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Biological Sciences

THE DIET OF THE FLORIDA POMPANO (*TRACHINOTUS CAROLINUS*) ALONG THE EAST COAST OF CENTRAL FLORIDA

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ABSTRACT: *The diet of the Florida pompano (Trachinotus carolinus) was investigated by examining stomach contents of adults from the Indian River and juveniles from the surf zone off Brevard County. Juveniles consumed primarily benthic crustaceans, mainly Emerita talpoida, and the bivalve, Donax variabilis. The diet of the adults consisted mainly of bivalve molluscs in the families Tellinidae, Mactridae, and Arcidae. In comparison with juveniles, the adults displayed a decrease in the number of planktonic organisms that are selected as prey items. Availability of prey appears to be more important than caloric content of prey in determining the diet of T. carolinus. The diet of adult pompano may be more diverse in those individuals found near the inlet regions of the lagoon. Our findings differ from previous studies that have determined bivalves to be more important in the diet of juvenile Florida pompano and crustaceans to be dominant in the diet of adult Florida pompano. **

ALTHOUGH a number of limited studies have been conducted on the diet of adult *Trachinotus carolinus* (Evermann and Marsh, 1902; Tracy, 1910; Miles, 1949; Gunter, 1945; Finucane, 1969), there is no information available from Florida's Indian River. Similarly, the diet of juvenile pompano has not been investigated on the east coast of Florida, although the diet of juveniles has recently been investigated in Louisiana (Bellinger and Avault, 1970), Georgia (Fields, 1962), and in Tampa Bay, Florida (Finucane, 1969). We describe the diet of adult Florida pompano inhabiting the Indian River of Florida in the area of Brevard and Indian River counties, and of juveniles inhabiting nearshore waters in this region during their initial summer growth period.

METHODS—Adult pompano were collected in the Indian River between Vero

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Beach and Cocoa from March through August 1978 at the sites indicated in Fig. 1. Although adults are present in the Indian River throughout the entire year, this study was designed to determine the diet of these fish during the period of their maximum abundance and activity in estuarine waters. Obtaining suitable numbers of specimens at other times of the year would be difficult because of local migratory patterns of these fish. Similarly, juveniles may be taken from the sandy shore beach habitat only during the period of time commencing in April and extending through late October.

Adult fish were obtained from the catches of commercial fishing boats cruising the Indian River during the hours between sunset and sunrise. A hand-held spotlight was used to detect areas of fish concentration. The "flight" of pompano exposed to a spotlight beam has been well documented (Phillips, 1952). This technique is used by commercial fishermen to locate fish. The fish were taken with a 10 cm mesh-layered pompano gill net. The nets were between 549 and 1,097 m in length; all were 1.2 m deep. Only mature specimens, longer than standard length of 24 cm, were retained in the gill net. After the fish were removed from the gill net, the water temperature at the catch site, the locality of the catch site, and the standard length of each fish were recorded. To analyze the stomach contents, the entire digestive tracts were removed, immediately injected with 10% formalin, and separately placed in sealed vials.

Juvenile pompano were collected during daylight hours within the period of their maximum recruitment upon beaches in the study area. A 13 m one-eighth-inch mesh nylon bag seine was used to obtain the juveniles during July and August. The digestive tract of each juvenile was injected with 10% formalin, and the entire fish was immediately preserved in 10% formalin.

In the laboratory, the gut contents were removed by flushing with 50% ethanol. Prey items were then separated, identified, and counted with a dissecting microscope. Prey items were segregated according to taxon for each sample period and dried at 60°C to a constant weight. The resultant groups of each type of prey item were then weighed. Thus, the relative utilization of the various types of prey items are expressed as proportions of the total diet in terms of dry weight. Although volumes are more commonly used in studies of fish diets, they are difficult to estimate accurately. The relative caloric contribution of heavily utilized prey items by juveniles was determined by obtaining live representatives of these and measuring the caloric content of the entire animal, including shell, with a Parr 1214 oxygen bomb calorimeter. Because adults heavily utilized only a single type of prey item, caloric analysis of their diet was not performed.

RESULTS—A total of 176 mature individuals was obtained in 11 collections. To investigate local variation in the diet of the pompano caught in the study area, each collection was categorized as being obtained in 1 of 3 predetermined regions: the Banana River-Eau Gallie region, the Sebastian Inlet region, and the Sebastian-Vero Beach region. The fish collected ranged from 200–275 mm in standard length (mean = 241 mm). Only 54 individuals had identifiable prey items in their digestive tracts, indicating that mature pompano may feed primarily during the daylight hours.

