FOOD AND FEEDING OF THE TOMTATE, *HAEMULON AUROLINEATUM* (PISCES, HAEMULIDAE), IN THE SOUTH ATLANTIC BIGHT[1]

The tomtate, *Haemulon aurolineatum*, is an abundant demersal fish in a variety of marine habitats in the South Atlantic Bight, the Gulf of Mexico, and the Caribbean Sea (Darcy 1983). They are a reef-associated species (Parrish and Zimmerman 1977), and in the South Atlantic Bight they are most commonly found over hard or "live" bottom reefs in depths < 55 m (Struhsaker 1969; Manooch and Barans 1982; Sedberry and Van Dolah 1984). While occasionally taken in trawl catches over open, sandy habitats on the southeastern continental shelf (Wenner et al. 1980), they are much more abundant in trawls directed at sampling hard bottom, and generally rank in the top three demersal species by number or weight in trawl catches (Wenner 1983; Sedberry and Van Dolah 1984; Sedberry unpubl. data). Although they are frequently caught on hard bottom reefs in the South Atlantic Bight, the dependance of these fishes on hard bottom habitat for food is unknown. Previous investigations in the Caribbean have indicated that tomtate are not obligatory reef dwellers and that they forage extensively in open sandy areas (see Darcy 1983 for review). Because of the importance of this species in the hard bottom ichthyofauna of the South Atlantic Bight and its importance to fisheries associated with hard bottom reefs, a knowledge of its food habits is important to our understanding the ecology of this habitat. Tomtate may be important in transferring energy from the expansive sand areas of the shelf onto the much more restricted hard bottom habitat, and their feeding behavior in the South Atlantic Bight may be important in maintaining the higher biological productivity of hard bottom areas, relative to the open sandy shelf.

To determine foraging habitat of the tomtate, an investigation on food habits was conducted. The purpose of this note is to report the results of that study and to relate the feeding behavior to existing knowledge of the ecology of hard bottom areas in the South Atlantic Bight.

Methods

Tomtate were collected during seasonal cruises in 1980 (two cruises – one in winter and one in summer) and 1981 (four cruises – one each in winter, spring, summer, and fall) by trawl from eight hard bottom reef stations off South Carolina and Georgia. Stations were located in each of three depth zones representing the inner shelf (16-22 m depth, three stations), middle shelf (23-38 m, four stations), and the outer shelf (47-67 m, one station). Detailed descriptions of station locations and habitat can be found in Sedberry and Van Dolah (1984) and Wenner et al. (1984). Each station was mapped using loran C and underwater television, and all sampling was conducted in hard bottom areas mapped by using this technique (Sedberry and Van Dolah 1984).

Tomtate were measured (standard length, SL) at sea and their stomachs removed if not conspicuously empty. Stomachs were individually labeled and preserved in 10% seawater-Formalin[2].

Stomachs were washed in tap water and transferred to 50% isopropanol in the laboratory, and contents of individual stomachs were sorted by taxa and counted. Colonial forms (e.g., hydroids, bryozoans) and algae were counted as one organism. Volume displacement of food items was measured using a graduated cylinder, or estimated by using a 0.1 cm^2 grid (Windell 1971).

Since the methods of food habits quantification are variously biased (Hynes 1950; Pinkas et al. 1971; Windell 1971), the relative contribution of different food items to the total diet was determined using three methods: 1) percent frequency occurrence (F), 2) percent numerical abundance (N), and 3) percent volume displacement (V). These three values were calculated for individual prey species, for prey grouped by higher taxonomic categories, and for higher taxonomic categories pooled for 100 mm intervals of standard length. To determine the dependance of tomtate on hard bottom prey organisms, stomach samples were compared with benthic samples using Ivlev's index of electivity (Ivlev 1961), calculated as follows:

$$E = \frac{P_1 - P_2}{P_1 + P_2}$$

where P_1 is the percentage of the diet comprised by a given prey taxon and P_2 is the percentage of the food complex in the environment (i.e., in benthic samples) comprised by the same prey taxon. Electivity values range from -1 to $+1$. Negative values imply that the prey species is avoided by the predator or that it

[1]Contribution No. 179, South Carolina Marine Resources Research Institute, P.O. Box 12559, Charleston, SC 29412.

