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Robin M. Overstreet
Gulf Coast Research Laboratory

Richard W. Heard
Gulf Coast Research Laboratory

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FOOD OF THE RED DRUM, *SCIAENOPS OCELLATA*, FROM MISSISSIPPI SOUND¹

ROBIN M. OVERSTREET AND RICHARD W. HEARD

Parasitology Section, Gulf Coast Research Laboratory,
Ocean Springs, Mississippi 39564

ABSTRACT Examined digestive tracts of the red drum in Mississippi Sound contained mostly decapod crustaceans. Crustaceans accounted for 34 of 59 encountered taxa, more than reported from any other region. Nevertheless, the general diet for 104 fish with food contents out of the 107 examined is similar to that reported for red drum in several other studies from other areas. In addition to crustaceans, fishes followed by polychaetes occurred as the most important items (in 99, 43, and 15% of the drum with food, respectively). Blue crabs occurred in even more drum than the frequently encountered penaeid shrimps. Other commercial species were negligible in the diet. Sixteen large drum from Georgia beaches were also examined; unlike those from Mississippi, many of these contained echinoderms, but not polychaetes or penaeids. We suggest that the red drum's migrations may be regulated by optimal abundance of specific types of dietary organisms.

INTRODUCTION

The red drum, *Sciaenops ocellata*, also commonly called redfish or channel bass, is an important sportfish in Mississippi coastal waters. Consequently, in order to appreciate that fish's relationship with other organisms in the region, we investigated its specific diet in Mississippi and examined the relative extent of its predation on commercial shrimps and crabs. In the northern Gulf of Mexico, the drum typically feeds (1) in shallow marsh areas rooting about with its head lowered and its tail occasionally out of the water; (2) in relatively deep inshore water in depressions behind sandbars or channels adjacent to mud- or grassflats (Yokel 1966), or (3) for large adults, in Gulf water, usually near shore, but occasionally several kilometers offshore. The amount of drum caught from a locality appears directly related to the locality's amount of estuarine area (Yokel 1966).

MATERIALS AND METHODS

A total of 107 red drum, 104 with food in their stomachs or intestines, was collected between May 1976 and August 1977 by hook and line or gill net and placed on ice or frozen until examined. The fish came from a variety of habitats: (1) near barrier islands, (2) open water of Mississippi Sound, and (3) Davis Bayou, Biloxi Bay, and other sites adjacent to marsh grass. After taking standard lengths (SL) of fish, we either immediately identified food items or preserved them in 10% formalin. Twenty-two additional adult drum were examined from Sapelo Island, Georgia, and treated identically.

RESULTS

Fifty-nine different taxa plus remains of several more unidentified ones occurred in the red drum (Table 1). Most

of these were crustaceans and all but one drum with food contained at least one crustacean (99%). Even with the extensive variety in crustaceans, few of which had been reported previously as drum food, blue crabs and penaeid shrimps occurred most frequently. The commonly encountered penaeid and palaemonid shrimps, however, occurred in a smaller percentage of fish longer than 50 cm than of shorter fish. On the other hand, the percentages of drum with blue crabs, the stomatopod *Squilla empusa*, and some other items were greater in the larger fish (Table 2).

Fishes, occurring in 43% of the drum, constituted the second most abundant item. These occurred more commonly in larger fish (Table 2); 65% of those drum over 50 cm had fish in their stomachs compared with 43 and 30% in the two smaller groups. Polychaetes also contributed to the diet, but appeared less important in fish over 50 cm. Other items were rare in the drum examined from Mississippi.

Some seasonality in diets was apparent (Table 3). As examples, some relatively uncommon food items, annelids, echinoderms, and a bryzoan (probably ingested passively while feeding on another organism), occurred only during winter and spring, whereas the stomatopod occurred exclusively during spring and fall. On the other hand, when considering the prevalent blue crabs and penaeid shrimps, we found the percentage of crabs was greater in spring and summer and that of the shrimps in winter and fall.

The contents of 16 relatively large drum from Sapelo Island, Georgia, are listed in Table 4.

DISCUSSION

Even though we list many more specific food items than other reports on the red drum's food, our findings agree generally. Pearson (1929), Gunter (1945), Kemp (1949), Miles (1949;1950), and Knapp (1950) from Texas; Fontenot and Rogillio (1970) and Boothby and Avault (1971) from Louisiana; and Yokel (1966) from Florida all provided data on over 100 examined drum. Contents from numerous juvenile drum have also been recorded from Texas by Miles

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TABLE 1.
Percentage of occurrence of organisms and other material obtained from the stomachs and intestines of 104 red drum in Mississippi Sound.

