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Reading the tale of two rivers: Historical analysis in support of river park management

Note: Aspects of this article were adapted from Engstrom (2009), an introduction to "The recent environmental history of the upper Mississippi River," a special issue of the *Journal of Paleolimnology* (fig. 1).

Figure 1. Cover of the special issue of the *Journal of Paleolimnology*, published in May 2009. The issue examines the environmental history of the Mississippi and St. Croix rivers in the vicinity of Mississippi National River and Recreation Area (Minnesota) and St. Croix National Scenic Riverway (Wisconsin).

MOST OF THE WORLD'S GREAT RIVERS have been substantially altered by centuries of land use conversion, urbanization, and hydrological modification, and North America's greatest river, the Mississippi, is no exception. Some 1,765 river miles (2,840 km) upstream of the Gulf of Mexico lies the confluence of two contrasting tributaries that in many ways epitomize these alterations (fig. 2). One is the main stem of the Mississippi itself, an often turbid and nutrient-rich waterway draining half the state of Minnesota. The Mississippi National River and Recreation Area protects a 72-mile (116 km) reach of this tributary, integrating water from northern forests, vast agricultural landscapes, and the twin cities of Minneapolis and St. Paul. The other is the St. Croix River, which drains largely forested parts of eastern Minnesota and northwestern Wisconsin. One of the eight original rivers protected under the 1968 Wild and Scenic Rivers Act, the St. Croix is often cited as a pristine example of a northern temperate river.

The challenges of managing riverine parks are well recognized. Large, complex watersheds with diverse land uses, multiple pollution sources, and overlapping jurisdictions are common. Determining management goals for national park units in these settings can be difficult, and is often complicated by a lack of information on baseline or reference water quality conditions. In this respect the Mississippi National River and Recreation Area and the St. Croix National Scenic Riverway are at a relative advantage. Long-term water quality monitoring records spanning three decades are available for both park units. Additionally, by fortunate "accident" of geologic history, both the upper Mississippi and the St. Croix rivers possess natural riverine impoundments (Lakes Pepin and St. Croix, respectively), which preserve in their sediments a historical record of changing land use and water quality.

A recent special issue of the *Journal of Paleolimnology* (published online at http://www.springerlink.com/content/100294/; print version volume 41, number 4, May 2009) is devoted to a collection of studies that describe the recent environmental history of these two river impoundments and provide an important context for current water quality management decisions. Blumentritt et al. (2009) summarize the glacial-fluvial origin of Lakes Pepin and St. Croix and their postglacial history. The remaining papers pick up the story near the onset of Euro-American settlement in the early 19th century, quantifying historical nutrient, sediment, and trace metal loading (Balogh et al. 2009; Engstrom et al. 2009; Lafrancois et al. 2009; Triplett et al. 2009), exploring likely drivers of major water quality changes (Edlund et al. 2009a; Mulla and Sekely 2009), and characterizing biological outcomes of these changes (Edlund et al. 2009b).

Collectively, this body of work shows that both lakes (and both park units) have changed substantially since Euro-American settlement. The paleolimnological studies (fig. 3), corroborated by long-term monitoring records, clarified the magnitude of water quality changes in the upper Mississippi River and provided clear evidence that the St. Croix is not immune to the effects of land conversion and population growth. Engstrom et al. (2009) found that sediment loading to Lake Pepin had increased by an order of magnitude since Euro-American settlement and that phosphorus loading had increased sevenfold. Similarly, Triplett et al. (2009) found that phosphorus loading to Lake St. Croix had increased

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Figure 2. The relatively clear waters of the St. Croix River (draining largely forested lands) join the sediment-laden waters of the upper Mississippi River (draining agricultural and urban lands) within the boundaries of the Mississippi National River and Recreation Area and Lower St. Croix National Scenic Riverway at Prescott, Wisconsin.

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Figure 3. Mark Edlund and Laura Triplett collect a sediment core from Lake St. Croix, St. Croix National Scenic Riverway. Sediment samples provided historical evidence for change in water quality in the lake since Euro-American settlement in the region.

fourfold since the mid-1900s, coincident with major shifts in diatom species assemblages and productivity (Edlund et al. 2009a).

These findings have greatly improved managers' understanding of baseline water quality conditions in both rivers and formed the basis for ongoing nutrient and sediment management activities. Plans for mitigating water quality impairments (known as total maximum daily loads, or TMDLs) are under way for Lakes Pepin and St. Croix and rely heavily on this group of studies. In the case of Lake St. Croix, an interagency watershed planning team, chaired by staff from St. Croix National Scenic Riverway, used results from Edlund et al. (2009a, b), Lafrancois et al. (2009), and Triplett et al. (2009) directly to develop biologically based numeric nutrient goals for Lake St. Croix. Together these studies represent a scientific advancement in the application of paleolimnological methods to large river systems. Just as importantly, they serve as an example of how effective cooperation among scientists and agency managers can lead to sound watershed stewardship and ultimately the protection of park aquatic resources.

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