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Great Lakes Science Center

Global Climate Change and Hydrology Effects

The roles of climate-driven vegetation changes and autogenic successional changes were studied in ridge and swale terrains along the Lake Michigan coast to evaluate the potential effects of global climate change on Great Lakes wetlands. Study sites at the southern and northern ends of the lake spanned a wide latitudinal range but were influenced by the same lake-level changes. Three types of study were conducted along a transect spanning the chronosequence of wetlands at each site. A 4700-year lake-level history, serving as a proxy for climate change, was reconstructed using sedimentological techniques. Long-term changes in vegetation were reconstructed using paleoecological techniques to determine the response to past climate changes. Modern vegetation was characterized at each site by sampling plant communities along transects in the wetlands between the ridges and then compared with the paleoecological record.

Modern wetland vegetation at the south end of the lake consists of submersed, floating, and emergent marsh communities demonstrating classic marsh successional patterns as wetlands increase in age with distance from the lake, but these patterns have been strongly influenced by past human activity. Modern vegetation at the north end of the lake demonstrates classic boreal succession patterns, grading from wet sand-flat communities to sedge/leatherleaf floating mats to tamarack swamp to cedar swamp as wetlands increase in age. However, inland from the 71st of 89 ridges, the wetlands revert to sedge/leatherleaf dominance with a marked reduction in trees, especially cedar.

The marsh communities (south) might be expected to respond differently than the sedge mat and swamp communities (north) to changes in precipitation and evapotranspiration associated with climate change. However, differences in the role of ground water in local hydrology may explain differences in vegetation patterns among wetlands of differing ages at a given site or differences in vegetation response to past climate changes among sites. Ground-water effects on the older, sedge/leatherleaf wetlands at the northern site seem to be greater than on the younger wetlands closer to Lake Michigan, with greater or more constant supplies perhaps resulting in deeper water and precluding establishment or retention of forested wetlands. Similarly, the overall influence of ground water at the northern site seems greater than at the southern site, with more constant supplies of cold water overriding any air-temperature or precipitation effects of climate change. At the northern site, local conditions seem to dictate wetland hydrology, and a vegetation response to past climate change was not identified in paleoecological work. At the southern site, climate exerts greater control over local hydrology, and wetland vegetation showed a response to past climate changes. These results suggest that wetland response to climate change may be site-specific and dependent on the role of ground-water hydrology, as well as the plant community type associated with the climatic region. More detailed hydrologic studies are needed to substantiate these conclusions and should be incorporated into any project of this nature.

Aerial photograph of ridge and swale terrain near Manistique, Michigan, at north end of Lake Michigan showing a chronosequence of wetlands between beach ridges formed during receding stages of the lake.

Douglas A. Wilcox, USGS Great Lakes Science Center, Ann Arbor, MI; Stephen T. Jackson, University of Wyoming, Laramie, WY; and Todd A. Thompson, Indiana Geological Survey, Bloomington, IN collaborated on this study.

Great Lakes Science Center
1451 Green Road
Ann Arbor, Michigan 48105
(734) 994-3331
http://www.glsc.usgs.gov