Karenia Report, October 5, 2007
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On August 30, dinoflagellates resembling *Karenia spp*. were detected by the University of Delaware Citizen Monitoring Program (UD CMP) in water samples collected just inside the Indian River inlet on a “spring” flood tide. Initially, samples had been collected to help delineate the extent of an ongoing bloom of *Chattonella cf. verruculosa* in a canal system within White Creek, which appeared for the most part to be limited to the canal system. Samples were shipped overnight to Dr. Carmelo Tomas at the University of North Carolina at Wilmington (UNCW) who identified the algae as *Karenia papilionacea* on August 31. The CMP and the Delaware Department of Natural Resources and Environmental Control Division of Water Resources (DNREC DWR) immediately coordinated wide-scale, frequent surveillance at the Indian River Inlet and at several ocean and lower Delaware Bay beaches. This was coupled with targeted sampling events by boat in shellfish harvesting areas of the Inland Bays, the lower Delaware Bay, and in offshore ocean waters until the bloom could no longer be detected on September 12. During the second week, *Karenia brevis* was detected as a secondary member of the bloom. Less intensive surveillance continued at shoreline and offshore locations throughout September.

Blooms of the Florida red-tide dinoflagellate, *Karenia brevis*, have been associated with shellfish toxicity, massive fish kills, and human respiratory irritation from aerosolized toxin for more than 100 yrs, but isolation and characterization of the toxin, brevetoxin, was only completed in 1981. In the past 5-10 years, there have been taxonomic revisions regarding the genus *Karenia*, and taxonomists currently recognize four additional “brevis-like” species, one being *K. papilionacea*, formerly known as *K. brevis* “butterfly type”. Typically, these dinoflagellates are found in the Gulf of Mexico, but occasional blooms have been seen along the Atlantic coast of Florida since 1972. Blooms of *K. brevis* have migrated to the Atlantic by entrainment in Gulf Stream waters. Previously, the northern-most coastal landfall of a toxic *K. brevis* bloom in the U.S. was in North Carolina during the fall and winter 1987-88. During this persistent bloom, 48 cases of Neurotoxic Shellfish Poisoning were documented and the economic losses due to the closure of shellfish beds exceeded $24 million dollars.

Apparently, the potential for toxicity in *K. papilionacea* is much lower than for *K. brevis*, although there is still uncertainty, especially since *K. papilionacea* is typically found further offshore than *K. brevis*. In Florida, detecting cell densities of *K. brevis* at or above 5,000 cells/L triggers closure of shellfish harvesting areas until toxin tests on shellfish meat indicate acceptable levels. During the first few days that the bloom was noticed, our estimated densities of *K. papilionacea* along the coast and in the Inland bays ranged from 12,500 to 75,000 cells/L, but there were no indications of toxicity such as dead fish, invertebrates, or brevetoxin aerosols. On September 4, additional water samples from ocean beaches were sent to Dr. Tomas at UNCW for toxin tests and for further cell identification and enumeration. On September 5, shellfish meats were collected from just inside the Indian River Inlet and were shipped to Leanne Flewelling at the Florida Fish and Wildlife Research Institute (FWRI) for toxin tests. On September 5th, Dr. Tomas reported that it appeared that *K. brevis* was mixed in the bloom samples collected on September 4, but that cells were stressed and more time was needed for new cells to grow to make a definitive identification. On September 7, to ensure a rapid identification, fresh and preserved samples were sent to Jennifer Wolny at the Florida FWRI for identification and enumeration. She confirmed the presence of both species the next day. From September 4-7, the maximum cell density we observed on the coast was 300,000/L for *K. papilionacea* and 100,000/L for *K. brevis*. Due to the uncertainty regarding the potential for toxicity among *Karenia* species, the decision to send water and shellfish meats for toxin tests before the presence of *K. brevis* was confirmed turned out to be a fortunate precautionary measure. Tests on shellfish meat showed no toxicity (by ELISA on September 7 and by mouse bioassay on September 12). On September 13, Dr. Tomas reported that water samples contained very low levels of brevetoxin (LC-MS), and no effects were observed on fish in a bioassay. During the entire bloom, no signs of toxicity were evident from field observations.

During the two-week bloom in Delaware, *K. papilionacea* was consistently detected on the majority of the ocean beaches sampled from Fenwick Island to Cape Henlopen, but it persisted near the Cape for the longest time. Strong flood tides and on-shore winds repeatedly pumped *K. papilionacea* into the Indian River Inlet and, on September 1, it was detected throughout the approved shellfish harvesting areas in the Indian River Bay. In spite of this, it was detected very infrequently within the Inland Bays after that time. Similarly, in the Delaware Bay, *K. papilionacea* was detected as far as 12 miles up the Delaware Bay near the main channel on September 7, but otherwise it was only detected just inside Cape Henlopen during the last few days. An offshore transect on September 6 revealed the presence of *K. papilionacea* up to 9 miles offshore, with a peak cell density at 1 mile offshore (2,000,000 cells/L).

Preserved samples may reveal more detail regarding the presence of both species at lower cell densities than the detection limit of our rapid screening procedure (8,000/L), but currently, *K. brevis* was detected at Cape Shores, just inside the Delaware Bay, at ocean beaches extending to the Indian River Inlet, and up to 10 miles offshore on September 6, with a peak cell density at 1 mile offshore (225,000 cells/L).

There is still much to learn from this event. Scientists at UD, UNCW and FWRI have acquired cultures for future research and have offered to help with the analysis of preserved samples. Researchers in remote sensing and physical oceanography may be able to elucidate the mechanisms of transport retrospectively. Presumably, the bloom was entrained in the Gulf Stream, and wind and currents shaved off an eddy which was then driven onshore. Drought conditions, and low flows out of the Delaware Bay may have enhanced this movement, or may have kept near-shore salinities favorable for these off-shore dinoflagellates. It is quite possible that this occurred before, but went undetected.

Previously, we have sampled at the Indian River Inlet during Spring for other potentially toxic species that are common seen, but have lower potential for toxicity (*Pseudonitzchia spp.* and *Prorocentrum spp*.). In addition, we have sampled the ocean in response to discolored patches of water, but during this event, the water was remarkably clear. The event illustrated the need for routine surveillance of near-shore ocean waters, particularly for *Karenia spp*. in late summer. DNA probes could assist in the detection of these species at low or background cell densities.