Food Items	Occurrence (%)	Food Items	Occurrence (%)
Polychaetes		<i>Pinnixa</i> sp.	1.0
<i>Chaetopterus variopedatus</i> tube	1.0	<i>Portunus gibbesi</i>	5.8
<i>Glycera americana</i>	10.6	<i>Processa</i> cf. <i>hemphilli</i>	6.7
<i>Nereis succinea</i>	3.8	<i>Rhithropanopeus harrisi</i>	1.9
Unidentifiable polychaete	1.9	<i>Sicyonia brevirostris</i>	1.9
Stomatopod		<i>Sicyonia dorsalis</i>	1.0
<i>Squilla empusa</i>	8.7	<i>Speocarcinus lobatus</i>	1.9
Amphipods		<i>Tozeuma carolinensis</i>	1.0
<i>Ampelisca abdita</i>	1.0	<i>Trachypenaeus similis</i>	2.9
Unidentifiable amphithoid	2.9	<i>Uca longisignalis</i>	2.9
Decapods		Unidentifiable goneplacid	3.8
<i>Alpheus heterochaelis</i>	5.8	<i>Upogebia affinis</i>	1.0
<i>Alpheus normanni</i>	2.9	Ectoproct	
<i>Callinectes</i> remains	6.7	<i>Bugula neritina</i>	4.8
<i>Callinectes sapidus</i>	17.3	Holothuroid	
<i>Callinectes similis</i>	36.5	<i>Thyonacta mexicana</i>	1.0
<i>Chasmocarcinus mississippiensis</i>	1.0	Echinoid	
<i>Emerita talpoida</i>	1.0	<i>Mellita quinquesperforata</i>	3.8
<i>Euceramus praelongus</i>	1.0	Fishes	
<i>Hepatus epheliticus</i>	5.8	<i>Achirus lineatus</i>	1.0
<i>Hexapanopeus angustifrons</i>	5.8	<i>Anchoa mitchilli</i>	5.8
<i>Hippolyte pleuracantha</i>	3.8	<i>Brevoortia patronus</i>	1.0
<i>Leiolambrus nitidus</i>	1.0	<i>Cyprinodon variegatus</i>	2.9
<i>Lepidopa benedicti</i>	1.9	<i>Diplectrum</i> sp.	1.0
<i>Neopanope texana</i>	27.9	<i>Gobiosoma bosci</i>	1.9
<i>Ovalipes floridanus</i>	2.9	<i>Micropogonias undulatus</i>	1.0
<i>Palaemonetes pugio</i>	8.7	<i>Mugil cephalus</i>	1.0
<i>Palaemonetes vulgaris</i>	5.8	<i>Myrophis punctatus</i>	8.7
<i>Penaeus aztecus</i>	3.8	<i>Paralichthys lethostigma</i>	1.0
<i>Penaeus duorarum</i>	16.3	<i>Selene vomer</i>	1.0
<i>Penaeus</i> remains	6.7	<i>Symphurus plagiusa</i>	4.8
<i>Penaeus setiferus</i>	11.5	Unidentifiable blenniid	1.0
<i>Periclimenes longicaudatus</i>	1.0	Unidentifiable fish remains	23.1
<i>Persephona punctata aquilonaris</i>	3.8	Unidentifiable goby	4.8
<i>Pinnixa chacei</i>	1.9	Algae	2.9
		Detritus	1.9

TABLE 2.

Percentage of occurrence of organism-groups in the digestive tracts of 104 red drum by length-groups from Mississippi Sound.

Food Items	Length of Fish in mm SL			Total (%)
	190-349	350-499	500-780	
	43 fish	35 fish	26 fish	
Polychaetes	18.6	17.1	7.7	15.4
Bryzoan	2.3	5.7	7.7	4.8
Echinoderms	0.0	2.9	11.5	3.8
Stomatopod	2.3	2.9	26.9	8.7
Amphipods	7.0	2.9	0.0	3.8
Penaeid shrimps	44.2	42.9	30.8	40.4
Palaemonid shrimps	18.6	20.0	0.0	14.4
Callinectes crabs	48.8	62.9	53.8	54.8
Other decapods	37.2	65.7	80.8	57.7
Fishes	30.2	42.9	65.4	43.3
Algae	2.3	5.7	0.0	2.9
Detritus	4.7	0.0	0.0	1.9

TABLE 3.

