because of the limited data for the species.

***109. Targett, T. E. 1978. Food resource partitioning by the pufferfishes *Sphoeroides spengleri* and *S. testudineus* from Biscayne Bay, Florida. Marine Biology 49:83-91.**

The authors investigated interspecific and intraspecific food resource partitioning by two coexisting species of *Sphoeroides*. Bandtail puffer, *Sphoeroides spengleri,* and checkered puffer, *S. testudineus,* occur along the east coast of the U. S. and parts of the Gulf of Mexico to Brazil. Bandtail puffer (16-129 mm SL; n=453 with food of 460 collected) and checkered puffer (72-208 mm SL; n=339 with food of 349 collected) were sampled from a Biscayne Bay, Florida, seagrass bed by stretched mesh bag seine. Data were reported as percent composition by weight. Bandtail puffer mostly ate amphipods and some isopods at small sizes (16-59 mm). Larger fish (60-89 mm) ate bivalves, gastropods, and brachyuran crabs. Bandtail puffers (> 90 mm) consumed brachyuran crabs. Checkered puffers ate gastropods and brachyuran crabs at 72-149 mm (similar to bandtail puffers). Larger fish (> 150 mm) ate brachyuran crabs and bivalves. Prey overlap for the overall diet, overlapping sizes, and abundant size groups was about half (0.5, 0.63, 0.49, respectively). However, the prey overlap was much less when the specific taxa within each group were considered, meaning that some amount of food partitioning occurred. Checkered puffers were more generalized feeders than bandtail puffers, yet potentially out-compete bandtail puffers for preferred brachyura, bivalvia, and gastropoda prey. Neither species fed at night, though this is based on a very low sample size. Detritus and seagrass were probably ingested accidentally. This study was included due to the lack of diet data on these species from the southeast United States.

***110. Teixeira, R. L. and J. A. Musick. 2001. Reproduction and food habits of the lined seahorse, *Hippocampus erectus* (Teleostei: Syngnathidae) of Chesapeake Bay, Virginia. Brazilian Journal of Biology 61:79-90.**

The objectives of this study were to assess the abundance, reproduction, and feeding habits of the lined seahorse, *Hippocampus erectus,* in Chesapeake Bay. Lined seahorses occur along the east coast of North America and the northern Gulf of Mexico to Argentina. Lined seahorses (23-126 mm TL; n=133 with food of 136 collected) were sampled from eelgrass beds and estuarine sites in the lower York River, Virginia, by trawling. Data were reported as percent frequency of occurrence and percent number. The sex ratio was skewed toward females. The reproductive period occurred from May to October. Number of eggs/embryos and oocytes were correlated with size and weight. Feeding was limited by snout shape and width. At all sizes,

lined seahorses mostly ate amphipods. Small fish (< 60 mm TL) fed mainly on amphipods, and mid-size fish (60-99 mm TL) fed almost exclusively on amphipods. This study was included due to the lack of diet data for this species from the southeast United States.

***111. Thomas, C. J. and L. B. Cahoon. 1993. Stable isotope analyses differentiate between different trophic pathways supporting rocky-reef fishes. Marine Ecology Progress Series 95:19-24.**

The objectives of this study were to distinguish among five reef associated fish species using multiple stable isotope analyses and to determine whether these differences corresponded to differences in the food chains supporting each fish. All fish occur in the southeast U. S. Round scad, *Decapterus punctatus* (104-183 mm SL; n=100)*;* red porgy, *Pagrus pagrus* (190-323 mm SL; n=100)*;* vermilion snapper, *Rhomboplites aurorubens* (159-310 mm SL; n=100)*;* spottail pinfish, *Diplodus holbrooki* (91-223 mm SL; n=100)*;* and tomtate, *Haemulon aurolineatum* (113-152 mm SL; n=100), were sampled from benthic and pelagic environments 5, 23, and 38 miles offshore in Onslow and Long Bays, North Carolina, by hook and line, trawl, microbarb spear, and some commercial catches. Data were reported as ^{13}C:^{14}C, ^{15}N:^{14}N, ^{34}S:^{32}S ratios. Carbon and nitrogen values were used to separate species by diet, but including sulfur increased the power to distinguish species. Benthic feeders C values were slightly more enriched (less negative) than pelagic feeders. The isotopic turnover in muscle tissue is slow, so these analyses describe an average of assimilation over many seasons. Differences in stomach contents across locations were probably the result of changing food availability.

