

Gulf Research Reports

Volume 6 | Issue 3

January 1979

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Harriet M. Perry

Gulf Coast Research Laboratory

Kenneth C. Stuck

Gulf Coast Research Laboratory

Harold D. Howse

Gulf Coast Research Laboratory

DOI: 10.18785/grr.0603.16

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Recommended Citation

Perry, H. M., K. C. Stuck and H. D. Howse. 1979. First Record of a Bloom of *Gonyaulax monilata* in Coastal Waters of Mississippi. *Gulf Research Reports* 6 (3): 313-316.

Retrieved from <http://aquila.usm.edu/gcr/vol6/iss3/16>

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FIRST RECORD OF A BLOOM OF *GONYAULAX MONILATA* IN COASTAL WATERS OF MISSISSIPPI

HARRIET M. PERRY, KENNETH C. STUCK
AND HAROLD D. HOWSE
*Fisheries Research and Development,
and Microscopy Sections,
Gulf Coast Research Laboratory,
Ocean Springs, Mississippi 39564*

ABSTRACT Data are presented on a bloom of the toxic dinoflagellate *Gonyaulax monilata* in coastal waters of Florida, Alabama, Mississippi and Louisiana. This paper documents the first record of a bloom of this species in Mississippi Sound and adjacent Gulf of Mexico.

INTRODUCTION

Red tides resulting from toxic dinoflagellate blooms are a common phenomenon in the coastal waters of Florida and Texas. Periodic blooms of the unarmored dinoflagellate *Gymnodinium breve* have created both economic hardships and public health problems for residents of the Florida west coast for over 100 years. *Gymnodinium breve* tides occur most frequently from Anclote Keys off Tarpon Springs to the Florida Keys (Joyce and Roberts 1975). Toxic red tides in northern Gulf waters more often are associated with blooms of the armored dinoflagellate *Gonyaulax monilata*.

Howell (1953) first described *G. monilata* and found it was associated with discolored water and small fish kills on the east coast of Florida near Melbourne. He also identified this dinoflagellate as the causative organism for the red water and fish kill reported by Connell and Cross (1950) from Offats Bayou, Galveston, Texas (Wardle et al. 1975). Gates and Wilson (1960), Marvin (1965), Marvin and Proctor (1965), Ray and Aldrich (1966) and Wardle et al. (1975) have since documented the occurrence of summer blooms of *G. monilata* in the Galveston area. Williams and Ingle (1972) studied a *G. monilata* bloom associated with a fish kill from the west coast of Florida, establishing the first record of its occurrence in offshore waters.

Red tides caused by toxic dinoflagellate blooms have not been reported from Mississippi Sound, although phytoplankton blooms causing discolored waters are a frequent occurrence during warmer months. The senior author observed extensive blooms of the blue-green alga *Oscillatoria erythraeum* in waters near the offshore barrier islands in August 1974 and July 1976. Small localized blooms along mainland beaches may be responsible for the "jubilees" that occur periodically (Gunter, personal communication).

MATERIALS AND METHODS

Aerial surveys were made on August 14, 17, 21, 29 and on September 25, 1979, to monitor the bloom and map the

affected areas in Mississippi waters. A number of investigations were conducted by boat to collect samples of the organism and to check for fish kills. Cell counts were made from dip samples taken in areas of intense water discoloration. After measuring the volume of the sample, it was gently mixed and an aliquot withdrawn. The aliquot was placed in a settling chamber for a period of 24 hours. The organisms were identified and counts made in 50 fields (chosen randomly) at a magnification of 250X using a Zeiss inverted microscope equipped with phase contrast. Determination of numbers of organisms per liter was made using the following formula:

$$\text{cells/liter} = \frac{\text{number counted} \left[\frac{\text{total area}}{\text{area covered}} \right] \left[\frac{\text{concentrated volume}}{\text{aliquot volume}} \right]}{\text{liters filtered}}$$

Observations by personnel of the National Marine Fisheries Service (NMFS) Laboratory in Pascagoula, Mississippi, and reports from local fishermen were also recorded.

RESULTS AND DISCUSSION

Reports of red water in the vicinity of Ship Island Pass were received by Gulf Coast Research Laboratory personnel on 8 August 1979. Analysis of samples taken on 9 August confirmed the presence of large numbers of the dinoflagellate *G. monilata*.