[2]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

is unavailable to the predator. Positive values imply that the predator prefers the prey species or that it is feeding on prey species which occur in a different habitat than those sampled by the benthic sampler. A value near zero implies no selectivity by the predator; i.e., the fish is feeding on the prey in proportion to the prey's relative abundance.

Benthic samples and stomach collections were pooled by depth zone (inner, middle, and outer shelf) for comparison; however, too few tomtate for adequate comparison were collected at outer shelf stations. Benthic samples were obtained with diver-operated suction sampler at the seven inner and middle shelf, hard bottom sites during the same time periods in 1980 and 1981 as the fish collections were made. The suction sampler is very effective at sampling macroinvertebrates on hard substrates (Chess 1979; Wenner et al. 1983). Five replicate benthic samples were taken during the six cruises at each reef that was sampled for fishes, and these samples (30 for each reef) are believed to be adquate representatives of the hard bottom invertebrate fauna in

TABLE 1.—Percent frequency occurrence (F), percent number (N), and percent volume (V) of food items in *Haemulon aurolineatum* stomachs collected at hard bottom areas in 1980 and 1981.

Taxon	Food item	F	N	V
Algae				
	Sargassum sp.	1.0	0.1	0.1
Cnidaria				
Hydrozoa				
	Dynamena cornicina	1.0	0.1	<0.1
	Lictorella convallaria	1.0	0.1	<0.1
	Sertularia sp.	1.0	0.1	<0.1
	Total Hydrozoa	3.2	0.2	<0.1
Anthozoa				
	Actiniaria undetermined	5.3	0.4	0.6
Platyhelminthes				
	Turbellaria undetermined	5.3	1.0	0.7
Annelida				
Polychaeta				
	Ampharete sp.	1.0	0.1	<0.1
	Amphinomidae undetermined	1.0	0.1	<0.1
	Arabella iricolor	2.1	0.2	0.5
	Arabellidae undetermined	1.0	0.1	0.1
	Armandia maculata	6.3	2.4	0.3
	Capitellidae undetermined	5.3	0.4	0.4
	Ceratonereis mirabilis	1.0	0.1	<0.1
	Chloeia sp.	1.0	0.1	0.2
	Chloeia viridis	1.0	0.1	0.4
	Chone americana	2.1	0.2	<0.1
	Diopatra cuprea	1.0	0.1	<0.1
	Drilonereis sp.	2.1	0.2	0.1
	Eunice vittata	1.0	0.1	<0.1
	Eunice websteri	1.0	0.1	<0.1
	Eunicidae undetermined	1.0	0.1	<0.1
	Exogone dispar	2.1	0.2	<0.1
	Glycera sp.	5.3	0.4	1.2
	Glycera americana	3.2	0.2	0.8
	Glycera tesselata	2.1	0.2	0.3
	Goniadides carolinae	1.0	0.1	<0.1
	Harmothoe sp.	2.1	0.2	<0.1
	Lumbrinerides acuta	1.0	0.1	<0.1
	Lumbrineris coccinea	2.1	0.2	0.9
	Lumbrineris sp.	1.0	0.1	0.9
	Malanidae undetermined	3.2	0.5	0.2
	Nephtyidae undetermined	1.0	0.1	<0.1
	Nephtys incisa	1.0	0.1	<0.1
	Notomastus americanus	1.0	0.1	<0.1
	Notopygos crinita	1.0	0.1	0.1
	Onuphis sp.	1.0	0.1	<0.1
	Onuphis eremita	1.0	0.1	<0.1
	Onuphis nebulosa	1.0	0.1	0.4
	Opheliidae undetermined	1.0	0.1	<0.1
	Phyllodoce castanea	1.0	0.1	<0.1
	Phyllodoce groenlandica	1.0	0.1	0.1
	Phyllodoce longipes	1.0	0.2	<0.1
	Phyllodoce sp.	1.0	0.1	<0.1
	Phyllodocidae undetermined	1.0	0.1	<0.1
	Polychaeta undetermined	5.3	0.4	3.1
	Progoniada regularis	1.0	0.1	<0.1
	Psalmmolyce ctenidophora	2.1	0.2	1.5
	Sabellidae undetermined	1.0	0.1	0.2
	Scoloplos rubra	1.0	0.1	0.2
	Sphaerodoridae undetermined	1.0	0.1	<0.1
	Syllidae undetermined	2.1	0.2	<0.1
	Syllis sp.	3.2	0.2	0.1
	Syllis regulata carolinae	1.0	0.1	<0.1
	Terebellidae undetermined	2.1	0.2	2.0
	Travisia parva	1.1	0.2	0.1
	Total Polychaeta	46.3	8.7	14.6
Mollusca				
Gastropoda				
	Caecum pulchellum	1.0	0.1	<0.1
	Diodora cayenensis	1.0	0.1	<0.1
	Gastropoda undetermined	1.0	0.1	0.4
	Naticidae undetermined	1.0	0.1	<0.1
	Total Gastropoda	3.2	0.3	0.5
Pelecypoda				
	Ervilia concentrica	5.3	38.2	6.3
	Mactra fragilis	1.0	0.1	0.2
	Pelecypoda larvae	1.0	0.1	<0.1
	Total Pelecypoda	7.4	38.3	6.5
Cephalopoda				
	Octopus sp.	1.0	0.1	0.9
Pycnogonida				
	Anoplodactylus insigniformis	1.0	0.1	<0.1
Crustacea				
Copepoda				
	Calanopia americana	5.3	13.0	0.3
	Longipedia helgolandica	2.1	0.6	<0.1
	Microsetella norvegica	1.0	0.2	<0.1
	Saphirella tropica	1.0	0.1	<0.1
	Temora stylifera	3.2	0.4	<0.1
	Temora turbinata	6.3	1.2	<0.1
	Undinula vulgaris	1.0	0.1	<0.1
	Total Copepoda	13.7	15.4	0.4
Stomatopoda				
	Gonodactylus bredini	2.1	0.2	1.4
	Lysiosquilla scabricauda	1.0	0.1	1.7
	Stomatopoda larvae	3.2	0.3	0.3
	Stomatopoda undetermined	4.2	0.3	0.4
	Total Stomatopoda	10.5	0.8	3.8
Mysidacea				
	Bowmaniella portoricensis	3.2	0.2	0.1
Cumacea				
	Cumacea B	1.0	0.1	<0.1
	Oxyurostylis smithi	3.2	0.2	<0.1
	Total Cumacea	4.2	0.3	<0.1