Percentage of occurrence of organism-groups in the digestive tracts of 104 red drum by season from Mississippi Sound.

Food Items	Season				Total (%)
	Winter	Spring	Summer	Fall	
	30 fish	34 fish	26 fish	14 fish	
Polychaetes	33.3	14.7	0.0	7.1	15.4
Bryzoan	13.3	2.9	0.0	0.0	4.8
Echinoderms	3.3	8.8	0.0	0.0	3.8
Stomatopod	0.0	17.6	0.0	21.4	8.7
Amphipods	0.0	0.0	3.8	14.3	3.8
Penaeid shrimps	53.3	23.5	30.8	71.4	40.4
Palaemonid shrimps	23.3	8.8	15.4	7.1	14.4
Callinectes crabs	36.7	70.6	65.4	35.7	54.8
Other decapods	86.7	70.6	19.2	35.7	57.7
Fishes	56.7	41.2	26.9	50.0	43.3
Algae	6.7	0.0	0.0	7.1	2.9
Detritus	3.3	0.0	3.8	0.0	1.9

TABLE 4.

Percentage of occurrence of organisms from the digestive tracts of 16 specimens of red drum, 43 to 102 cm long, caught from June through August 1970 at different beach localities of Sapelo Island, Georgia.

Food Items	Occurrence (%)
Molluscs	
<i>Barnea truncata</i>	6.3
<i>Petricola pholadiformis</i>	6.3
<i>Sinum perspectivum</i>	6.3
Crustaceans	
<i>Callinectes sapidus</i>	31.3
<i>Callinectes similis</i>	12.5
<i>Hepatus epheliticus</i>	6.3
<i>Ovalipes ocellatus</i>	12.5
<i>Pagurus longicarpus</i>	6.3
<i>Portunus gibbesi</i>	12.5
Echinoderms	
<i>Mellita quinquesperforata</i>	18.8
<i>Sclerodactyla briareus</i>	37.5
Fishes	
<i>Fundulus majalis</i>	6.3
<i>Leiostomus xanthurus</i>	6.3
<i>Menticirrhus americanus</i>	6.3
<i>Mugil cephalus</i>	18.8
<i>Opsanus tau</i>	6.3
<i>Trachinotus carolinus</i>	6.3
<i>Trinectes maculatus</i>	6.3
Unidentified fish	6.3

(1950) and from Louisiana by Bass and Avault (1975). Other less extensive data on food items were reported by Reid (1955), Reid et al. (1956), Simmons (1957), Breuer (1957), Darnell (1958), Inglis (1959), Springer and Woodburn (1960), and Simmons and Breuer (1962). Basically, crustaceans and fishes provided most of the reported food items for the red drum. Components fluctuated some because of various factors. Shrimps and crabs comprised the most frequently encountered crustaceans, and the frequencies of those organisms varied considerably. Gunter (1945) implied that crabs were eaten more in bay waters, whereas shrimp dominated the diet in and near Gulf water; Pearson (1929) considered the blue crab most important as food when small or in molting condition; Miles (1950) thought fishes and crabs became important when shrimp became scarce; Yokel (1966) found shrimp most important in South Florida from July to September, but crabs most important during the other periods; Yokel also found the red drum to eat proportionally more crabs as it grew larger, with xanthid crabs gaining in importance and portunids losing in importance; and Boothby and Avault (1971) considered crabs and shrimp of equal importance in the diet.

Fishes also composed an important part of the red drum's food. Boothby and Avault (1971) found fish in 75% of the stomachs constituting 35% of the food's volume in a south-

eastern Louisiana marsh. All other studies found fish of less importance to drum except that of Inglis (1959) who examined small drum and possibly Breuer (1957) and Simmons (1957) who did not provide data. In most areas, fish appear to become less important to large drum even though often making up a significant part of the drum's diet. Reid et al. (1956) recorded 23 menhaden in one drum. On the other hand, Pearson (1929) suggested small mullet provide the best bait for large drum, and shrimp provide it for small ones. If crabs are to be used as bait, Simmons and Breuer (1962) said the legs should be removed and the body halved. Most feeding takes place in early morning and late evening.

Our study on food contents in Mississippi Sound shows several trends. Three of these are: (1) that polychaetes, especially *Glycera americana*, are fairly important components, being most commonly seen in fish smaller than 50 cm; (2) that echinoderms are eaten by large fish; and (3) that many different decapods, at least 34 in number, provide food. Crabs occurred in more stomachs than shrimps, but both groups, especially commercial species, constitute heavily preyed-on organisms. Actually, the lesser blue crab, *Callinectes similis*, not previously reported from the red drum (except possibly by Kemp [1949] as *C. danae* [see Williams 1974]), occurred in more fish than *C. sapidus* (37 versus 17%).

