Wisconsin natural resources. Vol. 28, No. 3 June 2004

[Madison, Wisconsin]: Wisconsin Department of Natural Resources, June 2004

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WISCONSIN NATURAL RESOURCES

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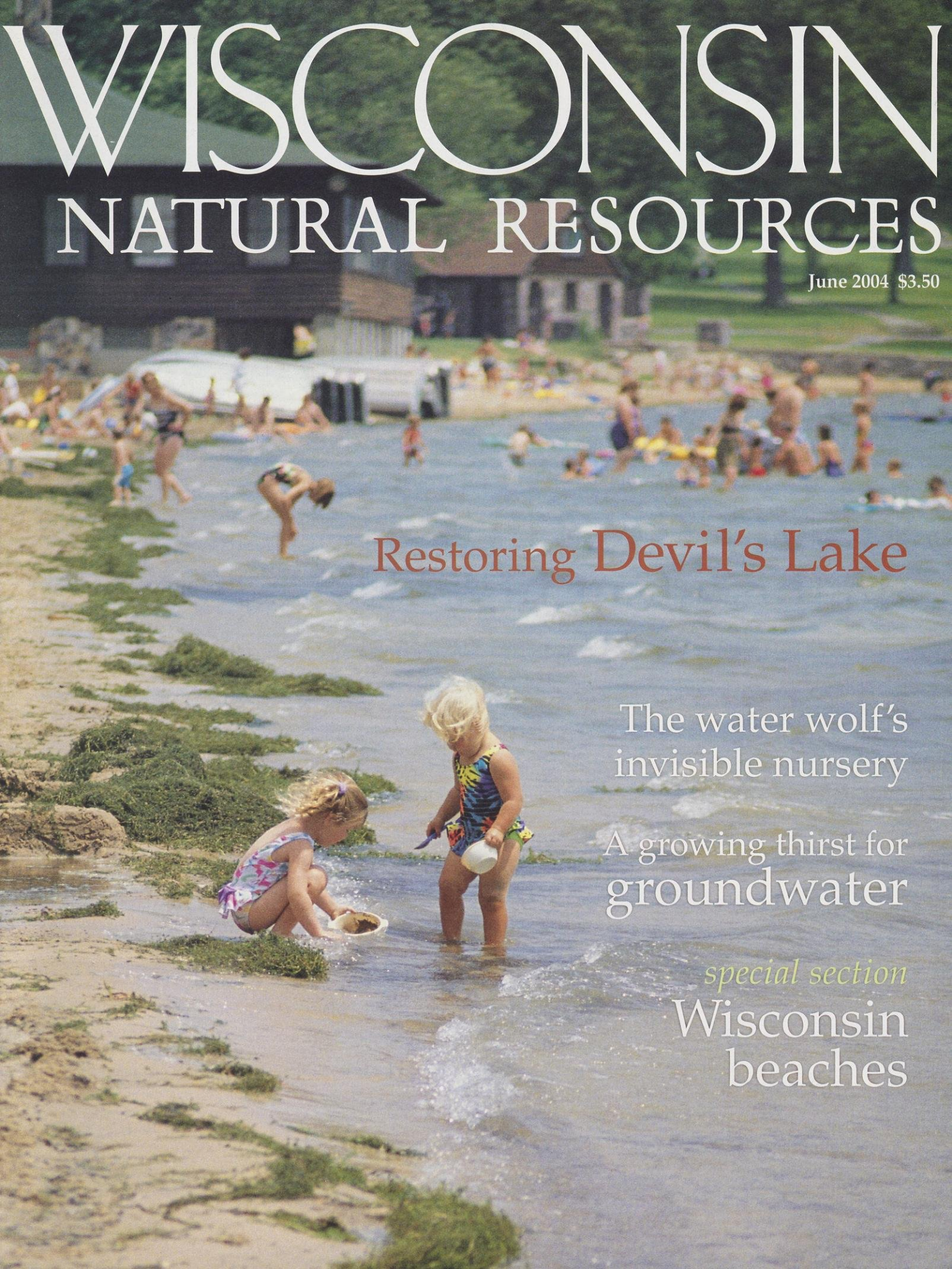


Restoring Devil's Lake

The water wolf's invisible nursery

A growing thirst for groundwater

special section
Wisconsin beaches

Wild ginger "couples" sway in the breeze.

