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OBSERVATIONS ON MASS MORTALITIES OF THE SOOTY EEL, *BASCANICHTHYS BASCANIUM*, AND THE SPECKLED WORM EEL, *MYROPHIS PUNCTATUS*, ASSOCIATED WITH A FISH KILL IN THE MISSISSIPPI SOUND

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ABSTRACT Mass mortalities of the sooty eel, *Bascanichthys bascanium*, and the speckled worm eel, *Myrophis punctatus*, were observed in association with a fish kill which occurred the morning of 18 June 1994 on the south shore of Deer Island, a nearshore barrier island located off Biloxi, Mississippi. *B. bascanium* and *M. punctatus*, as well as other fishes, were found dead and dying near the shore in reddish-brown water and along a lengthy stretch of fringing sandy beach. Both species of eels are infrequently reported from Mississippi waters but were the most abundant fishes recorded from the kill. A visual census conducted along ~1.6 km of shoreline and partially submerged tidal flat estimated eel mortalities at 8,000 individuals. The presence of highly discolored water and the lethargic behavior displayed by live eels and other fishes at the site of the kill suggested the episode may have been related to a localized phytoplankton bloom.

Introduction

Two species of the circumglobal ophichthid eel genus *Bascanichthys* Jordan and Davis, *B. bascanium* (Jordan) and *B. scuticaris* (Goode and Bean), are reported from the Gulf of Mexico (Leiby and Yerger 1980). Both species occur inshore and in shallow bays, however, only *B. bascanium* has been reported to occur off Mississippi (Leiby and Yerger 1980). The speckled worm eel, *Myrophis punctatus* Lütken, also occurs in nearshore waters of the Gulf of Mexico (Joseph and Yerger 1956; Springer and Woodburn 1960) and occasionally enters fresh water (Gunter 1956; Hoese and Moore 1977). According to Hoese and Moore (1977), only the juveniles of *M. punctatus* are found inshore, however, McCosker et al. (1989) reported that the normal locality for *M. punctatus* is inshore waters.

In a review of the taxonomic history of the genus *Bascanichthys* in the western Atlantic Ocean, Leiby and Yerger (1980) reported only 9 specimens of *B. bascanium* in available collections from Mississippi waters, and presented the only known published account of the occurrence of *B. bascanium* off Mississippi. *B. bascanium* was not collected during an extensive fisheries sampling program conducted in Mississippi coastal waters during 1982-95 by personnel of the Gulf Coast Research Laboratory, Ocean Springs, Mississippi (James Warren, personal communication). Only 74 specimens of *Myrophis punctatus* were collected during the same 14-year project, and Christmas and Waller (1973) reported they collected only one speckled worm eel from Mississippi waters during a study of estuarine fishes conducted during 1968-69.

With few exceptions (Gunter and Lyles 1979; Christmas and Waller 1973) the mortalities of specific fishes associated with "fish kills" which have occurred in Mississippi coastal waters have not been reported in the scientific literature, and none of the published reports identified the sooty eel and the speckled worm eel as components of the dead fish fauna. Considering the uncommon status ascribed *B. bascanium*, locally, and the infrequently reported occurrence of *M. punctatus* in local field collections, observations of mass mortalities of both species associated with a fish kill in Mississippi waters were considered noteworthy.

The fish kill we report here occurred on 18 June 1994 along the southern shoreline of Deer Island, an uninhabited nearshore barrier island located off Biloxi, Mississippi. Deer Island borders the Mississippi Sound on its south shore and the Bay of Biloxi on its north shore (Figure 1). The island is 6.4 km in length and 0.4 km at its widest point and is accessible only by water. Observations on the fish kill per se are less complete than is desirable, but in view of the relative absence of published local accounts on this subject it seemed worthwhile to present them in some detail.

Methods

On 18 June 1994 at 0900 h, one of us (RPD) encountered a fish kill in progress along the south beach of Deer Island. Later (1100 h) during the same day, both authors visited the site of the kill and made various qualitative observations during an investigation of the central portion of the island's southern shoreline.

