ACES Final Report Executive Summary

Part 1 Web Summary Report

Period covered by report: October 2001 to December 2003
Date of Final Report: March 31, 2004
Award Number: R-827072-01-1
Title: Changes in water conditions and sedimentation rates associated with construction of the Mobile Bay Causeway
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Institution: University of South Alabama
Research category: Regular grant
Project Period: October 2001 to December 2003

Objectives: This research focuses on Chocalata Bay, a floodbasin now isolated from the larger estuary of Mobile Bay by the Mobile Bay Causeway. Sediment cores from selected locations to the north and south of the Causeway are used to give information on pre- and post-construction conditions in and around Chocalata Bay that can help decision-makers to determine the best course of action to take in mitigating the environmental impact of the Causeway. The study uses (1) diatom analysis as an indicator of water conditions; (2) pollen and phytoliths as indicators of vegetation change; (3) grain size analysis as an indicator of energy conditions; and (4) Cesium 137 (Cs-137), and Lead-210 (Pb-210) to provide dating control for critical horizons in the cores.

Summary of Findings:

Fieldwork was accomplished during the summer of 2002. At least three sediment cores were taken at each of four sites in Chocalata Bay. The longest core (Core 1, 190 cm) was retrieved from the northernmost site. Cores in Chocalata Bay north of the Causeway are at least 1 meter long, those south of the Causeway are slightly shorter. During 2003, work focused on processing samples for pollen and biogenic silica, counting pollen, determining organic carbon content and grain size, and completing Cesium-137 counts. This project provided research experience for one graduate student from marine sciences and six undergraduate students (1 from physics, 2 from biology, 3 from geography, and 1 from geology). Diatom investigations related to this research will be part of a Ph.D. dissertation for one graduate student.

Results to date

Cesium-137 is present only in the top 20 cm of cores inside Chocalata Bay while analysis of the core south of the Causeway has Cesium-137 down to 50 cm. Other cores from sub-estuaries around Mobile Bay have Cesium-137 down to 50-100 cm. This suggests that the sedimentation rate in Chocalata Bay is low because it is currently isolated from Mobile Bay, its primary sediment source. Claims that the Causeway made Chocalata Bay fill up faster with sediment are not supported by our data. If we extrapolate that sedimentation rate back in time, the sediments corresponding to Causeway construction are about 40 cm downcore. Grain size

analyses of the sediment cores indicate that Chocalata Bay was changing from an estuarine to a deltaic environment before Causeway construction. Mobile Bay/delta regional processes controlled the depositional environment. After construction, more specific local influences dominated.

Pollen analysis of Core 1 (and others) shows that pine, bald cypress, and oak have always been the dominant pollen contributing taxa, however at about 40 cm in Chocalata Bay cores, disturbance indicators become important. This coincides well with our extrapolation from the Cesium-137 data that this level marks Causeway construction. Interestingly, water milfoil pollen is not apparent until about 30 cm downcore, some 15-20 years after the Causeway was built. Although some Mobilians blame the Causeway for the proliferation of this invasive aquatic species, our data does not confirm the relationship.

We grouped diatoms into both morphology and salinity classes. In general, biraphid diatoms are mobile while all others attach to plants or sediment. Biraphid diatoms are more common in lower energy environments. They dominate the upper 40 cm of Core 1 inside Chocalata Bay. The upper 40 cm also has slightly higher percentages of freshwater diatom taxa.

These data all confirm that about 40 cm of sediment has accumulated in Chocalata Bay since the mid-1920s. It became calmer and slightly fresher after the Causeway was built. With isolation from Mobile Bay, sedimentation decreased. Although the Causeway obviously had an effect on Chocalata Bay, no dramatic recent changes are evident in the sedimentary record. Efforts to remove parts of the Causeway will disturb the habitat that now exists and may not lead to "restoration" of the original conditions.

Publications/Presentations:

Fearn, M. and McCullough, C. 2004. Ecological impacts of causeway construction. In: 2004 Abstract Volume, The Association of American Geographers 100th Annual Meeting, Philadelphia, Pennsylvania, CD-ROM.

Fearn, M.L., 2004. Ecological Impacts of Causeway Construction, Southeastern Coastal and Atmospheric Processes Symposium, University of South Alabama, March 27.

McCullough, C., Ellison, P. and Fearn, M. 2004. Did Causeway Construction Change Conditions in Chocalata Bay? University of South Alabama Research Forum.

Haywick, D.W., Fearn, M.L. and Sanders, J.M.. 2003. Sedimentation rates in marginal marine environments in southern Alabama, In: 2003 Abstracts with Programs, Geological Society of America, 2003 Annual Meeting, November 2-5, Seattle, WA. Geological Society of America.

Future Activities: Final data processing for this research is not complete, however, no further expenses will be incurred. We will submit our completed final report within six months (no later than September 31, 2004).

Supplemental keywords: estuary, ecosystem, indicators, decision making, Alabama, EPA Region 4.

Relevant web sites: http://www.usouthal.edu/geography/fearn/Causeway.htm

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