St. Croix Watershed Research Station

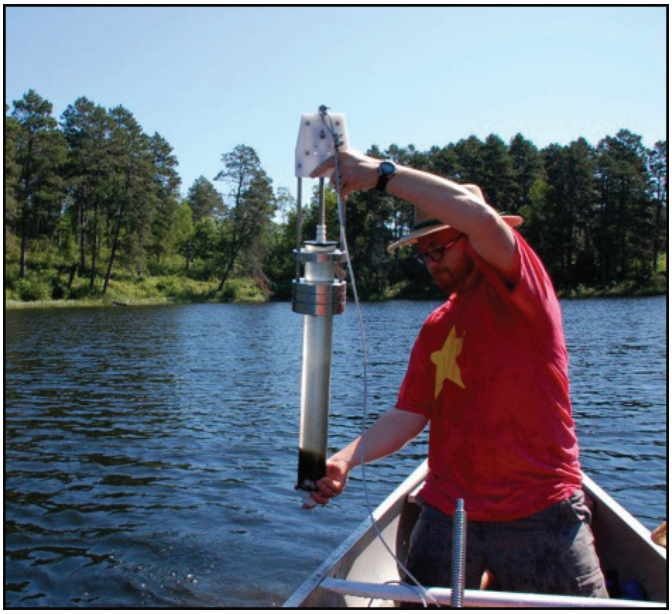
Highlights of 2011 - 2012

Science Museum of Minnesota

Are Rivers Becoming More Erosive?

Erosion along the LeSueur River east of Mankato; photo by Carrie Jennings

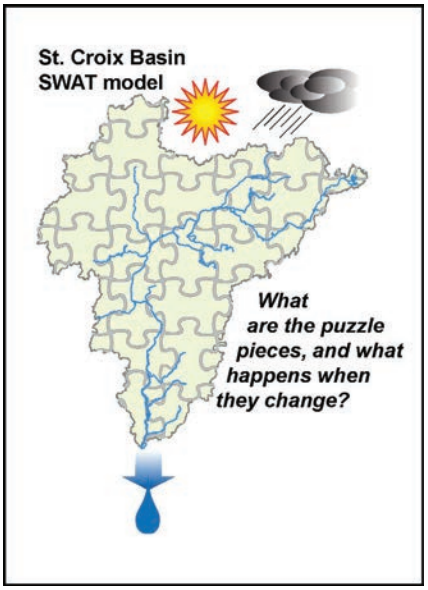
Scientists at the Research Station, the University of Minnesota, and the National Center for Earth Surface Dynamics (NCED) are working together to assess the impacts of 20th century agricultural practices on river flows and sediment loading to the Minnesota and upper Mississippi rivers. Sediment source fingerprinting in Lake Pepin along with detailed sediment budgets of agricultural rivers are clearly showing that erosion of near-channel environments such as streambanks and bluffs are now the dominant source of suspended sediment in the Minnesota River and its tributaries. And a report just published shows that erosion from these sources has increased about 5X over the past 100 years. This raises the question: Have our rivers become more erosive and if so, why? The answer to the first part of that question is a resounding "yes" based on the recent evaluation of historical flows and climate in 21 Minnesota watersheds with differing land-use practices. Results show that flow in many rivers has more than doubled since 1940 and that these flow increases are causing river channels to widen, thus increasing suspended sediment loads. Changes in precipitation, crop conversion, urbanization, and tile drainage over the last 70 years were examined to determine which factors were most responsible for the increased river flows. And counter to certain prevailing views, results show convincingly that artificial drainage, rather than increased precipitation, is the principal driver behind the increasing erosivity of our agricultural rivers.