A visual survey was conducted along a randomly selected stretch (~1.6 km) of the island's south shoreline in order to investigate the magnitude of the kill and to ascertain which species were affected. With the exception

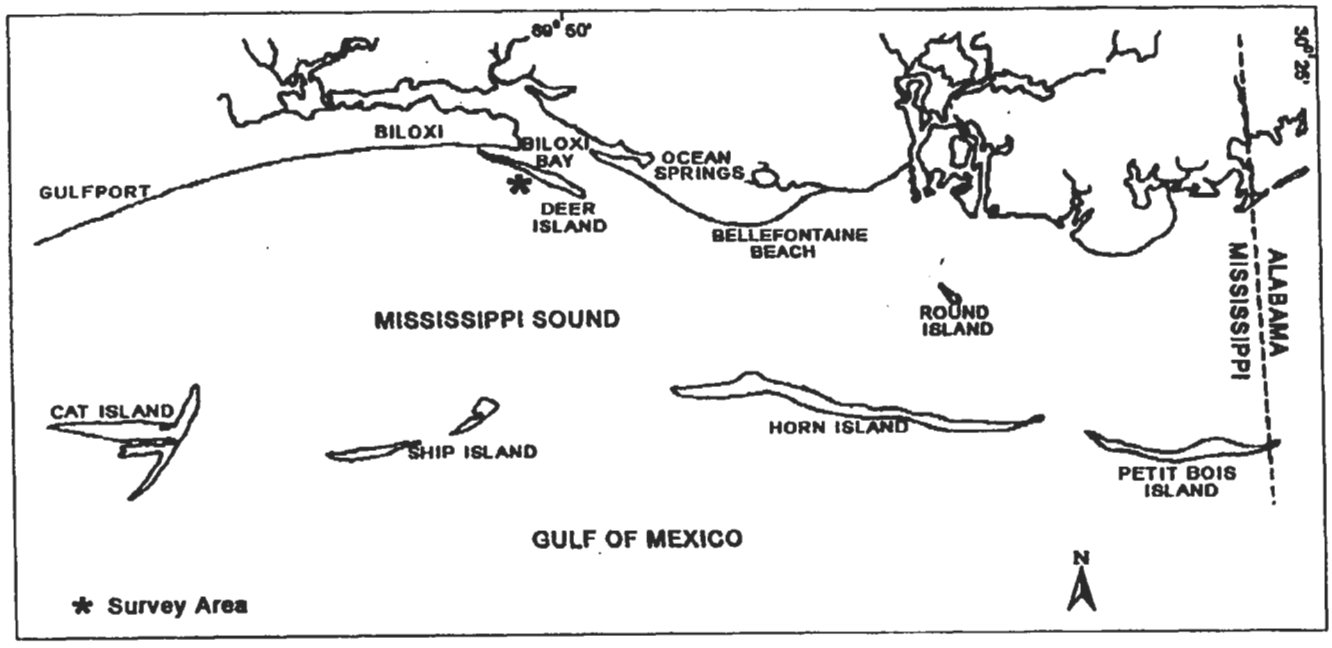

Figure 1. Map of the Mississippi Sound showing the location along the southern shoreline of Deer Island where mass mortalities of *Bascanichthys bascanium* and *Myrophis punctatus* were observed.

of eels, only the fishes which were washed-up on the beach or which were stranded at the water's edge were included in our initial survey. Fishes were identified in the field, and their numbers were estimated. Due to the extraordinarily high number of eels observed, another visual survey was conducted at two locations along the 1.6 km of shoreline, considered representative of the affected area, specifically for the purpose of obtaining a reasonable estimate of the number of eels present. The survey consisted of counting the approximate number of eels along two transects established perpendicular to the beach and located ~0.8 km apart. Each transect extended from the mark of recent high tide on the beach seaward across the submerged tidal flat for a distance of ~50 m, the point at which the discolored water prohibited visibility of the seafloor. The number of eels observed per m^2 of substrate along the length of each transect was noted. These values were used to estimate the total number of eels affected by the kill along the 1.6 km section of the island's south shore. The expansion formula used to estimate total numbers of dead/dying organisms (Harper and Guillen 1989) was:

$$\frac{\text{km of beach examined} \times 1000 \times \text{fish counted}}{\text{Sum length of transects (m)}}$$

On-site identification of eels was not feasible, thus specimens (dead and dying) were randomly collected along the transects and throughout the survey area for laboratory identification. Specimens were later preserved in 10% buffered formalin.

RESULTS

An investigation conducted at the site of the kill revealed substantial numbers of fish and a few (<50) blue crabs (*Callinectes sapidus*) dead and dying near and along the shore in reddish-brown water and along a lengthy stretch of fringing sandy beach.