Gonyaulax monilata is a small, sub-spherical armored dinoflagellate that appears somewhat flattened through the antero-posterior axis. It characteristically forms chains of up to 40 cells in length (Figure 1), but also may exist as single cells (Howell 1953). The incidence of long chains in a bloom serves as an index of the growth phase (Aldrich et al. 1967). Rapidly increasing populations have the highest percentages of individuals in long chains, while short chains of two and four cells are more common during the stages of maximum and declining numbers.

The initial aerial survey on 14 August located extensive

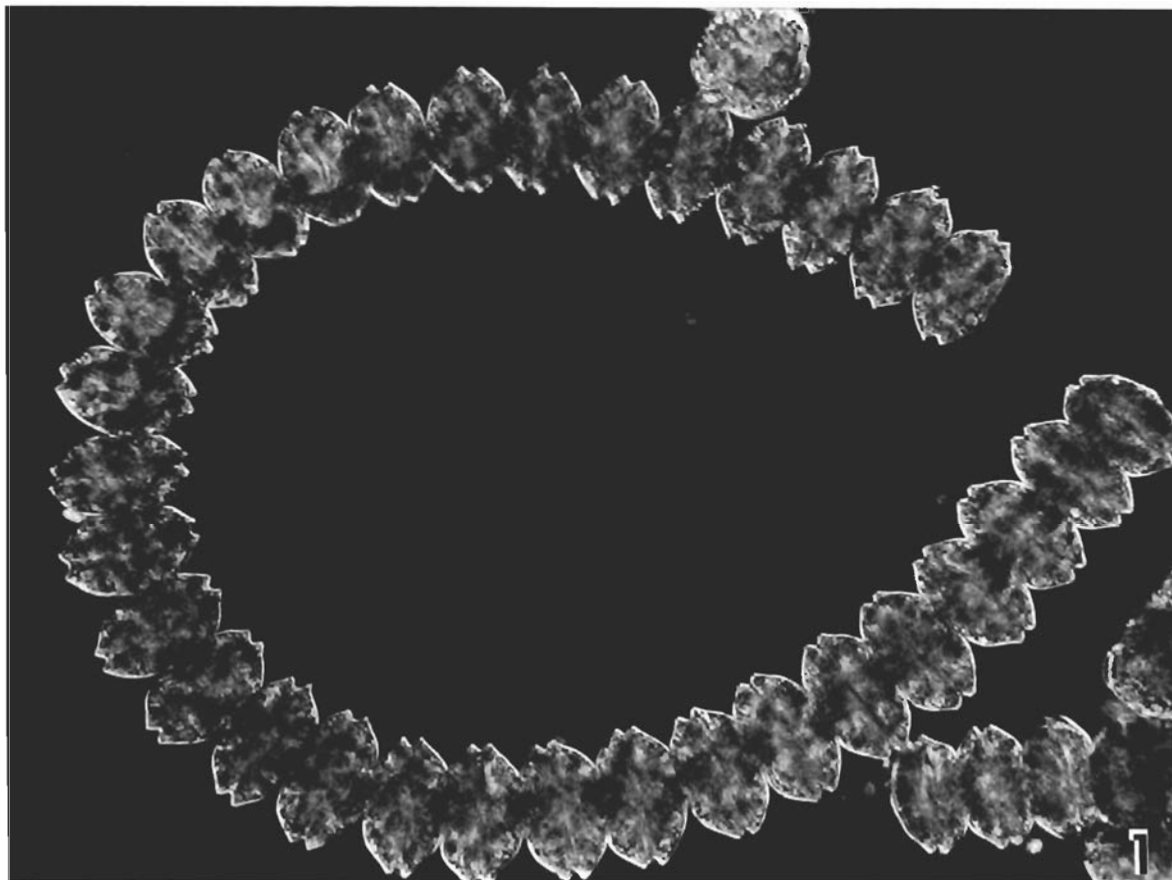


Figure 1. A photomicrograph of *Gonyaulax monilata* showing the long chain structure characteristic of this dinoflagellate. Normarski differential interference contrast, X 210.

areas of discolored water in the western sector of Mississippi Sound and adjacent Gulf of Mexico (Figure 2).

Heaviest concentrations of the organism were found between Cat and Ship islands. Long streaks of red water were noted south of these islands extending into upper Chandeleur Sound, Louisiana. Large patches of discolored water were observed in Mississippi Sound to the north of Cat Island reaching to within 3 miles of the mainland in the Pass Christian area. Smaller patches occurred south of Horn and Petit Bois islands and near Round Island, south of Pascagoula.