each depth zone (Wenner et al. 1983, 1984). Details of benthic sampling and structure of the invertebrate communities are described elsewhere (Wenner et al. 1983, 1984). The electivity index was calculated for each species that were numerically dominant in fish stomachs or in benthic samples collected within the two depth zones (inner and middle shelf).

Results and Discussion

Haemulon aurolineatum had a generalized diet and fed on about 120 species of prey (Table 1). Polychaetes and amphipods were the most important food and were eaten with almost the same frequency. Polychaetes, however, made up a large volume of prey because of their large size. Decapods were also frequently consumed, but made up a small percentage of the volume or number of prey items. Pelecypods were the most abundant prey and cephalochordates, while infrequently consumed, made up a large portion of food volume because of their large size. Fishes also made up a large portion of food volume and copepods, though small in volume displacement, were often eaten in large numbers.

TABLE 1.—*Continued.*

Taxon / Food item	F	N	V
Tanaidacea			
Apseudes sp. B	1.0	0.7	<0.1
Isopoda			
Carpias bermudensis	1.0	0.1	<0.1
Erichsonella filiformis	1.0	0.1	<0.1
Eurydice littoralis	3.2	0.2	0.1
Paracerceis caudata	1.0	0.1	<0.1
Total Isopoda	6.3	0.4	0.1
Amphipoda			
Acanthonotozomatidae	1.0	0.1	<0.1
Ampelisca sp.	1.0	0.1	<0.1
Ampelisca cristoides	1.0	0.1	0.1
Ampelisca schellenbergi	3.2	0.3	0.1
Ampelisca vadorum	1.0	0.1	0.1
Amphipoda E	3.1	0.2	<0.1
Amphipoda G	1.0	0.2	<0.1
Amphipoda undetermined	2.1	0.2	0.1
Caprella equilibra	13.7	1.7	0.2
Caprella penantis	3.2	0.4	0.1
Cerapus tubularis	1.0	0.1	<0.1
Elasmopus sp. A	2.1	0.4	<0.1
Elasmopus sp.	1.0	0.1	<0.1
Erichthonius brasiliensis	12.6	2.1	0.2
Gammaropsis sp.	2.1	0.4	<0.1
Lembos unicornis	1.0	0.1	<0.1
Leucothoe spinicarpa	1.0	0.1	<0.1
Liljeborgia sp. A	2.1	0.2	<0.1
Luconacia incerta	2.1	1.5	0.1
Lysianopsis alba	4.2	0.7	0.1
Melita appendiculata	2.1	1.0	0.1
Metharpinia floridana	1.0	0.2	<0.1
Microjassa sp. A	1.0	0.2	<0.1
Monoculodes sp.	1.0	0.1	<0.1
Photis sp.	3.1	0.4	<0.1
Photis pugnator	1.0	0.2	<0.1
Phtisica marina	2.1	0.3	<0.1
Rhepoxynius epistomus	2.1	0.2	<0.1
Rudilemboides naglei	6.3	0.7	<0.1
Stenopleustes sp. A	1.0	0.1	<0.1
Stenothoe sp.	3.2	0.2	<0.1