Most of the fish were found crowding the water's edge and were either floating or lying on the bottom, and most of those were dead. Fishes included in our shoreline assessment were: Atlantic stingray (*Dasyatis sabina*), gulf menhaden (*Brevoortia patronus*), hardhead catfish (*Arius felis*), pinfish (*Lagodon rhomboides*), croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), stargazer (*Astroscopus y-graecum*), striped burrfish (*Chilomycterus schoepfi*), southern flounder (*Paralichthys lethostigma*), blackcheek tonguefish (*Symphurus plagiusa*), hogchoker (*Trinectes maculatus*) and eels. *D. sabina*, *A. y-graecum*, *C. schoepfi* and *P. lethostigma* were each represented by fewer than 5 specimens, whereas we estimated the number of individuals for each of the other species encountered, with the exception of the eels, to range between 50-100. Small croaker, hardhead catfish and spot were among the most numerous fishes observed, however, most striking by far was the vast number of eels, later identified as the sooty eel, *Bascanichthys bascanium*, and the speckled worm eel, *Myrophis punctatus*.

Eels were prevalent along the 1.6 km of shoreline examined, and occurred from the water's edge to the most recent high tide mark located ~1.5 m up the face of the

moderately sloping beach. Most eels found on the beach were dead and lay totally exposed on the sand, while the few live individuals were lethargic and partially burrowed, tail-first, in the moist sand. Many eels were also observed along the expanse of the submerged (0.5 m water depth) tidal flat which extended several meters off the island's south beach, where dead eels lay either fully exposed or partially burrowed in the sandy substrate. Live eels on the tidal flat were found partially burrowed with their torsos waving rhythmically in the near calm waters. We estimated that greater than 75% of the eels observed on the tidal flat were dead.

The results of a visual survey conducted along two 50 m transects provided an estimate of 5 eels/m^2 of substrate. A cursory examination of a wide expanse of the tidal flat revealed estimated numbers of eels per square meter of substrate analogous to numbers estimated along the transects. We estimated the number of dead and dying eels along the 1.6 km section of the south shore at 8,000 individuals. We believe this to be a conservative estimate.

Identifications of dead and dying eels collected randomly throughout the survey area (N=41) indicated that *B. bascanium* and *M. punctatus* were present in roughly the same numbers in our samples (*B. bascanium*, N=23; *M. punctatus*, N=18). Total lengths of *B. bascanium* and *M. punctatus* ranged 133-474 mm and 104-155 mm, respectively. We were assisted in our identification of *Bascanichthys bascanium* by descriptive information provided by Leiby and Yerger (1980). No other species of eels were found.

DISCUSSION

Sporadic nearshore mortalities of demersal fish and crustaceans occur throughout the world (Loesch 1960). These events occur with some frequency and at many locations along the U.S. Gulf coast (Gunter and Lyles 1979) and are generally associated with blooms of phytoplankton, usually diatoms or dinoflagellates. Conspicuous outbreaks of discolored water caused by phytoplankton blooms periodically occur in Mississippi coastal waters (Perry et al. 1979; Eleuterius et al. 1981). Because many of these outbreaks are of short duration, they receive little or no attention and are rarely reported in the scientific literature. Phytoplankton blooms are often suggested as the cause of fish kills and "jubilees" which occur along the Mississippi coast (Perry and McLelland 1981). The phenomenon wherein fish and crabs crowd into shallow water along the beaches of Mississippi and Alabama during summer months is locally termed jubilee and was first reported by Loesch (1960) and later by Gunter and Lyles (1979).

Gunter and Lyles (1979) reported on the occurrences and probable causes of jubilees and fish kills along Bellefontaine Beach (Figure 1) located in Jackson County, Mississippi and remarked that such events were probably related to dinoflagellate blooms observed in the area. Fish kills associated with blooms were generally initiated in the early morning hours between midnight and daylight and occasionally continued into the day (Gunter and Lyles 1979). The largest fish kill observed by Gunter and Lyles (1979) along the Bellefontaine shoreline extended for a distance of about 8 km and "perhaps further". Bellefontaine Beach is located ~5.0 km east of Deer Island.

The specific cause(s) of the fish kill we observed was unknown, however, the event apparently had been on-going for several hours. Upon first arriving at the scene we speculated that the fish floating along the shoreline were by-catch from shrimping vessels working in the Mississippi Sound, but we quickly realized that the profusion of live, albeit languid, fish and crabs crowding the water's edge, the abnormally high numbers of dead and moribund eels blanketing the tidal flat and the presence of highly discolored water signalled a fish kill was in progress. The fact that eels had uncharacteristically emerged from their burrows en masse along the tidal flat during daylight, many ultimately to die, indicated the presence of unfavorable conditions.