Two hearts in three-four time

Anita Carpenter

Brightly colored warblers flit overhead in trees that are barely leafed-out. The tiny sprites are restless, consuming as many insects as possible on this short stopover in their northern flight. They spend so little time with us that I'm engrossed watching and identifying them. Soon my neck stiffens from looking up so long. I bend my head down. That's when I discover the green carpet of double hearts. Wild ginger, a native Wisconsin plant, quilts much of the forest floor in this rich maple woods. Soon I'm down on my hands and knees taking a closer look at this unique plant.

Each plant measures about four to six inches tall and is composed of two heart-shaped leaves facing each other on short separate stems. They remind me of ballroom dancing partners gazing into each other's eyes as the music begins. Although these "dancers" are immobile, save for swaying in the occasional breeze, they crowd the forest floor. As each plant grows in close proximity, new plants arise from shallow, pipe cleaner-sized rhizomes. The growth pattern is more obvious at the colony's fringe as the new "couples" appear in lines as if preparing to dance a Virginia reel.

Wild ginger, *Asarum canadense*, is a perennial that prefers moist deciduous woods and shady riverbanks. It appears in late April to early May before the tree canopy is fully leafed-out. Taxonomists refer to the three- to four-inch fuzzy leaves as chordate, meaning heart-shaped, or reniform, meaning kidney-shaped.

continued on page 29

RJ & LINDA MILLER

(left) **Wild ginger's pungent red flower stays close to the ground within reach of the fly, gnat or beetle that pollinates it.** *(above)* **The plant sends up pairs of heart-shaped leaves on short stalks that sway in a light breeze.**

WISCONSIN NATURAL RESOURCES

June 2004
Volume 28, Number 3

SCOTT NIELSEN

RICHARD ROST

ROBERT QUEEN

COURTESY OF GREGORY T. KLEINHEINZ

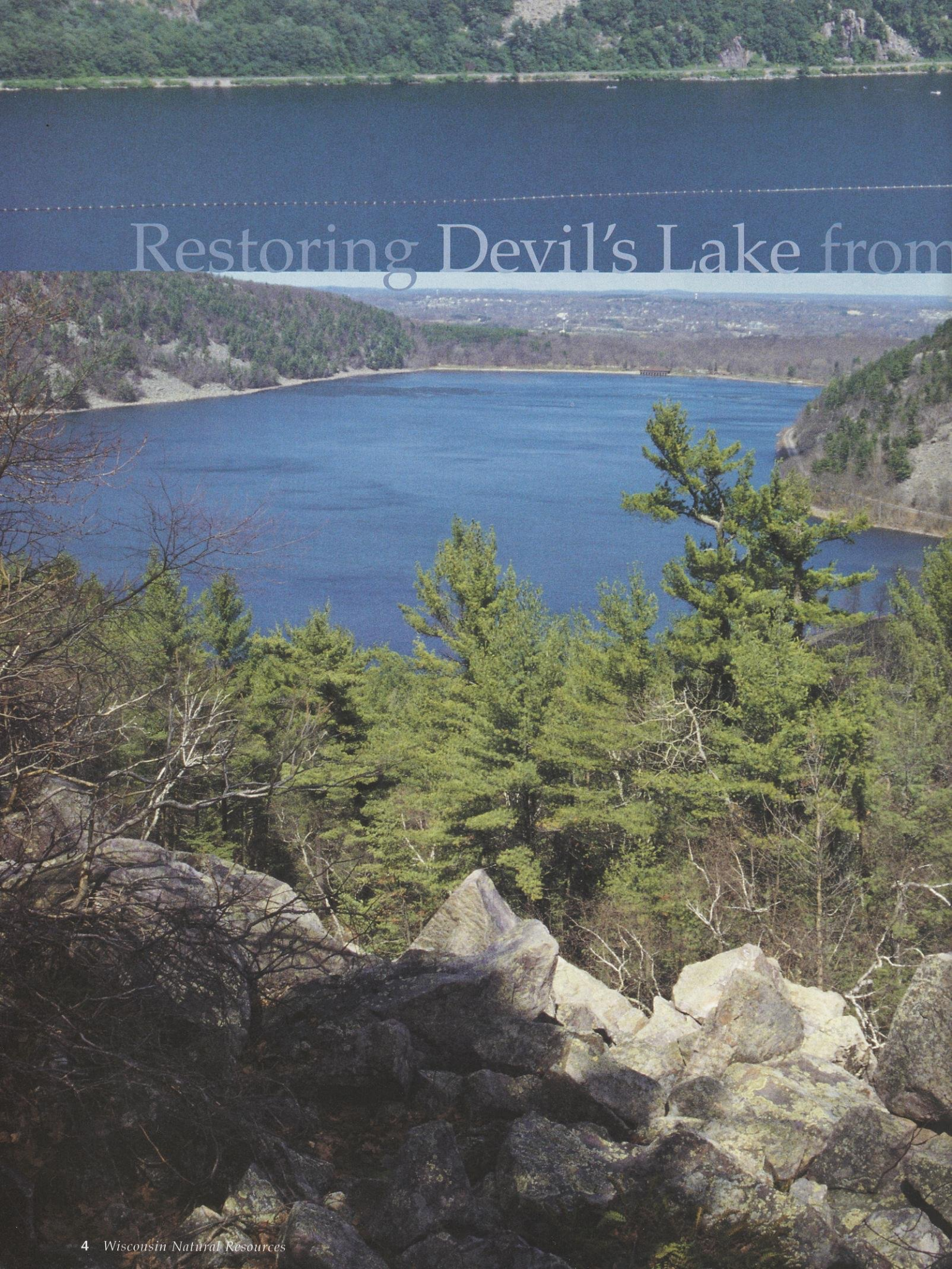
FRONT COVER: The beach at Devil's Lake should become even more inviting thanks to a phosphorus removal project. See p. 4.
ROBERT QUEEN, Madison, Wis.