Stenothoe georgiana	5.3	0.8	<0.1
Synchelidium americanum	1.0	0.1	<0.1
Tiron tropakis	1.0	0.1	<0.1
Total Amphipoda	47.4	12.8	1.3
Decapoda			
Albunea paretii zoea	1.0	0.1	<0.1
Alpheus normani	1.0	0.1	<0.1
Brachyura megalopae	1.0	1.2	0.1
Brachyura undetermined	2.1	0.2	0.3
Callianassa atlantica	1.0	0.1	.0.9

Taxon / Food item	F	N	V
Decapoda larvae	1.0	0.1	<0.1
Leptochela sp.	1.0	0.1	0.4
Leptochela papulata	7.4	0.7	1.7
Lucifer faxoni	3.2	0.4	<0.1
Lysmata sp.	1.0	0.2	<0.1
Natantia undetermined	4.2	0.4	0.6
Neopontonides beaufortensis	1.0	0.1	<0.1
Paguridae	1.0	0.1	<0.1
Periclimenaeus schmitti	1.0	0.1	<0.1
Periclimenes sp.	1.0	0.1	0.1
Periclimenes longicaudatus	2.1	0.2	0.1
Processa sp.	4.2	0.3	0.9
Processa hemphilli	1.0	0.1	0.2
Synalpheus minus	1.0	0.1	0.1
Synalpheus townsendi	1.0	0.1	<0.1
Thor sp.	1.0	0.1	0.2
Thor floridanus	1.0	0.1	<0.1
Trachypenaeus constrictus	2.1	0.2	0.1
Xanthidae	1.0	0.1	0.2
Total Decapoda	33.7	4.9	6.2
Sipunculida			
Sipunculida D	1.0	0.1	<0.1
Bryozoa			
Amathia distans	1.0	0.1	<0.1
Crisia sp.	1.0	0.1	<0.1
Diaperoecia floridana	2.1	0.2	<0.1
Discoporella umbellata	1.0	0.1	<0.1
Total Bryozoa	5.3	0.4	0.1
Echinodermata			
Echinoidea			
Clypeasteroidea undetermined	1.0	0.7	<0.1
Ophiuroidea			
Hemipholis elongata	1.0	0.1	<0.1
Ophiothrix angulata	3.2	0.4	0.4
Ophiuroidea undetermined	17.9	1.5	1.5
Total Ophiuroidea	22.1	1.9	1.9
Chaetognatha			
Chaetognatha undetermined	1.0	0.1	<0.1
Chordata			
Cephalochordata			
Branchiostoma caribaeum	4.2	12.4	41.6
Pisces			
Bothidae undetermined	1.0	0.1	0.2
Clupeidae undetermined	1.0	0.1	1.0
Hypleurochilus geminatus	1.0	0.1	0.4
Teleostei larvae	1.0	0.1	<0.1
Teleostei undetermined	10.5	0.7	18.8
Total Pisces	14.7	1.0	20.5
Number of stomachs examined:	154		
Examined stomachs with food:	95		

Ophiuroids were frequently consumed but were usually represented in stomachs by small arm fragments.

Small (1-100 mm SL) tomtate had a diet dominated numerically by very small crustaceans (copepods) and volumetrically by fishes and decapods (Table 2). Amphipods were most abundant prey taxon for 101-150 mm tomtate and polychaetes made up the greatest volume of food. Large (151-200 mm SL) tomtate primarily consumed pelecypods, which were the most abundant taxon, and cephalochordates, which were abundant in the diet and made up the greatest prey volume.

