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Modeling the Bathymetry of Catahoula Lake: Specialized Technology for Wetland Management

Catahoula Lake is the largest natural freshwater lake in Louisiana, covering more than 46 square miles (120 km^2) (fig. 1). The lake is a principal stopover and wintering site for hundreds of thousands of migratory waterfowl and shorebirds. Scientists from the USGS National Wetlands Research Center are applying some of the research facility=s specialtiesCwetland plant research, aerial and ground surveys, digital mapping, and computer modelingCto facilitate wetland management at Catahoula Lake.

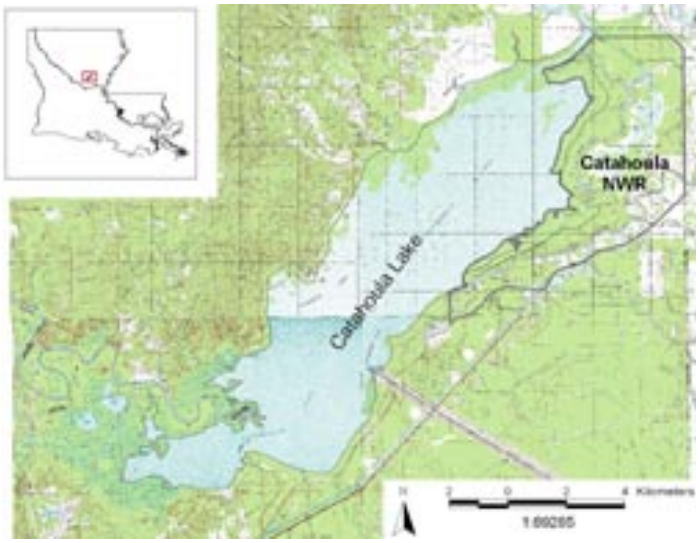

Figure 1. Catahoula Lake National Wildlife Refuge lies on the eastern shore of Catahoula Lake in central Louisiana.

Lake Management

Catahoula Lake is long and shallow with major seasonal fluctuations in water levels. The difference between annual low and high water levels can be 18 feet (6 m) or greater when flooding is extreme. Local rainfall and backwater flooding from the Red, Black, and Mississippi Rivers largely determine lake levels. In 1972, a gated diversion canal was constructed to control water levels.

U.S. Fish and Wildlife Service personnel at Catahoula National Wildlife Refuge manipulate lake water levels under shared management responsibility with the Louisiana Department of Wildlife and Fisheries and the U.S. Army Corps of Engineers. The goal of the current lake management plan is to maintain seasonal trends of winter and spring high water and summer and fall drawdown primarily to provide optimal habitat for migratory birds.

The drawdown periods are characterized by dramatically reduced water levels that are about 8 feet (2.4 m) lower than normal winter and spring water lake level. Refuge personnel were concerned that lake level management could have an undesired effect on the quality and distribution of freshwater emergent plant species. USGS researchers were called upon to determine whether changes in lake-bottom vegetation may be related to drawdown management. Researchers used various crafts and specialized technologies to measure and map the lakebed.

Bathymetric Survey

USGS researchers conducted field surveys of Catahoula Lake during spring high water and summer drawdown to measure water depth, lake bottom slope, and shoreline extent. A laptop computer linked with a Global Positioning System (GPS) receiver and a sonic depth finder recorded water depth (bathymetric) and location data taken during spring at normal high water (fig. 2). With GPS locational data, researchers recorded shoreline extent (i.e., where water meets land) and used survey results to create a detailed model of lake bathymetry, or bottom topography.

Figure 2. USGS scientists logged simultaneous depth measurements and GPS positions across the lakebed at high water every 6-10 feet (2-3 m) along transects spaced at 0.6-mile (1-km) intervals.

Aerial and Ground Surveys

The Catahoula Lake Management Plan calls for drawdown to begin in July of each year. Refuge personnel open the diversion canal floodgate, which allows the lake to drain over a period of weeks. During the drawdown period, USGS researchers used an aircraft equipped with GPS tracking capability to map the retreating shoreline at different lake levels. Following drawdown, lake levels receded to a designated base pool height that is called Apermanent pool.@ Researchers then used an airboat and GPS recorder to map the shoreline of the permanent pool at its seasonal low stage. The shoreline mapping by aircraft and airboat demonstrated concentric boundaries of the lake as it changed with drawdown and provided accurate estimates of the lake=s surface area at each stage (fig. 3). A laser level system and GPS were used to survey the elevation of the exposed lakebed slope above the permanent pool.