BACK COVER: The Peshtigo Fly-Fishing Area was established in 2001 as part of our newest state forest. Celebrate 100 years of Wisconsin forestry. Visit www.wisconsinforestry.org for upcoming events statewide.
ROBERT QUEEN, Madison, Wis.

PUBLCE-012
ISSN-0736-2277

Wisconsin Natural Resources magazine (USPS #34625000) is published bimonthly in February, April, June, August, October and December by the Wisconsin Department of Natural Resources, 101 S. Webster St., Madison, WI 53702. The magazine is sustained through paid subscriptions. No tax money or license fees are used. Preferred Periodicals postage paid at Madison, WI. POSTMASTER and readers: subscription questions and address changes should be sent to Wisconsin Natural Resources magazine, P.O. Box 7191, Madison, WI 53707. **Subscription rates are: $8.97 for one year, $15.97 for two years, $21.97 for three years. Toll-free subscription inquiries will be answered at 1-800-678-9472.**

Printed in the U.S.A. on recycled paper using soy-based inks in the interest of our readers and our philosophy to foster stronger recycling markets in Wisconsin.



Restoring Devil's Lake from

the bottom up

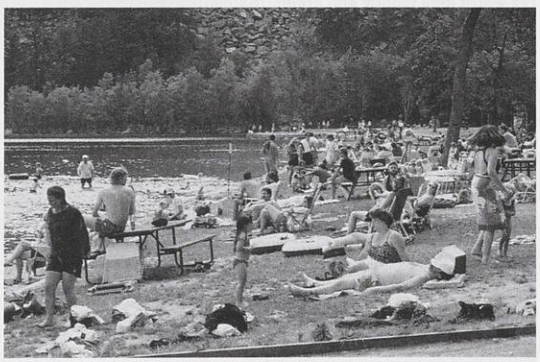
A 15-year DNR project will reduce phosphorus by withdrawing water from the deepest part of Devil's Lake.

Richard C. Lathrop, Timothy J. Astfalk, John C. Panuska and David W. Marshall

As the centerpiece of Wisconsin's most popular state park, Devil's Lake in Sauk County is a real gem — a 372-acre lake set in a spectacular setting among towering quartzite bluffs whose talus boulders tumble steeply to shimmering water.

Though the lake is renowned for its clear waters due to naturally low fertility from its small forested watershed, in recent years the lake sometimes looks more emerald than diamond, especially near shore.

The park draws well more than a million visitors each year and it's been a busy place for more than a century. Since the late 1860s, Devil's Lake has been a favored playground. Over the course of 100 years up to four resorts and more than 60 private cottages surrounded the lake's shoreline. Their primitive outhouses and septic systems undoubtedly leached phosphorus into the lake. Additional phosphorus seeped in from a park sewer main that broke in the late 1970s until it was repaired in the early 1980s. And an additional amount of phosphorus entered the lake from farm runoff coming from the southwest bluff. Today, the farms, resorts and all but four of the cottages are gone as the public park expanded from its inception in 1911.