A similar pattern of distribution was noted on 17 August, although the water discoloration was less intense. On 21 August, the bloom appeared to be dissipating (Figure 3). The long streaks of red water south of Cat and Ship islands had virtually disappeared and the patches occurring north of Cat Island were diminished in size. A few streaks of intense water discoloration were observed to the east of Grand Island (Halfmoon Island) and a semicircular patch was noted between Cat Island and Isle au Pitre, Louisiana. By 29 August, only a few patches of red water were sighted north of Cat Island and near Grand Island. Visual observations on 30 August by NMFS personnel aboard the R/V OREGON II indicated that the bloom still persisted in off-

shore waters in the area of 29° 15' N, 88° 40' W.

No areas of water discoloration were observed on the final survey on 25 September. The heavy seas and winds brought about by Hurricane Frederic (which struck the Mississippi/Alabama coast on 11–12 September) appeared to have completely dissipated the bloom.

The initial outbreak of the *G. monilata* bloom followed a period of lowered salinities in Mississippi Sound due to heavy rains associated with Hurricane Bob (11 July) and Tropical Storm Claudette (23 July). Surface temperatures and salinities during the bloom ranged from 30.0 to 30.8°C and 24.0 to 26.0 ppt, respectively.

Extensive blooms of *G. monilata* occurred in Florida and Alabama concurrent with the Mississippi outbreak. Large areas of discolored water were reported in the Pensacola Bay estuary (William Young, Florida Department of Environmental Regulation [FDER], personal communication) and in lower Mobile Bay and adjacent offshore waters (Walter Tatum, Alabama Department of Natural Resources, personal communication). Personnel of the FDER monitored the bloom in Pensacola Bay from 2 August until 24 August. A maximum cell count of 3.18×10^7 cells/liter was taken on 15 August. Water temperature was 28.0°C and salinity 14.0 ppt at the time the above sample was collected. Small

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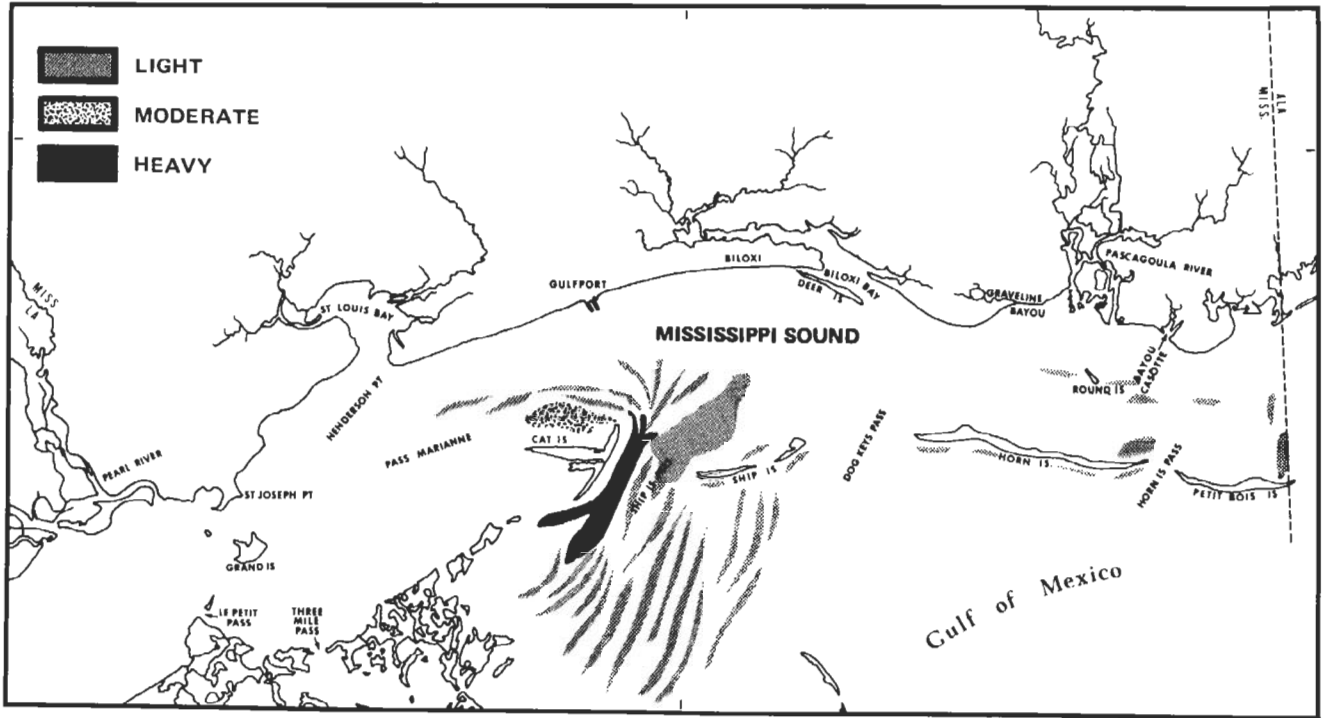


Figure 2. Areal distribution of bloom on 14 August 1979.