***112. Topp, R. W. and F. H. Hoff. 1972. Memoirs of the *Hourglass* cruises. Flatfishes (Pleuronectiformes). Marine Research Laboratory, Florida Department of Natural Resources, St. Petersburg, Florida. Volume 4:1-135.**

The authors summarized and described the abundance, food habits, maturation, spawning, and growth of flatfish of the west Florida coast. Eighteen species of juvenile and adult flatfish that also occur in the southeast U. S. were described: Lined sole, *Achirus lineatus,* ocellated flounder, *Ancyclopsetta quadrocellata,* eyed flounder, *Bothus ocellatus,* spottail flounder, *B. robinsi,* anglefin whiff, *Citharichthys gymnorhinus,* spotted whiff, *C. macrops,* spotfin flounder, *Cyclopsetta fimbriata,* fringed flounder, *Etropus crossotus,* gray flounder, *E. rimosus,* shrimp flounder, *Gastropsetta frontalis,* naked sole, *Gymnachirus melas,* gulf flounder, *Paralichthys albigutta,* dusky flounder, *Syacium papillosum,* spottedfin tonguefish, *Symphurus diomedianus,* largescale tonguefish, *S. minor,* pygmy tonguefish, *S. parvus,* blackcheek tonguefish, *S. plagiusa*, and spottail tonguefish, *S. urospilus*. Shrimp flounder, ocellated flounder, and dusky flounder ate mostly crustaceans and fish. Spotfin flounder (2 specimens) ate fish only. Gray flounder, eyed flounder, lined sole, naked sole, spottedfin tonguefish, blackcheek tonguefish, and spottail tonguefish were benthic feeders and ate mostly crustaceans, benthic polychaetes, and mollusks. Fringed flounder and spottail flounder were also benthic feeders, but took occasional excursions into the water column. Anglefin whiff and spotted whiff ate small crustaceans. Largescale tonguefish (1 specimen) had the remains of a polychaete. Pygmy tonguefish ate crushed shell and detritus.

***113. Young, R. F. and H. E. Winn. 2003. Activity patterns, diet, and shelter site use for two species of moray eels, *Gymnothorax moringa* and *Gymnothorax vicinus*, in Belize. Copeia 2003:44-55.**

The authors examined the activity, diet, and shelter use of two moray eels. Spotted moray, *Gymnothorax moringa,* and purplemouth moray, *G. vicinus,* occur along the southeast U. S. coast and Gulf of Mexico to Brazil. Spotted moray (379-808 mm TL; n=71) and purplemouth moray (403-947 mm TL; n=60) were sampled from a Belizean back reef by snorkeling with hand nets and quinaldine. Data were reported as percent weight, Horn index of niche overlap, and Morisita's index of niche overlap. The site used was similar for the two morays. Spotted morays left shelters nearly twice as often as purplemouth morays. Both ranged from 10-100 m from home to grassbeds. Both fed at night. Purplemouth morays fed on fish mainly on nights with inclement weather. Spotted morays fed on crabs in both calm and inclement nights. Prey size was similar for the two species. Food partitioning was the result of different behavioral patterns related to weather. This study was included due to the lack of diet data from the southeast United States.

LITERATURE CITED

Bjorgo, K. A., J. J. Isely, and C. S. Thomason. 2000. Seasonal movement and habitat use by striped bass in the Combahee River, South Carolina. Trans. Am. Fish. Soc. 129:1281-1287.

Booth, D. J., M. J. Kingsford, P. J. Doherty, and G. A. Beretta. 2000. Recruitment of damselfishes in One Tree Island lagoon: Persistent interannual spatial patterns. Mar. Ecol. Prog. Ser. 202:219-230.

Busch, W.–D. N., B. L. Brown, and G. F. Mayer (Eds.). 2003. Strategic guidance for implementing an ecosystem-based approach to fisheries management. United States Department of Commerce, National Oceanic and Atmospheric Administration, NMFS, Silver Spring, MD. 62 p. http://ocean.floridamarine.org/efh_coral/pdfs/MafacReportEcoMgmt.pdf. Last accessed 13 November 2004.

Chesapeake Fisheries Ecosystem Plan Technical Advisory Panel. 2004. Fisheries ecosystem planning for Chesapeake Bay. Chesapeake Fisheries Ecosystem Plan Technical Advisory Panel. 363 p. http://noaa.chesapeakebay.net/Fish/FEP_DRAFT.pdf. Last accessed 15 November 2004

Chao, L. N. and J. A. Musick. 1977. Life history, feeding habits, and functional morphology of juvenile sciaenid fish in the York River Estuary, Virginia. Fishery Bulletin 74:657-702.

Dobrzynski, T. and K. Johnson. 2001. Regional council approaches to the identification and protection of habitat areas of particular concern. NOAA/NMFS, Office of Habitat Conservation, 1315 East West Highway, Silver Spring, Maryland. http://ocean.floridamarine.org/efh_coral/pdfs/RegionalApproachestoHAPCs.pdf. Last accessed 13 November 2004.

Gray's Reef National Marine Sanctuary (GRNMS). 2004. About Gray's Reef National Marine Sanctuary. Shades of Gray 1:8.

Liem, K. F. 1980. Adaptive significance of intra- and interspecific differences in the feeding repertoires of cichlid fishes. Am. Zool. 20:295-314.

Link, J. S. 2002. What does ecosystem-based fisheries management mean? Fisheries 27:18-21.