RICHARD C. LATHROP

(left) Devil's Lake, nestled between towering quartzite bluffs, is the centerpiece of Wisconsin's most visited state park.
(above) Sewage seepage from 100 years of park visitors, cottages and resorts built up a legacy of phosphorus in the lake sediments.
(middle) Phosphorus fuels algae growth that feeds snails hosting a parasite that causes swimmer's itch.
(top) A solution now includes drawing phosphorus-rich water through a sunken pipe that extends 4,150 feet from shore to the lake's deepest spot.

Phosphorus stays and cycles

Unfortunately, a lot of the phosphorus remains in the lake's deep-water sediments. This is because Devil's Lake is a seepage lake with no outlet to naturally dilute and flush out the phosphorus. While few nutrients from the watershed reach the lake today, the phosphorus stored in the lake's bottom sediments recycles each year making the overall fertility level of the lake abnormally high.

Studies by DNR researchers show that the phosphorus temporarily binds to iron compounds in the lake's sediments at times of the year when the overlying water is oxygen-rich. By late spring as the water warms up, the lake stratifies with a less dense warm water layer near the surface. By mid-summer, the denser colder water on the bottom loses its oxygen (anoxia). The phosphorus is then released from the sediments and builds up in the bottom waters from late summer through about mid-October. At that time the surface waters have cooled causing the lake to "turn over" and allowing the phosphorus to mix throughout the entire lake.

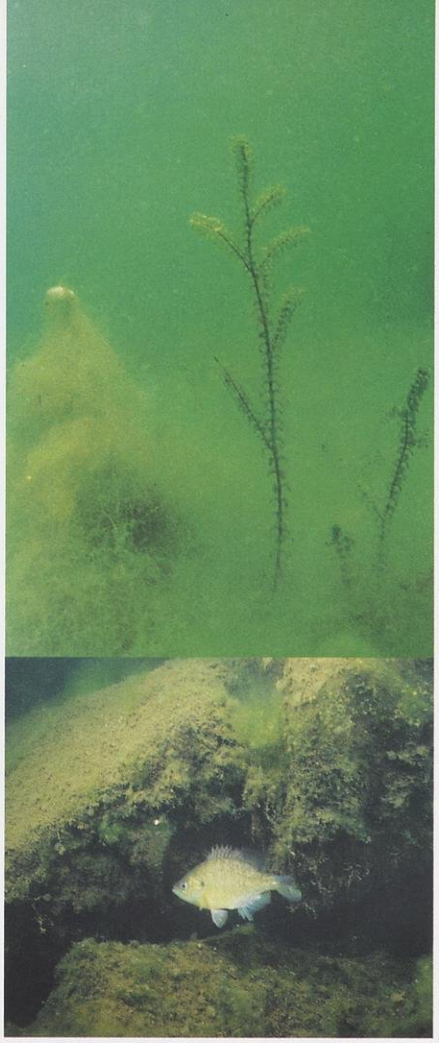
Algae growth raises concerns

The end result of that mixing has longer lasting effects in the lake. By spring and early summer, the phosphorus has begun fueling the growth of different forms of algae: free-floating (phytoplankton), filamentous and attached (periphyton). Since the late 1970s, the free-floating algae in late summer and early fall have become really noticeable to visitors, especially the SCUBA divers who enjoy exploring Devil's Lake's deep waters. Noxious blue-green algae blooms that accumulated on the downwind shorelines particularly alarmed park personnel and visitors alike.

Beginning in the early 1990s, the free-floating phytoplankton blooms became less severe while the two other forms of algae became more noticeable. Filamentous algae formed thick cotton candy-like mats that draped over the bottom and smothered larger plants. Trapped air bubbles caused these mats to rise like green stalagmites toward the water surface. At the same time, the underwater boulders along the east and west shorelines were covered with a green carpet of periphyton algae. Near the beaches on the north and south shores, the bottom sediments and larger aquatic plants were also heavily coated with periphyton. These algae serve as the main food source for 17 species of snails, three of which can be intermediate hosts to a parasite that causes swimmer's itch, a painful nuisance that cuts park attendance and local tourism.