Many hard bottom invertebrates that were abundant in suction samples at inner and middle shelf sites were not important in the diet of tomtate (Table 3). Of the eight dominant hard bottom invertebrate species, only two (the polychaete *Chone americana* and the corophoid amphipod *Erichthonius brasiliensis*) at inner shelf sites and one (the caprellid amphipod *Luconacia incerta*) at middle shelf sites made up a greater percentage of the diet than they did of benthic samples. On the other hand, invertebrates that were common in stomachs were generally not abundant in benthic samples and electivity values were usually positive.

Tomtate are apparently not completely dependent on hard bottom habitat for prey. Some of the most abundant prey species are pelagic (e.g., brachyuran megalopae, copepods). Most benthic prey are infaunal species that are restricted to soft sediments. *Armandia maculata*, a dominant prey species on the inner shelf, is a deposit-feeding polychaete that burrows in soft sediments (Fauchald and Jumars 1979). *Ervilia concentrica*, an important prey species on the middle shelf, was not collected at any of the 11 hard bottom stations. This bivalve is common in soft sediments (Porter 1974). The cephalochordate *Branchiostoma caribaeum*, a common prey species on the middle shelf that was very rare in benthic samples, is also an infaunal sand bottom species (Hildebrand and Schroeder 1928). Thus, a large portion of the prey of *Haemulon aurolineatum* are not hard bottom epifaunal species, suggesting that tomtate are not

TABLE 2.—Percent frequency occurrence (F), percent number (N), and percent volume (V) of higher taxonomic groups of food in the diet of *Haemulon aurolineatum*, by length interval.

	Length Intervals (mm SL)								
	1-100			101-150			151-200		
Prey taxon	F	N	V	F	N	V	F	N	V
Algae	4.8	0.4	2.6						
Cnidaria									
Hydrozoa							6.2	0.3	<0.1
Anthozoa				8.3	1.1	3.0	6.3	0.3	0.4
Turbellaria				12.5	4.0	6.3	4.2	0.7	0.1
Annelida	19.0	1.5	11.4	62.5	15.6	35.9	50.0	9.4	13.5
Mollusca									
Gastropoda				8.3	1.1	4.7	2.1	0.2	<0.1
Pelecypoda				4.1	0.6	<0.1	12.5	57.2	8.0
Cephalopoda							2.1	0.1	1.1
Arthropoda									
Pycnogonida				4.2	0.6	0.1			
Copepoda	47.6	77.1	14.4	4.2	0.6	<0.1	4.2	0.3	<0.1
Stomatopoda	19.0	1.9	14.7	12.5	1.7	2.2	6.2	0.3	4.0
Mysidacea							6.2	0.3	0.1
Cumacea	4.8	0.4	0.2				6.2	0.3	<0.1
Tanaidacea				4.2	0.6	<0.1			
Isopoda				12.5	1.7	0.1	6.2	0.3	0.2
Amphipoda	33.3	6.0	7.3	79.2	58.3	7.7	39.6	5.9	0.5
Decapoda	19.0	9.8	20.8	33.3	5.6	11.3	39.6	3.2	5.6
Sipunculida	4.8	0.4	0.7						
Bryozoa				8.3	1.1	0.4	6.2	0.3	<0.1
Echinodermata									
Echinoidea							2.1	0.1	<0.1
Ophiuroidea	14.3	1.1	1.7	25.0	5.0	8.0	22.9	1.4	1.0
Chaetognatha	4.8	0.4	0.4						
Chordata									
Cephalochordata				4.2	0.6	2.4	6.2	18.4	51.1
Pisces	4.3	1.1	26.0	16.7	2.2	17.8	12.5	0.7	14.1
Number of stomachs examined:		28			44			79	
Examined stomachs with food:		21			24			48	
Mean length of fish with food (mm SL):		71.5			138.2			168.3	
Length extremes in interval (mm SL):		49-99			101-150			151-198	

