Water Quality Shapes the Health of the River

By Shawn Giblin

Above and right: Mats of raw sewage floated in the Mississippi near the Twin Cities in the 1930s.

Our understanding of how rivers work and our interest in healthy rivers have advanced steadily and swiftly over the last century, thanks in part to work done on the Upper Mississippi.

When today's students learn about the Cuyahoga River in the 1950s and 1960s they have difficulty believing that the river was so polluted that it actually started burning. A 1969 article in *Time* described the Cuyahoga as a river that "oozes rather than flows" and in which a person "does not drown but decays."

When I show students pictures from the 1930s of sewage mats on the Mississippi in the Twin Cities, many think that I am kidding them. I see disbelief in their faces when I read the passage from Cal Fremling's famous book, *Immortal River*: "The fetid, festering accumulation of raw sewage led the U.S. Bureau of Fisheries to report that during August of 1927, forty-five miles of the river below St. Paul lacked sufficient oxygen to sustain fish life of any kind." Schoolkids quickly understand that situations like these angered people and motivated them to demand solutions.

Congress passed the Clean Water Act in 1972 with the simple objective of making surface waters "fishable and swimmable" again. The major provisions of the Clean Water Act required states to establish water quality standards, required permits to discharge pollutants into public waters and authorized funds for publicly owned wastewater treatment plants.

America has launched many great ideas. The Clean Water Act and the cleanups that followed may rank as America's best idea. Other landmark legislation followed, including the DDT ban in 1972, the PCB ban in 1979, the phase-out of leaded gasoline from 1973 to 1996 and the ban on lead shot for waterfowl hunting in 1991.

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Turning the River Around

The science of water quality seems like a collection of meaningless numbers until we show how it affects the people who enjoy the Mississippi River, and the plants, fish and other wildlife that rely on the river for survival.

As we reduced pollutants in the Mississippi River, fish became safer to eat and wildlife recovered. Sediment samples recently collected by the Wisconsin Department of Natural Resources at Lock and Dam 3 (Red Wing, Minn.) and Lock and Dam 4 (Alma, Wis.) found polychlorinated biphenyl (PCB) concentrations about one-quarter to one-fifth of those observed in the late 1980s. The mercury concentration in sediment at lock and dams 3 and 4 was roughly half that observed in late 1980s.

In 1972, one active bald eagle nest remained on the Upper Mississippi River Wildlife and Fish Refuge. Current counts

exceed 300 active eagle nests. Similar counts of fish-eating birds, mink and other wildlife have increased with the eagle recovery. These recoveries are a source of national pride and potent evidence of the power of science coupled with the will to act.

As water quality and wildlife recovered, river towns enjoyed a resurgence as vibrant hubs with an improved quality of life. Cal Fremling recounted in *Immortal River*: "Several river cities have erected eagle watch facilities that attract hundreds of eagle watchers. Shoppers strolling down the main street of Alma, Wis., have grown accustomed to seeing eagles flying at treetop height."

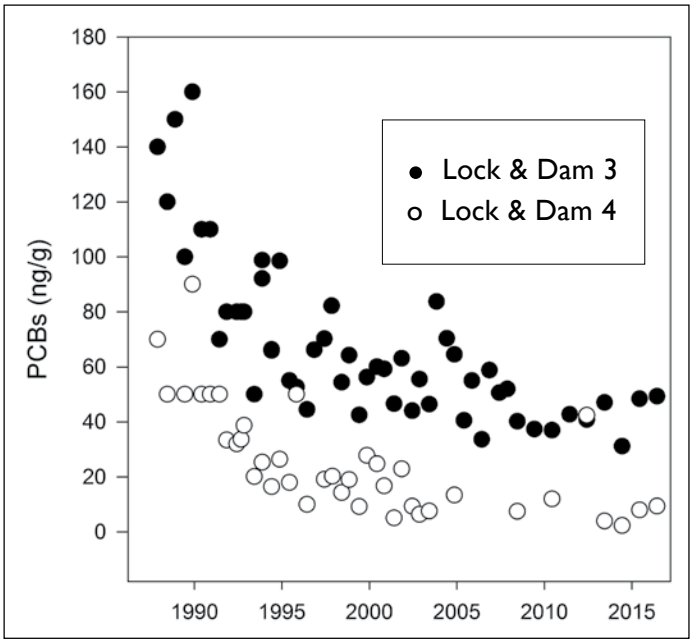
Confluence of the Mississippi (lower) and St Croix (upper) rivers at Prescott, Wis. (Jeff Janvrin)

Lessons from a Drought

Ecological trends from the Mississippi River downstream of Lake Pepin over the last 30 years provide hope and a vision for an improved river. During the late 1980s, following several years of drought, submersed aquatic plants — such as wild celery and coontail — almost disappeared. As a result, the water became turbid from algae and sediment, and native game fish populations collapsed — changing a fish community dominated by native fish with abundant fish predators to one dominated by invasive common carp with few fish predators. Once the river shifted to this degraded condition, powerful internal forces kept the system trapped there for more than 10 years. Without submersed plants to buffer wave action, bottom sediments were constantly stirred up, reducing water clarity. Increased numbers of common carp also kept the bottom sediments stirred up by rooting around looking for food. Top predators, such as northern pike, which hunt by sight, couldn't thrive in the murky water. With fewer predators, the carp populations grew quickly.

