THE MELVERN LAKE FISH KILL: RED TIDE IN KANSAS?

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Although marine dinophycean algae have been implicated repeatedly in massive fish kills and in the contamination of seafood intended for human consumption, the toxicological attributes of freshwater dinoflagellates have received comparatively little scientific attention. This report examines the role of the freshwater dinoflagellate, *Gymnodinium acidotum*, in the recent die-off of more than 30,000 fish in Melvern Lake, a large (28 km^2) multipurpose reservoir located on the Marais des Cygnes River in east-central Kansas (Figure 1). Also considered are the potential human health ramifications of *G. acidotum* blooms in Melvern Lake and in similar lakes utilized extensively for public recreation and domestic water supply.

Chronology of Events

The Kansas Department of Health and Environment (KDHE) was first notified of the Melvern Lake fish kill on July 31, 1990. It was learned at that time that the initial stages of the kill had been documented as early as July 26, 1990. Coinciding with the fish kill was a conspicuous, blue-green discoloration of the lake water column, reportedly resulting from a very dense bloom of heavily pigmented, athecate dinophycean algae.

Water quality biologists from KDHE were dispatched to the reservoir on July 31, 1990 to independently verify the occurrence of the fish kill and to collect lake water samples for chemical analysis and microbial and toxicological examination. KDHE personnel visited Melvern Lake on seven other occasions during the period August 1-10, 1990 to gather more comprehensive information on the biological and physicochemical properties of the lake and to obtain, in cooperation with the Kansas Department of Wildlife and Parks (KDWP), fish tissue samples and whole fish specimens for histological and gross pathological examination and pollutant residue analysis.

Pending the results of these analyses, an advisory was issued jointly by KDHE and KDWP cautioning against the utilization of Melvern Lake (and the Marais des Cygnes River immediately downstream of the reservoir) for contact and consumptive recreation, livestock watering, and public drinking water supply. The advisory prompted the temporary closure of the reservoir and compelled municipal drinking water plants drawing from the reservoir (or from the river immediately below the reservoir) to obtain their raw water from back-up sources.

Results of Field and Laboratory Studies

Approximately 90 percent of the fish that died during the Melvern Lake fish kill were channel catfish (*Ictalurus punctatus*). Other afflicted species included smallmouth buffalo (*Ictiobus bubalus*), white crappie (*Pomoxis annularis*), freshwater drum (*Aplodinotus grunniens*), longnose gar (*Lepisosteus osseus*), and carp (*Cyprinus carpio*). Extensive chemical analysis of lake water, lake sediment, and fish tissue samples and pathological examination of fish tissue specimens ruled out disease, anoxia, or high levels of conventional pollutants, metals or biocides as probable causative agents in the Melvern Lake fish kill.

Microscopic examination of lake water and surficial sediment samples revealed high densities of the relatively rare dinoflagellate, *G. acidotum*. The lysed remains of *G. acidotum* cells packed the intestinal lumen of all channel catfish specimens. Severe hemorrhaging and sloughing of the intestinal epithelial lining suggested that the fish had suffered from an uncommonly strong gastrointestinal irritant, presumably associated with the ingested dinoflagellate cells. Lake water containing *G. acidotum* exhibited no ambient acute toxicity to fathead minnow (*Pimephales promelas*) or water flea (*Daphnia pulex*) during laboratory toxicity tests. However, lyophilized phytoplankton materials, comprised almost entirely of *G. acidotum*, demonstrated acutely lethal effects in laboratory mice following intraperitoneal doses of 500-1,000 mg kg^{-1}.

Conclusions

These preliminary findings suggest that the environmental and human health ramifications of freshwater dinoflagellate blooms may be more important than heretofore acknowledged. To adequately provide for the protection of the public health and welfare, as well as for the maintenance of viable fish communities in water bodies subject to blooms of *G. acidotum*, more definitive information is needed on (1) the environmental factors regulating the growth and toxicity of *G. acidotum*, (2) the potency and specificity of the ichthyotoxin(s) produced by the dinoflagellate, and (3) the human health risks associated with the ingestion of dinoflagellate toxin(s) in drinking water, with the consumption of "contaminated" fish, and with direct human exposure to *G. acidotum* during contact recreational activities.

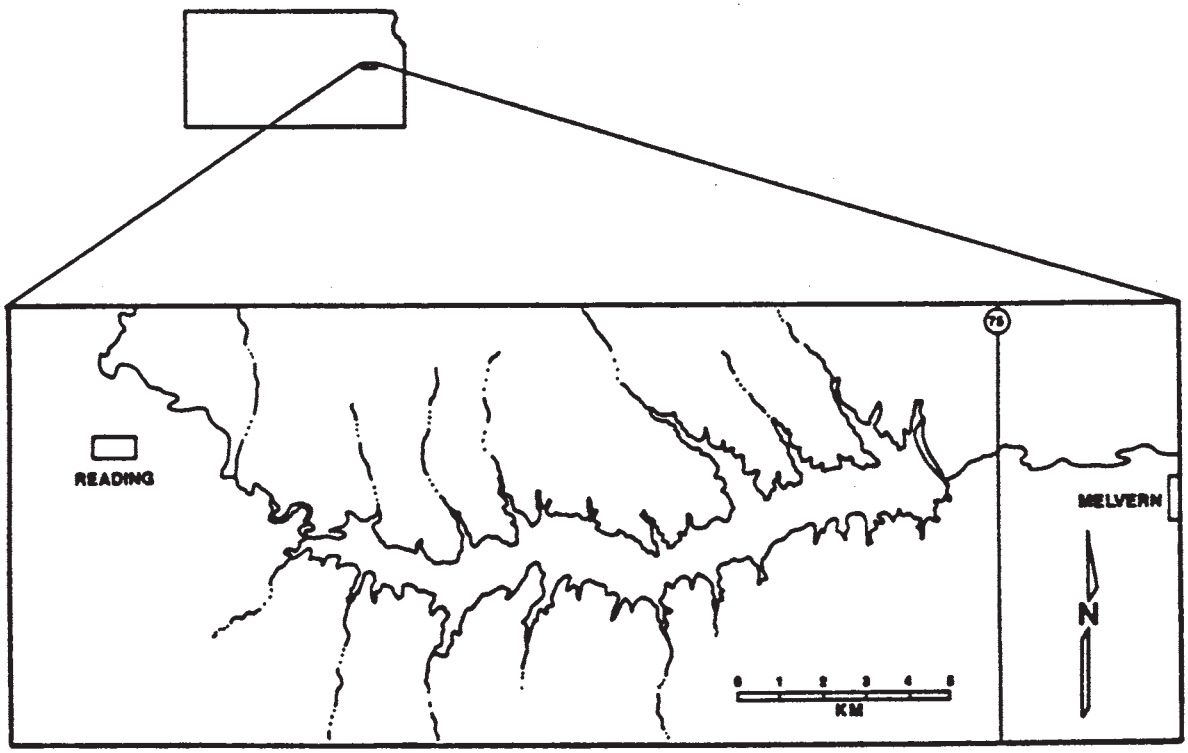

Figure 1. Melvern Lake and vicinity.