restricted to hard bottom habitat for food resources. Although numerous in hard bottom areas (it ranked third in total number and second in total weight in trawl catches over all eight trawlable stations and six sampling periods combined in 1980 and 1981), *Haemulon aurolineatum* has been characterized as a reef-related species; i.e., it uses the reef for only part of each day (Parrish and Zimmerman 1977). Randall (1967) found sand-dwelling organisms in 16 tomtate stomachs he examined, but the habitat of the decapods, the predominant prey, could not be inferred from his results. Parrish and Zimmerman (1977) noted a diet dominated by sand-flat invertebrates for an unspecified number of tomtate collected in the Caribbean. Parrish and Zimmerman (1977) reported nocturnal foraging, with tomtate sheltering in the reef during the day. During extensive (about 70 dives) daytime scuba observations by the author off of South Carolina and Georgia, no tomtate that exhibited foraging behavior was seen, and large schools were often noted "stacked up" at the edge of rock ledges protruding out into sand areas. Apparently, nocturnal feeding behavior described for tomtate in the Caribbean is also typical for the species in the South Atlantic Bight. Tomtate forage, apparently at night, on sand bottom areas of the shelf or in sand patches often found adjacent to rock outcrops, returning to the reefs for shelter during the day. This behavior probably results in considerable energy transfer, in the form of feces, from open sand bottom areas of the shelf onto hard bottom reefs.

The fact that two hard bottom invertebrate species (*Erichthonius brasiliensis* and *Luconacia incerta*) were common in tomtate stomachs and that many additional hard bottom species (e.g., hydroids, many amphipods, alpheid decapods, and bryozoans) are occasionally eaten indicates that tomtate also forage to a limited extent on hard bottom.

The high diversity found in hard bottom invertebrate communities (Wenner et al. 1983) could be attributed, in part, to predation by abundant and diverse fish communities (Petersen 1979). However, as noted by Wenner et al. (1983), available data indicate that few dominant species of hard bottom invertebrates are heavily preyed upon by fishes (Sedberry and Nimmich[3]). Tomtate, an abundant

[3]Sedberry, G. R., and T. A. Nimmich. Food habits of some fishes associated with live bottom habitat off the South Atlantic coast of the U.S.A. Manuscr. in prep. South Carolina Marine Resources Research Institute, P.O. Box 12559, Charleston, SC 29412.

TABLE 3.—Relative abundance (percent of total number of individuals) and electivity index values (E) of dominant species in suction samples (Group A) and *Haemulon aurolineatum* stomachs (Group B) by depth zone. Dominant species included those that ranked in the five most abundant species within each Group (A or B) in either depth zone, for collections pooled for all years and seasons.

	Percent of total number of individuals					
	Inner shelf			Middle shelf		
	Benthic samples	Fish stomachs	E	Benthic samples	Fish stomachs	E
Group A:						
Chone americana	0.33	0.36	0.04	0.81	0.09	−0.79
Erichthonius brasiliensis	2.89	9.32	0.53	0.30	0.19	−0.24
Exogone dispar	3.71	0.72	−0.68	0.47		−1.00
Filograna implexa	20.42		−1.00	63.87		−1.00
Luconacia incerta	3.27	0.36	−0.80	1.03	1.77	0.26
Malacoceros glutaeus	0.41		−1.00	0.81		−1.00
Podocerus sp. A	2.87		−1.00	0.27		−1.00
Syllis spongicola	2.15		−1.00	1.90		−1.00
Total	36.05	10.76		69.46	2.05	
Group B:						
Armandia maculata	0.22	10.75	0.96	0.03	0.19	0.73
Brachyura megalopae		6.09	1.00			0.00
Branchiostoma caribaeum			0.00	0.01	15.69	0.99
Calanopia americana		0.36	1.00		16.34	1.00
Caprella equilibra	1.55	2.87	0.30	0.34	1.40	0.61
Erichtonius brasiliensis	2.89	9.32	0.53	0.30	0.19	−0.24
Ervilia concentrica		0.36	1.00		48.18	1.00
Luconacia incerta	3.27	0.36	−0.80	1.03	1.77	0.26
Melita appendiculata	0.43	4.66	0.83	0.27		−1.00
Temora turbinata		4.30	1.00		0.28	1.00
Total	8.36	39.07		1.98	84.04	
Stomachs with food:		43			50	

predator on hard bottom areas (Sedberry and Van Dolah 1984), do not serve as "keystone" predators (Paine 1969) which influence community structure of invertebrates on South Atlantic Bight hard bottom reefs.

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