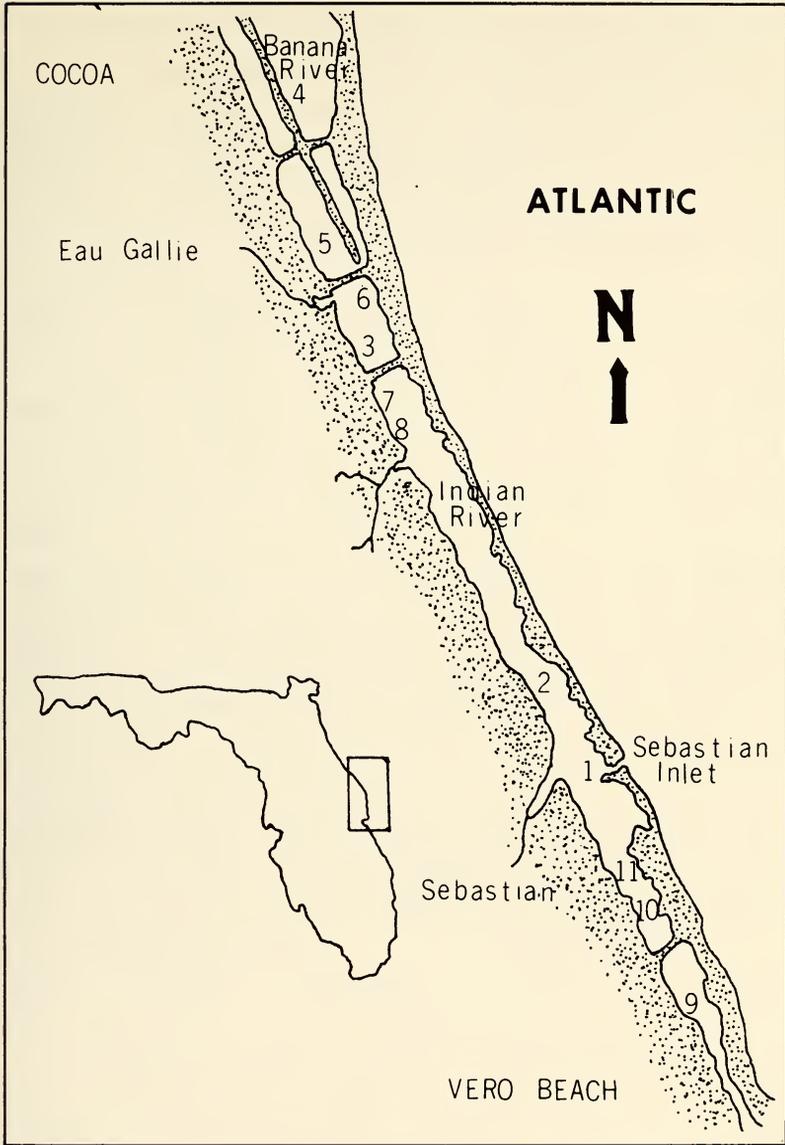


FIG. 1. Map of study area. Numbers indicate collection sites.

Bivalves were the dominant prey items of the adult fish (Table 1). This was consistent at all 3 regions of the study area. However, the utilization of many of the minor prey items differed between the 3 regions (Table 2). These data suggest that adult Florida pompano in this area forage primarily for bivalves. The differences observed probably reflect the differing availability of minor prey items at the 3 regions as a result of environmental differences, and possibly some seasonal effects. The dominant bivalves were of the genus *Tellina*, which comprised 33% of the identifiable bivalves. Although about 38% of the bivalves were

TABLE 1. Major prey items of juvenile and mature *Trachinotus carolinus* from the Central Eastern Coast of Florida for summer recruitment period, 1978.

Prey Item (Frequency of Occurrence)	(a) Total Dry Weight (mg)	(b) Percent of Total Dry Weight of Diet	(c) Average Caloric Value (cal/mg)	Total Caloric Contribution (a) X (c)
<u>Juveniles (N = 51)</u>				
Crustacea				
<i>Emerita talpoida</i> (38)	210	38.8%	3.064	693
Bivalvia				
<i>Donax variabilis</i> (16)	181	33.5%	2.255	408
<u>Adults (N = 54)</u>				
Bivalvia				
<i>Tellina</i> spp. (23)	2215	32.0%	NA	NA
Unidentified Bivalves (43)	2570	37.1%	NA	NA
Other Bivalve Species (34)	2008	29.0%	NA	NA

TABLE 2. Minor prey items of mature *Trachinotus carolinus* from the Indian River for summer spawning period, 1978 (N = 54).