Will Hobbs samples one of Minnesota's shallow lakes

Carbon Storage in Shallow Minnesota Lakes

The Minnesota landscape is dotted with hundreds of thousands of small shallow lakes and wetlands. Previous research has suggested that these ecosystems have the potential to sequester and bury more carbon (C) than some terrestrial or marine ecosystems. At the same time, many are impaired by excess nutrients and invasive fish species, especially in regions heavily influenced by human activity. Scientists at the Research Station are involved in a number of collaborative projects investigating the functioning and history of these shallow lake ecosystems, in addition to how efficiently they bury C and their role in the global C-cycle. In one key study staff scientist Will Hobbs has been working with researchers at the University of Minnesota and the University of St. Thomas to assess the factors influencing C-burial in 75 lakes throughout the state. A number of factors affect this burial rate: the amount of primary production in the lake (plants and algae), the amount of material coming into the lake from the surrounding watershed, the amount of oxygen in the sediments, and the rate of sediment accumulation. Using high-precision equipment to measure dissolved oxygen in sediment cores, Hobbs and others are beginning to understand the important role that sediment microbes play in breaking down some of the C and respiring it back to the atmosphere, preventing it from being buried. Collectively, the work underway will not only inform us how these ecosystems function, but may shed light on whether their role in the global C-cycle is significant enough to offset today's alarming CO_2 levels.



Model of St. Croix Basin Puts Puzzle Together

On this, everything depends: keep the water clean. This is the vision of the National Park Service (NPS) for the St. Croix, but where does one begin to protect the waters in an 8,000 square mile drainage basin? Urbanization and agriculture are scattered across the basin on different slopes and soils receiving rainfall that varies in pattern and amount every year. Each of these factors is a piece of the puzzle that together determines the water quality in the St. Croix. How do we put them all together, so we can see the big picture?

With funding from NPS, staff scientist Jim Almendinger has been constructing a computer model of the St. Croix basin that fits together the existing watershed data. The model uses the Soil and Water Assessment Tool (SWAT), which was developed by the U.S. Department of Agriculture and Texas A&M University, whose scientists are collaborating on the project with Almendinger. SWAT simulates rainfall-runoff processes and calculates the amounts of sediment, nutrients, and other pollutants transported from the land to our waterways. In the quest to reduce phosphorus loads by 20%, the model will be used to predict how water quality is affected by changes in land use, climate, or other "puzzle pieces." The model will be completed by the end of 2011.

Standing on the Shore

Toben Lafrancois surveys rock pools in the Apostle Islands

Standing on the shore of Lake Superior and marveling at its grandeur, it is easy to overlook the simple habitats underfoot. But for some species, such as the boreal chorus frog, the small pools in the cracks and crevices along the rocky shores are critical habitat. In partnership with the National Park Service and the University of Minnesota, station researchers Toben Lafrancois and Mark Edlund have been studying the rock pools at Isle Royale National Park and Apostle Islands and Pictured Rocks National lakeshores. Intensive fieldwork and mapping during the last two summers form the basis of the first ecological and water-quality surveys of these sensitive mini-ecosystems. The number of rock pools can be staggering-one small island at Isle Royale has over 33,000 pools. Rock pools are distributed in two zones moving away from the lake. "Splash" pools are nearer the waterline and can be regularly inundated by Superior's breaking waves. "Lichen" pools are higher on the rocks, and their hydrology is more dependent on precipitation and runoff. Water chemistry reflects these differences; splash pool chemistry is almost identical to Lake Superior waters, whereas lichen pools are more nutrient-rich, except that they lack nitrogen. Researchers have also surveyed the amphibians, insects, zooplankton, and algae in the pools to document breeding and nursery sites and phenology, and to create a baseline of species richness and diversity. These data are critical as shoreline habitats face threats from climate change, shipping spills, and increased visitorship.

"Home" Improvements

Just like homeowners, the Research Station has been facing issues with aging systems and inadequate storage and garage space. Vehicles were stored in former farm buildings or outside exposed to the elements. At the same time, data systems had grown so unwieldy that formerly neat wiring systems had exploded into a nightmare of wires and cables. This past year has seen major infrastructure improvements to alleviate these issues. In late fall, we completed construction of a new garage and maintenance building. This facility will provide garage space for station vehicles, boats, and field equipment and will eventually house the maintenance and fabrication shop. This construction project was made possible through a generous donation from the late Molly Brown of Osceola, Wisconsin, with additional funding from a bequest by the late James Taylor Dunn. As part of this overall project, visitor parking areas were also improved. Also completed this year was a major upgrade to the station's telecommunications systems. A new telephone system was installed, followed by a complete reconfiguration of the data and telecommunications wiring system. Working with the Science Museum's Information Technology staff, we centralized data connections and installed new data closets to house all IT equipment.