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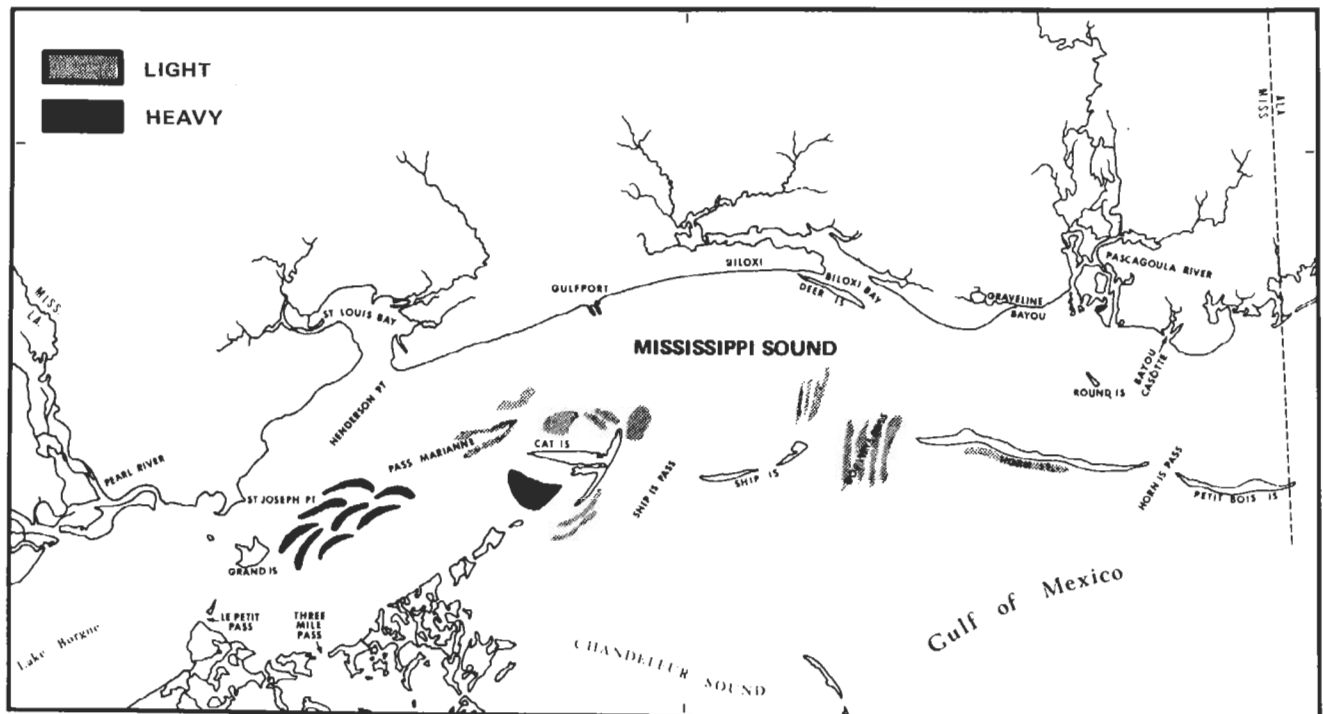


Figure 3. Areal distribution of bloom on 21 August 1979.

fish kills were associated with the bloom in both Florida and Alabama.

A maximum cell count of 1.65×10^7 cells/liter was made from a dip sample in heavily discolored water southwest of Cat Island, Mississippi, on 22 August. Although our cell counts were high enough to cause death in marine organisms (Wardle et al. 1975), no mortality was observed associated with the bloom in Mississippi. Because the bloom occurred in open waters and was patchy in its distribution, schools of fish evidently were able to avoid it.

ACKNOWLEDGMENTS

The authors thank Dr. R. B. Channel of Vanderbilt University for confirmation of identification of *G. monilata* and Chris Modert of Gulf Coast Research Laboratory (GCRL) who analyzed the plankton samples. For their help in field observations, appreciation is extended to R. M. Overstreet, Kay Richards, Kenneth Melvin, Myron Loman, Thomas Van Devender and James Warren, all of GCRL; to Bennie Rohr of the NMFS, and to the personnel of the Gulf Islands National Seashore, National Park Service.

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