Prey Item	Average Length of Prey in mm	<u>Frequency of Occurrence</u>		
		Banana River- Eau Gallie	Sebastian Inlet	Vero Beach- Sebastian
Crustacea	NA	2	2	1
Isopoda	4	0	1	0
Portunid				
Crab	70	0	1	0
Shrimp	7	2	0	1
Gastropoda	9	2	7	0
Insecta	5	1	0	0
Invertebrate				
Eggs	NA	1	8	0
Polychaeta	5	4	4	0
Plant Matter	12	0	4	0
Sand and Mud	NA	11	15	11
Parasitic Trematodes	NA	17	11	13

too fragmented for positive identification, most were probably *Tellina* species because they were in the same size range as the identifiable individuals.

A total of 51 juveniles was obtained in 3 collections from the surf zone of Brevard County beaches. Fourteen juveniles were collected in July and 37 juveniles were collected in August 1978. Specimens ranged from 10-65 mm in standard length with a mean of 34.7 mm. Only 1 digestive tract of the 51 juveniles did not contain material that could be identified as food. Because juveniles were collected during the day, this is further evidence that Florida pompano feed primarily during daylight hours.

Table 1 presents the major prey items taken from juvenile *T. carolinus* during the study period. The diet of juveniles consisted primarily of the crustacean, *Emerita talpoida*, and the Coquina clam, *Donax variabilis*. The dominance of these prey items probably reflects their availability in the shoreward margin of the surf zone. The dry weights of each of these 2 prey items were nearly equal (Table 1, column a). However, the caloric contribution of *Emerita talpoida* to the juvenile diet is considerably greater than that of *Donax variabilis* (Table 1, column d).

Table 3 gives the minor prey items of juveniles for the entire spawning and recruitment period. A comparison of these data with the minor prey items of adult Indian River pompano (Table 2) indicates that, as juveniles grow to maturity and enter the Indian River, there is a dietary shift from crustaceans to bivalve molluscs. The minor prey items utilized by the juveniles were of greater diversity than those utilized by adult pompano (Tables 2 and 3). This can be primarily attributed to the greater diversity of crustaceans in the diet of juveniles. There was little difference in the size of prey items selected by juvenile and mature pompano (Tables 2 and 3). This is somewhat surprising because the mouth sizes of juvenile and adult pompano are quite different.

TABLE 3. Minor prey items of juvenile *Trachinotus carolinus* off Brevard County for summer recruitment period, 1978 (N = 51).

Prey Item	Average Length of Prey in mm	Frequency of Occurrence
Crustacea	NA	49
Amphipoda	6	13
Cirripedia	3	1
Isopoda	4	6
Shrimp	9	25
Shrimp Larvae	2	1
Bivalvia	2	14
Gastropoda	1	1
Insecta	10	4
Invertebrate Eggs	NA	16
Polychaeta	4	9
Porifera	3	1
Sand and Mud	NA	23
Parasitic Trematodes	NA	15

DISCUSSION—The diet of adult *T. carolinus* in the Indian River differs from that of adult *T. carolinus* in other regions. The dominant food item in this region is bivalve molluscs. In waters off of Rhode Island, Texas, and Louisiana, adult pompano eat primarily shrimp and fishes (Tracy, 1910; Miles, 1949; Gunter, 1945). However, Florida pompano in Tampa Bay, Florida and Puerto Rico eat primarily bivalves (Evermann and Marsh, 1902; Finucane, 1969).

Adult *T. carolinus* in the Indian River may be characterized as generalized carnivores, feeding primarily upon infaunal bivalves. In the Sebastian Inlet, the diversity of prey items consumed by *T. carolinus* is considerably greater than that consumed by fish in the Banana River-Eau Gallie or Vero Beach-Sebastian regions. The inlet region probably supports a much richer fauna. However, it is possible that some of these observed differences in diet are related to seasonal fluctuations in prey abundance because collections in the 3 areas were made at different times.

Many adult fish had empty stomachs. Individuals, when gill netted, often regurgitate their stomach contents (Tabb, 1961). This may explain the large number of empty stomachs. It may also be possible that *T. carolinus* feed primarily during daylight hours and that by the time they were taken, digestion had been completed. However, no relationship was found between time of capture and fullness of gut, which may indicate that the schooling adults have no regular diel feeding pattern, but feed irregularly in response to chance encounters of prey and/or some sort of social signal. All juveniles analyzed were taken during daylight hours, and most yielded full digestive tracts.

The diet of juveniles in this region is similar to that of juveniles in other areas where the fish has been studied (Fields, 1962). However, our data show the relative absence of a diversity of molluscs and the dominance of a single crustacean, *Emerita talpoida*. Bellinger and Avault (1970) have reported that numerous bivalves, particularly the genera *Dosinia*, *Donax*, and *Mulinia*, are of importance in the diet of juvenile Florida pompano in Louisiana. Finucane (1969) reported that amphipods, larval and adult Diptera, and the mollusc *Donax variabilis*, all were important in the diet of very small juveniles caught in the Tampa Bay; larger juveniles ate mainly large crustaceans and molluscs.