Since our visit to the site of the fish kill was purely one of an inquisitive nature, we were without water sampling instrumentation and biological collecting gear and, therefore, were unable to measure water temperature and dissolved oxygen or to sample the discolored water for the presence of diatoms or dinoflagellates. The salinity of a small sample of water collected at the site and brought to the laboratory measured 6.3‰. Plans to return by skiff to the island later in the day for a more extensive investigation were curtailed by severe weather and rough seas. Inclement weather also prevented us from returning the following day (19 June) as well.

On the afternoon (1400 h) of 18 June we also inspected ~1.0 km of southern shoreline on the eastern end of the island and found no discolored water or indications of a fish kill. We did not examine the western end of the island, however it was reported to us that on the morning of 18 June a Biloxi fisherman "picked-up" more than 400 live flounders near the shore in "dark water" along the western end of the island's south beach, however, the fisherman made no comments regarding any sightings of dead or dying fish (Pat Kaluz, Biloxi Harbor Bait and Fuel Dock, personal communication). Although we observed a few fish floating at the surface of the water westward of the area we examined, we did not investigate, however, we believe it possible that the fish kill extended to the island's western end. To our knowledge no other accounts of discolored water or dead/dying fish within the vicinity of Deer Island were reported.

Perhaps the kill we witnessed during the morning of 18 June was a result of a localized, short-term phytoplankton bloom as suggested by the highly discolored water, however we did not detect the odor of decaying phytoplankton or hydrogen sulfide gas which reportedly often accompanies bloom related fish kills (Connell and Cross 1950; Gunter and Lyles 1979; Harper and Guillen 1989). Interestingly, one of us (RPD) previously had visited the identical area of the south shore on 17 June, the day prior to the episode, and observed no indications of a fish kill or discolored water. Jubilees that occur along the shores of Mobile Bay, Alabama usually develop rapidly in early morning hours before sunrise (Loesch 1960).

During a return visit to the kill site by one of us (RPD) on 20 June no discolored water was observed within the area. On that occasion water temperature and salinity were measured at 20° C and 7.2‰, respectively. Desiccated and partially decomposed carcasses of eels and other fishes were found widespread along the shoreline and tidal flat. No living eels were observed.

Gunter and Lyles (1979) reported that during three different jubilees along Bellefontaine Beach, menhaden, hogchokers, stargazers, croakers, hardhead catfish and "lots of eels" were either "sluggish" or dead and dying in either yellow-brown or reddish water. Loesch (1960) reported that species typically found during jubilees which occurred along the shores of Mobile Bay, Alabama were demersal species such as crabs, stingrays, flounders and worm eels, however, he noted that mortalities were rare and that people were not reluctant to eat fish and crabs taken during such incidents. The fishes listed by Loesch (1960) and Gunter and Lyles (1979) were among the species we encountered off Deer Island.

The actual areal extent and the magnitude of the effects of the fish kill were unknown. We could not realistically determine how far off the beach the discolored water extended. It is possible that some of the fishes observed near the shore had actually died further off the beach and were washed up by the recent high tide. Due to restricted visibility we were unable to determine if eels beyond the seaward terminus of the 50 m transects had been affected.

Leiby and Yerger (1980) stated that species of *Bascanichthys* appear to be more common in Gulf coastal waters than the various collecting methods indicate, and recounted that, following a red tide kill in September 1974 which extended from Pensacola to Panama City, Florida, examination of deteriorated fish carcasses in the field revealed a minimum of 30 specimens of *Bascanichthys* per 100 m of beach. Christmas and Waller (1973) collected only one specimen of *Myrophis punctatus* during a fisheries sampling program conducted along coastal Mississippi during 1968-69 and remarked that the speckled worm eel was probably much more abundant than their samples indicated. The infrequent occurrence of both species in local collections is probably related to the types of sampling gear and methods used and the fossorial habits of *B. bascanium* and *M. punctatus*. We report that *B. bascanium* and *M. punctatus* were found in abundance in the nearshore waters of the Mississippi Sound following a localized fish kill. Random collections (some removed from their burrows) of *B. bascanium* and *M. punctatus* from a partially submerged tidal flat off Deer Island showed that both species were members of the island's sandy south shore benthic community.

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