Knowledge about the habits of the decapods listed in Table 1 reveals that the red drum feeds in sandy to muddy bottoms from both shallow and moderately deep water. A few dietary organisms such as *Chasmocarcinus mississippiensis*, a commensal crab, have been observed in the locality infrequently. Most species, however, make up common components of the different ecosystems in and adjacent to Mississippi Sound.

Large drum feeding near the high energy beaches of Sapelo Island, Georgia, (Table 4) reveal crustaceans and fishes as important dietary components. They, however, also feed heavily on echinoderms. Additionally, molluscs occurred, but not polychaetes. As in Mississippi, the variety of both decapods and fishes is extensive.

Grassbeds also constitute an important community in which drum, especially preadults, feed. Specific animals act as indicators of fish feeding in that habitat. Some are *Neopanope texana*, *Hippolyte pleuracantha*, and *Penaeus duorarum*. Other animals support feeding activities in other areas. As examples, *Rhithropanopeus harrisi* shows feeding from upper-bay, low-salinity areas; *Uca longisignalis* from shallow mudflats; and *Emerita talpoida*, *Pinnixa chacei*, and *Mellita quinquesperforata* from open sandy beaches.

The seasonality of the drum's diet probably primarily reflects availability of the specific organisms, but some selectivity also appears evident. Fall is when shrimp, especially white shrimp, are abundant and when 71% of the drum had penaeid shrimp as food contents. On the other hand, many shrimp should also be available during spring and summer. During those two seasons, blue crabs seem to

have greater priority as food. When blue crabs were not prevalent during winter, various crabs and a few other miscellaneous decapods prevailed both as food contents and as common organisms in the habitat.

Whereas the menhaden and mullet are the most common dietary fishes in some areas, those items were not encountered commonly in our food samples. In fact, the most frequently identified fish were the speckled worm eel and bay anchovy. Many fish could not be identified because of their digested state.

Conspicuous by their absence were gastropods, bivalves, mysids, and copepods. These, especially the latter two, both of which are crustaceans, probably occur commonly in fingerling drum from Mississippi Sound.

Even though the diet of red drum from some other geographic regions consisted largely of individuals comprising one taxon, we did not encounter similar findings. We, however, did find 18% of the drum with a single food source and, of those, ten had a blue crab, six had a penaeid shrimp, two had the mud crab *Neopanope texana*, and one had a fish. About half of those drum came from the northern part of the Sound near marsh grass and the remainder came from near the barrier islands.

We did not sample small red drum; however, a few other workers have. Bass and Avault (1975), in the most extensive report, found that fish less than 30 mm fed primarily on zooplankton. As the fish reached 26 mm long, the frequency of calanoid copepods dropped off and that of mysids increased. Little difference occurred between food contents encountered during day or night until the drum reached 65 mm when consumption of shrimp prevailed during the day contrasting with that of fish at night. Polychaetes and amphipods also accounted for considerable food. Evidence

based on fewer samples by Hildebrand and Schroeder (1928), Miles (1950), Springer and Woodburn (1960), and Odum and Heald (1972) essentially corroborated the above findings. Inglis (1959), who examined fish 30 to 100 mm long from Texas, however, found about 80% contained fish, 10% contained amphipods, and fewer contained a variety of other organisms.

Migration of red drum might be dictated by the abundance of specific food items. In other words, the drum might continually migrate in a relatively consistent pattern in order to optimize specific rich food sources. Thus, fish would exploit different areas seasonally. The data from Sapelo Island, Georgia, reveal that large fish fed heavily during the summer on the five-lunuled sand dollar *Mellita quinquesperforata* and the sea cucumber *Sclerodactyla briareus* near the high energy sandy beaches. We also recovered similar items in a few fishes during May from Mississippi, and Thomas McIlwain (personal communication) found numerous individuals of the sea catfish, *Arius felis*; the sea pansy, *Renilla muelleri*; and *M. quinquesperforata* in six 9- to 10-kg fish caught off Horn Island in September 1966. Possibly the fish that ate echinoderms and associated infauna were migrating to other regions with relatively underutilized crustaceans, but taking advantage of different underutilized subsurface organisms on the way. These items are probably important to the overall diet of red drum and to its natural history.

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