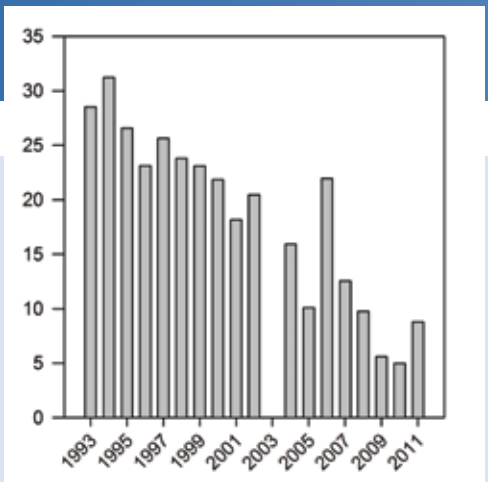
I was 14 years old, living near La Crosse, Wis., when this happened, and I recall it as a time of extreme frustration on the Mississippi. In a few years, the robust and healthy recreational fishery almost vanished. You couldn't help feeling like something cherished had been stolen from you, with no clear prospects for its return. We didn't understand the links between water quality and the health of the river, as we do today.

Fortunately, river scientists had a thorough and well-established monitoring program in place that captured the decline and eventual recovery in unprecedented detail. Data collected

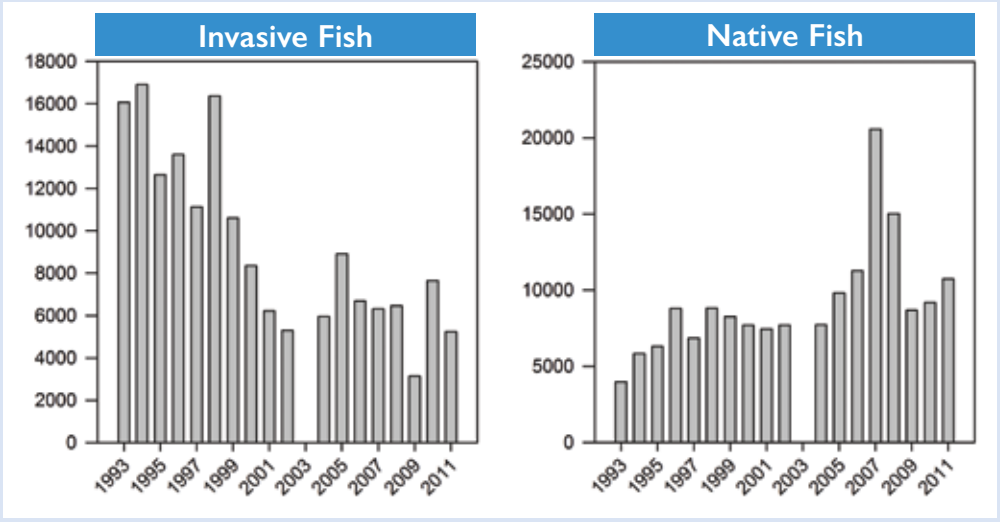


PCB (polychlorinated biphenyl) concentrations have declined in the river at Red Wing, Minn., (L&D3) and Alma, Wis., (L&D4).

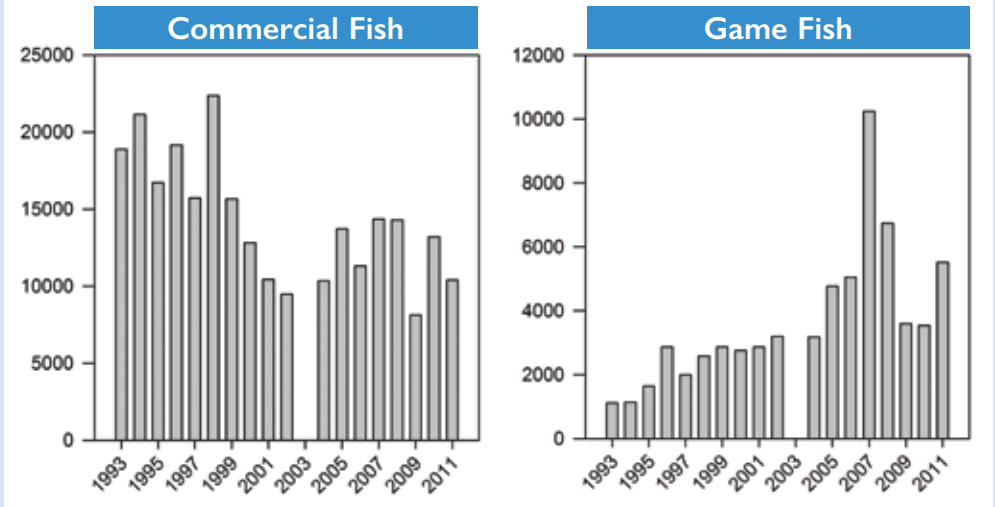
by the Upper Mississippi River Restoration-Long Term Resource Monitoring (UMRR-LTRM) program provides striking evidence of the ability of a river to heal, when given the chance. This recovery gave us an invaluable blueprint for restoring the river ecosystem. From 1993 to 2011, when Pool 8, near La Crosse, shifted from a turbid state (total suspended solids ~30 milligrams/liter) devoid of vegetation to a clear state (total suspended solids ~5 mg/L) with abundant submersed vegetation the UMRR-LTRM documented:



