

Toxic Chemicals and Trace Metals from Urban and Rural Louisiana Lakes: Recent Historical Profiles and Toxicological Significance

W. JAMES CATALLO,^{*,†}
MATTHEW SCHLENKER,[‡]
ROBERT P. GAMBRELL,[§] AND
BARBARA S. SHANE[⊥]

*Laboratory for Ecological Chemistry and Toxicology (SVM),
Institute for Environmental Studies, and Wetland
Biogeochemistry Institute, Louisiana State University,
Baton Rouge, Louisiana 70803-7511, and Radiation Protection
Division, Louisiana Department of Environmental Quality,
Baton Rouge, Louisiana*

Sediment cores collected from lakes in rural and urban/industrial areas of Louisiana were dated using ¹³⁷Cs, sectioned, and analyzed for a wide range of pollutant chemicals deposited during the period 1950–1991. Mutagenicity testing also was performed on extracts from the core sections. Statistical and other comparisons of chemical data indicated that annual loadings of polycyclic aromatic hydrocarbons, chlorinated chemicals, and trace metals were not significantly different in the urban lake vs the rural lake over the historical period compared. Mutagenic activity was detected in both lakes, primarily in sediments deposited between 1955 and 1980, with minimal activity before and after that period. This was a time of widespread industrial and agricultural activity in Louisiana, before restrictions on chemical releases to the environment were instituted and enforced.

The effects of environmental pollution on ecological and human health is of concern in Louisiana and elsewhere (1–3). Declines in ecosystem function or “health” resulting from chronic pollution occur in concert with other modifications (e.g., fragmentation of ecosystems) operating over decades or longer (4). Human health effects from exposure to environmental toxicants also may require extended periods to manifest and can reflect prolonged exposure to varying levels of pollution in conjunction with other factors (5). In both cases, the relationships between pollution and ecological and human health can be understood more fully when data on historical levels and types of environmental chemicals are integrated with estimates of exposure and biological effects (4, 6). This is the case especially when areas with different kinds and degrees of industrial and agricultural activities are compared.

Records of the distribution and abundances of natural and anthropogenic chemicals can be preserved in sequentially deposited, undisturbed sediment profiles in aquatic systems (7, 8). Geochronological data have been used to document historical changes in levels and compositional complexity of chemicals found in sediment profiles, and these have been related to human and natural processes (9–13).

The purpose of this work was to examine the historical profiles of toxic chemicals in lake sediments in rural vs industrialized areas of Louisiana over the last 50 years and to evaluate changes in mutagenicity of sediment extracts over this period. Related objectives were (a) to determine any significant differences in historical pollutant loadings between rural and urban/industrial areas in Louisiana, (b) to identify the sources of chemicals based on analysis of chemical distributions within samples, and (c) to evaluate these approaches for comparative impact and health assessment and epidemiological studies.

Methods

Study Sites. Two sites were selected in natural freshwater lakes in industrialized and rural areas of Louisiana (Figure 1). The lakes receive sediments primarily from proximal rather than allochthonous sources (i.e., no direct connections to large rivers). There has been no dredging or filling at either site and no direct inputs of point source wastes. Chemical inputs were restricted to the atmosphere and aquatic and terrestrial sources in the watershed.

The rural site was Larto Lake (LL), Catahoula Parish, LA, a backwater lake of approximately 1000 ha (15). The nearest city (Alexandria) is approximately 35 mi west of LL, and as of 1990, there were four hazardous waste sites in Catahoula Parish located >30 mi away from LL (16). The urban/industrial site was Lac des Allemands (LD), located in the Barataria Basin, LA (17, 18). The lake is located in a region

[†] Laboratory for Ecological Chemistry and Toxicology, SVM, LSU.

[‡] Institute for Environmental Studies, LSU.

[§] Wetland Biogeochemistry Institute, LSU.

[⊥] Louisiana Department of Environmental Quality.