Local citizens as well as park personnel have long sought answers to the vexing swimmer's itch problem in Devil's Lake. This desire precipitated a 1999 DNR research study that found high snail densities in the lake as a result of abundant food (periphyton). The study concluded that the only ecologically safe way to control swimmer's itch was to drastically reduce the snail populations by reducing their algae food source — effectively starving the snails. While snails can be poisoned with copper treatments, it's a short-lasting cure that isn't safe for fish and other aquatic organisms. It's also too expensive to carry out on the entire lake.

Algae also indirectly elevate mercury levels in the lake's fish populations, ultimately reaching levels of public health concern in large sport fish such as walleye. Inorganic mercury enters the lake from atmospheric pollution. Sulfate-reducing bacteria that thrive only in the oxygen-poor bottom waters in late summer convert the relatively harmless inorganic mercury to the toxic methyl-mercury form, which builds up in those waters until the lake mixes during fall turnover. At that time the methyl-mercury is readily taken up by phytoplankton and then concentrates as the methyl-mercury passes up the food chain to fish.



DAVID W. MARSHALL

DAVID W. MARSHALL

High phosphorus levels grow three kinds of algae in Devil's Lake: free-floating phytoplankton that make the water look cloudy and green, filamentous algae *(top)* and periphyton *(above)* that attach to rocks, plants and bottom sediments.

If researchers could find a way to reduce the buildup of methyl-mercury in the lake's bottom waters, mercury concentrations in fish should decline. While controlling atmospheric sources of mercury would reduce fish mercury levels in lakes both regionally and throughout the world, techniques to decrease the growth of sulfate-reducing bacteria in Devil's Lake should result in less methyl-mercury entering the food chain. One way of slowing the growth of these oxygen-hating bacteria would be to delay the onset of anoxia. Decreasing the amount of algae that settle to the bottom waters would slow decomposition by other bacteria that use up the available oxygen. This would give the sulfate-reducing bacteria less time to convert inorganic mercury to methyl-mercury before the bottom waters are re-oxygenated at fall turnover.

In summary, we'd expect many benefits from removing the legacy of phosphorus pollution now stored in Devil's Lake's deep-water sediments. Direct benefits would include fewer forms of algae growth and clearer water. Indirect benefits would include less chance for swimmer's itch and lower fish mercury levels. In addition, better oxygen conditions in the bottom water would improve cold water habitat needed by brown trout being stocked in the lake.

Developing a restoration project

A two-year study by DNR researchers from 1986–87 confirmed that algal blooms at Devil's Lake would continue unless high phosphorus concentrations could be curtailed. As in most lakes worldwide, it's easier to prevent the flow of phosphorus into lakes than to correct the situation after lakes are fertile. Techniques tried elsewhere to reduce lake fertility include dredging the nutrient-rich sediments, binding up the phosphorus in the sediments with chemical treatments, aerating the bottom waters to temporarily sustain the sediment's ability to bind phosphorus, or drawing phosphorus-rich waters from the bottom of the lake. The first three options were dismissed as unsuitable for Devil's Lake due to high cost (dredging), short-term effectiveness (chemical treatment and especially aeration) and strong opposition to adding chemicals like alum or other aluminum compounds to a lake classified by the DNR as an Outstanding Resource Water.

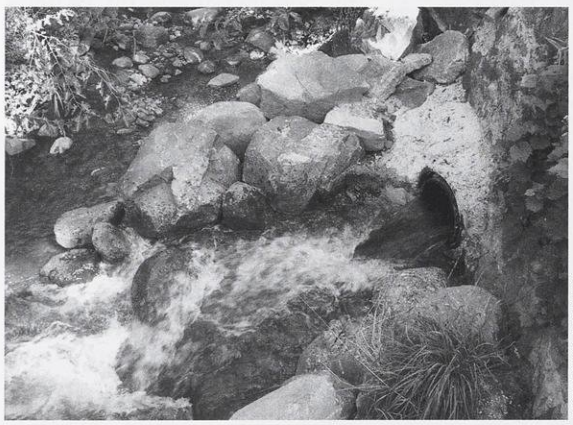
Drawing off bottom waters (technically called "hypolimnetic withdrawal") has been used on a few moderately

deep lakes and reservoirs in Europe and less often in North America. After the lakes stratify, the cold, phosphorus-rich bottom waters are withdrawn in late summer and discharged to a receiving stream. Bottom withdrawal hadn't been tried on a large seepage lake with no outlet like Devil's Lake. However, we felt the technique was feasible because the withdrawn water could be replaced by diverting clean runoff water from a nearby intermittent stream called Babbling Brook.