The diet of juveniles probably reflects the availability of prey items in the local habitat. *Emerita talpoida* and *Donax variabilis*, the most frequently observed prey items, are extremely common in the shoreward margin of the surf zone. The high frequency of *Donax variabilis*, an organism with a relatively low caloric content, in the diet of juvenile fish suggests that juvenile pompano do not preferentially select high calorie prey items. An optimal predator either meets its energy requirements in the least amount of feeding time or produces the greatest net energy gain for a given time spent feeding (Schoener, 1969). In areas of low food density, predators must spend great amounts of time finding edible foods. In areas of high food density, predators can become more selective, seeking only calorie-rich foods over an enlarged optimal foraging itinerary. It would appear that juvenile Florida pompano cannot afford to pass up an available food of relatively low caloric content (e.g., *Donax variabilis*).

Factors other than food density may influence the foraging behavior of juveniles. It is known that fish feeding upon sessile prey items, such as those utilized by the pompano, may forage over a wider area for food than fish that chase and capture their prey (MacArthur and Pianka, 1966). Interspecific competition may also influence foraging and prey selection. By removing food items and interfering with access to resources, competitors should reduce the foraging itinerary of a predator (MacArthur and Pianka, 1966). Numerous Atlantic permit (*Trachinotus fulcatus*) were caught concurrently with juvenile *T. carolinus*. Although the diet of the Atlantic permit was not investigated, Fields (1962) suggested that they eat many of the same items as the Florida pompano. Thus, the foraging behavior of Florida pompano is probably a compromise between many factors, including prey abundance, predators, and competition.

The diet of adult pompano in the Indian River is of lower diversity than the diet of juvenile oceanic pompano in this area. These data differ from the results of other studies that have reported feeding to become more diversified as pompano mature, and pharyngeal plates supplant teeth as the primary oral feeding structures (Finucane, 1969). No differences in the average size of prey items taken by juveniles and adults were evident. However, adults may take considerably larger prey items than juveniles if these items are available.

SUMMARY—1. The diet of juvenile *Trachinotus carolinus* on the beaches of Brevard County is dominated by crustaceans, particularly *Emerita talpoida*, and the bivalve *Donax variabilis*. 2. Prey items of juveniles are probably selected in proportion to their availability. 3. The diet of adult *T. carolinus* in the Indian River is dominated by bivalves, particularly those of the family Tellinidae. 4. As they mature and enter the Indian River, juveniles switch from a diet consisting primarily of bivalves and crustaceans to a diet consisting mainly of bivalves. There is a decrease in the number of planktonic foods selected as minor prey items by these fish. 5. The diet of adult Indian River pompano appears to be of greater diversity near the Sebastian Inlet region than in other areas of the river. 6. The large number of empty guts observed in samples of adults collected from the Indian River at night suggest that these fish feed mainly during daylight hours.

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DIURNAL VARIATION OF SELECTED PARAMETERS UNDER WATERHYACINTHS AND IN OPEN WATER

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ABSTRACT: *Variation of physico-chemical characteristics of a water column is important in any study on nutrient trace metal-ion removal and lake restoration practices. Diurnal variation of selected parameters was studied under a waterhyacinth (Eichhornia crassipes) mat as well as at an open water site in a lake in southwest Florida. Some similar trends were observed at both sites. Temperature, pH, and dissolved oxygen peaked at 1400 hr, whereas inorganic carbon, iron, and PO₄-P peaked between midnight and 0200 hr. Some site differences were also observed: (1) dissolved inorganic carbon was usually higher under the mat than at the open water site, (2) iron concentration exhibited a bimodal increase under the mat from 1400-2200 hr and 0200-0800 hr, but increased at the open water site from 2400-0600 hr, (3) PO₄-P increased from 2200 hr to midnight under the mat, but increased from midnight until 0600 hr at the open water site. The correlations between the data for each site indicate that a more rapid turnover of iron occurs within the micro-environment of the waterhyacinth-covered water column.**

BECAUSE of forming dense, impenetrable mats, the waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) is currently considered to be the most serious aquatic weed problem worldwide (Pieterse, 1978). Dense stands of these plants obstruct navigation, obstruct irrigation canals and farmland drainage (Penfound and Earle, 1948), block water intake tubes in hydro-electric units (Evans, 1963), increase water loss through evapo-transpiration (Timmer and Weldon, 1967), and limit the recreational uses of water bodies.

The determination of trace-metal uptake and storage by waterhyacinth is

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