As the water in Pool 8 of the Mississippi (La Crosse, Wis.) got clearer from 1993 to 2011 (as measured in milligrams of suspended solids per liter of river water), surveys found that fish populations changed too.



As Pool 8 got clearer, the biomass of invasive fish decreased and the mass of native fish increased.



As Pool 8 got clearer, the biomass of commercial fish (mostly carp, freshwater drum and buffalo fish) decreased and the mass of game fish increased.

- The non-native fish biomass (mainly common carp) decreased by two-thirds.
- The native fish biomass had more than doubled.
- The commercial fish biomass (dominated by common carp and other "rough fish") decreased by half.
- The game fish biomass (fish we like to catch, like bluegill, largemouth bass, yellow perch and northern pike) tripled.

And once again it resembled the Mississippi River prior to the big vegetation crash. The water was clear and the river was healthy again. The native fish and popular game fish were back in force.

Today's Challenge

The Clean Water Act dramatically improved water quality by reducing "end-of-the-pipe," or point-source, pollution from industrial and municipal wastewater. Our present-day challenge is primarily nonpoint-source pollution mainly from farm fields and urban runoff. We are currently plagued with a leaky landscape that is delivering more sediment, nitrogen and phosphorus than the river can effectively handle. It is critical for society to address this.

The quantity of nitrogen and phosphorus that the Mississippi River delivers to the Gulf of Mexico from the Midwest has increased dramatically during the last 100 years. These nutrients fuel large algae blooms in the Gulf. When the blooms die and sink to the bottom, the rotting algae depletes the oxygen in the water. This area of depleted oxygen in the Gulf of Mexico, the Dead Zone, can be as large as the state of Connecticut.

Here on the Upper Mississippi River, we also pay a heavy price for increased nutrients in the river. In summer, up to half of all the backwaters in the Mississippi River are covered by mats of duckweed and filamentous algae. These mats

A duckweed mat floats in Blue Lake between La Crescent, Minn., and La Crosse, Wis. (Kraig Hoff)

Clear water encourages plant growth in the river. (Reggie McLeod)

are fueled by excess nitrogen and phosphorus, and can dramatically degrade the recreational value and aesthetics of the backwaters. In addition to reducing recreation opportunities, these mats create "mini dead zones" of low oxygen scattered throughout the system. The mats of free-floating plants don't allow light to penetrate the water, dramatically reducing photosynthesis and oxygen production. They create a dark, lifeless environment in many backwater areas during the summer. Excessive nitrogen and phosphorus input can also fuel blue-green algae (cyanobacteria) blooms that release toxins into the water that can harm people, pets and wildlife.

> Clean water is the lifeblood of every community, particularly those lucky enough to sit alongside the Mississippi.

Sediment is another nonpoint pollutant being delivered to the Mississippi River at an accelerated rate. The current sedimentation rate in Lake Pepin is roughly 10 times the natural rate. At this rate Lake Pepin will be filled with sediment in roughly 300 years — a transition that would take thousands of years at normal rates. The impact of this rapid habitat loss is being felt in Bay City, Wis.; Wacouta Bay, in Minnesota; and in other communities along upper Lake Pepin.

Similar sedimentation patterns are playing out throughout the Upper Mississippi. If allowed to continue, silt will fill in many of our most productive backwaters in the next 50 to 100 years. Most river wildlife depends on backwater habitats at some phase of their life. As these backwater habitats are degraded or lost, the diversity of life and recreational opportunities on the river will decline, too.

Getting There

The Clean Water Act, and the many cleanup actions that followed, have made great strides in reducing the point source pollutants they were designed to reduce. They represent some of the most successful collective actions the nation has ever taken and should be celebrated. They also represent a shining example of combining the power of science, initiative and sound policy to heal the nation's surface waters for the benefit of all. Clean water is the lifeblood of every community, particularly those lucky enough to sit alongside the Mississippi. Now we need to remain vigilant to protect the progress we have made and move to address today's nonpoint pollution.

We need to invest in new technologies, conservation programs and improved water quality to ensure the Mississippi River we pass on to our children and grandchildren continues to get better.

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