National Marine Fisheries Service (NMFS). 1999. Essential fish habitat: New marine fish habitat conservation mandate for federal agencies. National Marine Fisheries Service, Habitat Conservation Division, Southeast Regional Office, 9721 Executive Center Drive North, St. Petersburg, FL 33702 http://ocean.floridamarine.org/efh_coral/pdfs/efhprime.pdf. Last accessed 13 November 2004.

National Marine Sanctuaries Act (NMSA). 2000. Title 16, Chapter 32 USC of the Marine Protection, Research, and Sanctuaries Act of 1972 as amended by Public Law 106-513, November 2000. http://www.sanctuaries.nos.noaa.gov/natprogram/nplegislation/NMSA.pdf. Last accessed 13 November 2004.

Parker, R. O., Jr. and R. L. Dixon. 1998. Changes in a North Carolina reef fish community after 15 years of intense fishing-global warming implications. Trans. Am. Fish. Soc. 127:909-920.

Robins, C. R., G. C. Ray, and J. Douglas. 1986. A field guide to Atlantic coast fishes of North America. Houghton Mifflin Company, Boston. 354 p.

South Atlantic Fishery Management Council (SAFMC). 1998. Habitat plan for the South Atlantic region: Essential fish habitat requirements for fishery management plans of the South Atlantic Fishery Mangement Council. South Atlantic Fishery Management Council. Charleston, South Carolina. 449 pp.

Tsou, T. S. and J. S. Collie. 2001. Predation-mediated recruitment in the Georges Bank fish community. ICES Journal of Marine Science 58:994-1001.

FISH SPECIES INDEX

Scientific Name	Study Number
**Lutjanus griseus*	33, 42, 64, 69
Lutjanus synagris	25, 33
Megalops atlantica	69
Membras martinica	1
Menidia beryllina	16, 19, 69
Menidia menidia	1, 29
Menticirrhus saxatilis	17, 99
Microgobius gulosus	16, 69
**Micropogonias undulatus*	17, 19, 37, 77, 102
Morone saxatilis	54
**Mugil cephalus*	19, 28, 48, 69
**Mugil curema*	48
Mycteroperca bonaci	12
Mycteroperca interstitialis	12
**Mycteroperca microlepis*	12, 66, 86
**Mycteroperca phenax*	12, 60
Mycteroperca venenosa	12
**Ocyurus chrysurus*	64
Oligoplites saurus	15, 16, 69
**Opisthonema oglinum*	16, 44
Opsanus beta	69
**Orthopristis chrysoptera*	16, 44, 108
**Pagrus pagrus*	55, 111
**Paralichthys albigutta*	32, 112
Paralichthys dentatus	74, 75
**Paralichthys lethostigma*	19, 31, 71, 75
Paranthias furcifer	12
Plectranthias garrupellus	12
Poecilia latipinna	69
**Pogonias cromis*	19, 71, 106
**Pomatomus saltatrix*	11, 68
Prionotus alatus	82, 84
**Prionotus carolinus*	76
Prionotus evolans	76
Prionotus martis	82, 84
**Prionotus ophryas*	82, 84
Prionotus roseus	82, 84
Prionotus salmonicolor (rubio)	82, 84
**Prionotus scitulus*	82, 83, 84
Prionotus tribulus	82, 84
Pseudopleuronectes americanus	99
**Rachycentron canadum*	2, 47, 96
Rhinoptera bonasus	97
**Rhomboplites aurorubens*	21, 35, 94, 111
**Rypticus maculatus*	12
Scartella cristata	62
Schultzea beta	12
**Sciaenops ocellatus*	4, 7, 19, 52, 69, 70
**Scomberomorus cavalla*	20, 30, 67, 87
**Scomberomorus maculatus*	30, 67, 88
**Scopthalmus aquosus*	101
**Seriola dumerili*	56
**Seriola rivoliana*	56
**Serraniculus pumilio*	12, 38
Serranus annularis	12
Serranus phoebe	12
**Serranus subligarius*	12, 39
Serranus tabacarius	12
Serranus tigrinus	12
Sphoeroides nephelus	16
**Sphoeroides spengleri*	109
Sphoeroides testudineus	109
**Sphyraena barracuda*	69, 89
Stellifer lanceolatus	102
**Stenotomus caprinus*	41
**Stenotomus chrysops*	51, 99
Strongylura marina	16, 19
Strongylura notata	9, 50
**Syacium papillosum*	112
**Symphurus diomedianus*	112
**Symphurus minor*	112
Symphurus parvus	112
**Symphurus plagiusa*	100, 112
**Symphurus urospilus*	112
Syngnathus floridae	9
Syngnathus scovelli	9, 45, 65
**Synodus foetens*	16, 69
**Tautoga onitis*	99
Thunnus albacares	24, 57
Thunnus atlanticus	57
Trachinotus falcatus	16
**Trinectes maculatus*	16, 19, 69
**Upeneus parvus*	14
Urophycis chuss	99
**Urophycis floridana*	95
**Urophycis regia*	95

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