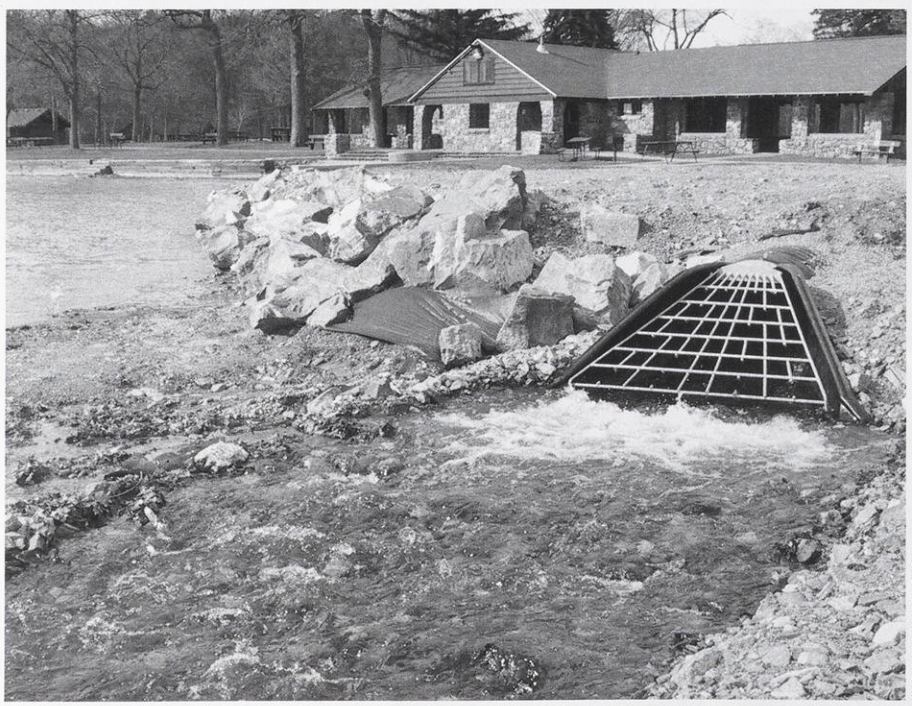
In fact, an old diversion ditch had been dug in the 1890s between Babbling Brook and Devil's Lake to allow water to be periodically added to the lake when lake levels were low. In the 1960s, the open ditch (known at that time as Inman's Canal according to Ken Lange, retired park naturalist) was replaced by a 30-inch culvert and covered over. Since the early 1970s the diversion system has not been used due to generally higher lake levels. In recent years, a section of the culvert pipe nearest Devil's Lake rusted away and collapsed making the system inoperative. However, we felt the diversion system could be refurbished as part of the project.

DNR researchers, managers and park personnel discussed the potential bottom withdrawal project in the fall of 2000 at the annual meeting of the Friends of Devil's Lake State Park. This nonprofit group continues to provide active support by volunteering time and fundraising for improvements at the park. They agreed to help sponsor the project and helped obtain a small grant to develop cost estimates for potential withdrawal designs. All designs called for installing a long pipe to the deepest spot in the lake to withdraw phosphorus-rich water, which would be discharged to Babbling Brook that flows to the Baraboo River. Water could either be pumped out of the lake or could be withdrawn by a passive siphon system (similar to a siphon used to clean a home aquarium). Researchers estimated the withdrawal system would need to run several weeks a year during September and early October for perhaps 15 years to reduce phosphorus levels in the lake. The siphon system was chosen for Devil's Lake because it would require no maintenance and no electricity to run it — a huge cost savings on such a long-term restoration project.

(below) **Water drawn from the lake bottom discharges to Babbling Brook in early fall.**
(bottom) **Clean water upstream from Babbling Brook is diverted fall through spring to replace bottom water containing high phosphorus.**



RICHARD C. LATHROP



RICHARD C. LATHROP

The spring of 2001 was spent doing an environmental analysis of the project and incorporating public comments. The project called for discharging water to Babbling Brook at a time of the year when the intermittent stream is normally dry, so consequences for the stream's aquatic life were judged minimal. Downstream effects on the Baraboo River were also determined to be minimal. Though the discharged water would be high in phosphorus, it represented less than one-tenth of one percent of the annual phosphorus load in the river. In addition, the water from Devil's Lake would also be flushing through the Baraboo River system after the summer growing season and a long time before the next growing season.