Digital Elevation Model

USGS researchers digitized elevation contours of the upland zone around Catahoula Lake into a geographic information system (GIS) to establish a base map for displaying the results of field surveys. Upland contours and bathymetric survey data were combined and interpolated to create elevation estimates for every square meter of lakebed and surrounding upland. Researchers then constructed a digital elevation model (DEM) of the interior and upland basin of Catahoula Lake (fig. 4).

As a geospatial tool for research and management, the DEM will be used to simulate alternative lake drawdown rates and schedules. The Catahoula Lake project has shown how specialized aircraft and watercraft, when combined with depth sounders, GPS, and modern surveying techniques, can be used to map and model landform elevation for important wetland sites.

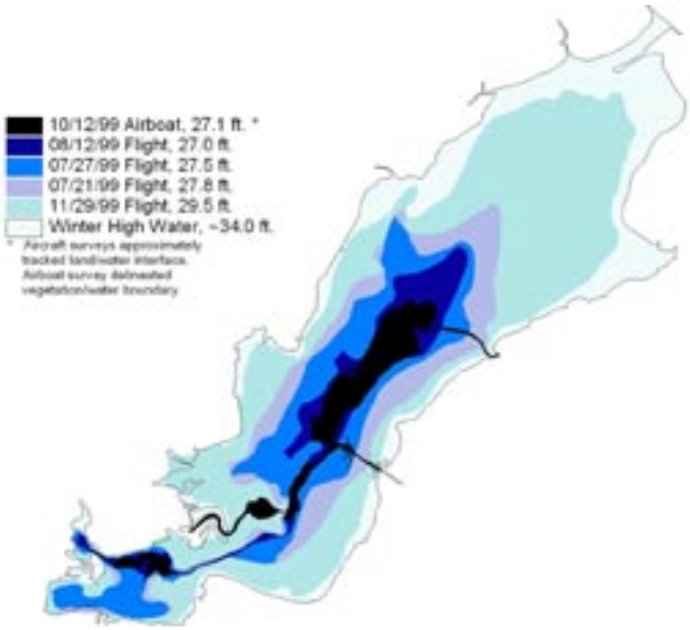

Figure 3. Perimeter shoreline surveys were mapped with GPS technology by aircraft and airboat during drawdown to calculate lake area at various stages.

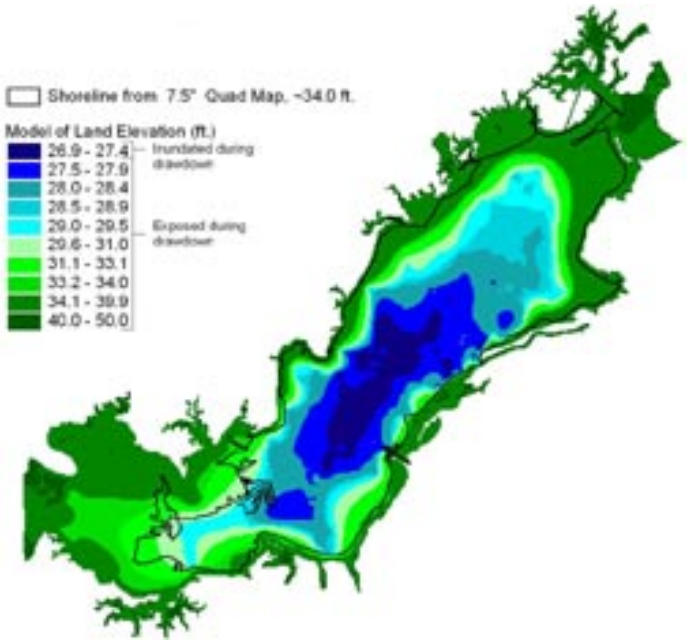

Figure 4. A digital elevation model (DEM) of the bottom topography of Catahoula Lake was created by computer technology to evaluate different drawdown schedules for wetland management.

For more information, contact

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