As regulatory hurdles were being cleared, work focused on finding grant money to pay for the siphon system, estimated to cost about $300,000 if DNR staff did the land survey work and were responsible for some of the preparations. The project proposal submitted by the Friends of Devil's Lake garnered a $200,000 State Lake Protection Grant, which was matched with an EPA Clean Lakes Grant for $100,000. An additional $5,000 came from a Friends of Wisconsin State Parks grant that was matched by the local Friends group to provide a total of $310,000.

Built on a tight schedule

All the financial pieces of the puzzle came together by mid-February 2002. Land surveys, contracts (including engineering services work by Mead & Hunt, Inc. of Madison) and the hunt for

supplies began soon after with tight deadlines to meet the goal of installing and operating the siphon system by early September 2002.

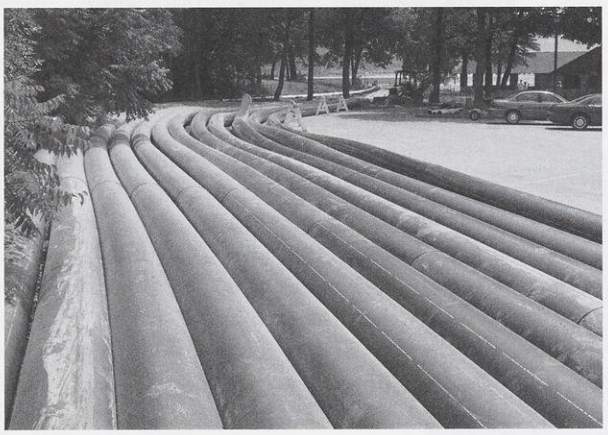
The system consists of 5,500 feet of 20-inch diameter plastic pipe with 4,150 feet resting on the lake bottom. Fifty-foot pipe sections were fused together and 320-pound concrete weights attached every 12 feet as "the big straw" was pushed out from shore to the lake's deepest spot — about 47 feet depending on lake level. The weights were needed to keep the pipe on the bottom once it was filled with water and sunk in place. The intake on the far end of the pipe is a 50-foot section drilled with holes along two sides to draw in water from just above the lake's bottom sediments.

On land the pipe was trenched into the ground with a manhole at the pipe's highest point and another where the siphon ended just below the main flow valve. The difference in water levels between the terminal manhole and the lake surface creates a pressure head difference (five to nine feet depending on lake level) that determines the flow rate of the siphon. A flow meter is located at the high point manhole. A vacuum pump is connected at the same location to prime the siphon by filling it with lake water.

A private contractor (Heartland Construction, Inc. of Baraboo) began constructing the pipe system in July 2002 as a small work crew started fusing pipe into 450-foot segments. To accommodate the park's summer influx of visitors and vacationers and to free up as many parking spaces as possible, the work crew had to clear the work area each Friday afternoon. Once the pipe segments were finished, a bigger work crew began attaching the concrete weights as the pipe was pushed into the lake. Even with weights attached, the pipe floated and it was all a barge could do to maintain tension on the pipe. Fusing together the in-lake portions took about a week and a half ending July 30.

Early on the morning of July 31, the contractor began trenching the near-shore lakebed inside an area that had been encircled by a silt curtain to contain any sediments stirred up in the process. The intake pipe section (with extra flotation attached and the holes sealed) was then pulled to the middle of the lake and connected via a flange joint to the main pipe. While the pipe was stretched taut by a barge, fire trucks from the Baraboo Fire Department and DNR forestry programs began filling the pipe from shore with lake water as a gallery of spectators watched. Since no one had experience sinking a 4,150-foot pipe weighted by 55 tons of concrete, project personnel and the contracting crew wrestled with some unanticipated problems. A few air pockets formed that traveled like Loch Nessie along the pipe's length until the monster "burped" at the end. There were other exciting moments as the pipe developed a slight twist as it sank. The holes on each side of the pipe intake section were re-aligned horizontally by rotating the intake at the flange joint just before the pipe intake sank. By late afternoon the pipe lay on the bottom with the intake holes perfectly positioned eight inches above the lake sediments at the lake's deepest spot.

(below) **Pipes fused into 450-foot lengths were built prior to installation.**
(middle) **Workers attached a 320-pound weight collar every 12 feet to keep the pipe on the bottom when filled with water.**
(bottom) **Another 1,350 feet of pipe was trenched on land from the lake to the discharge point.**



RICHARD C. LATHROP

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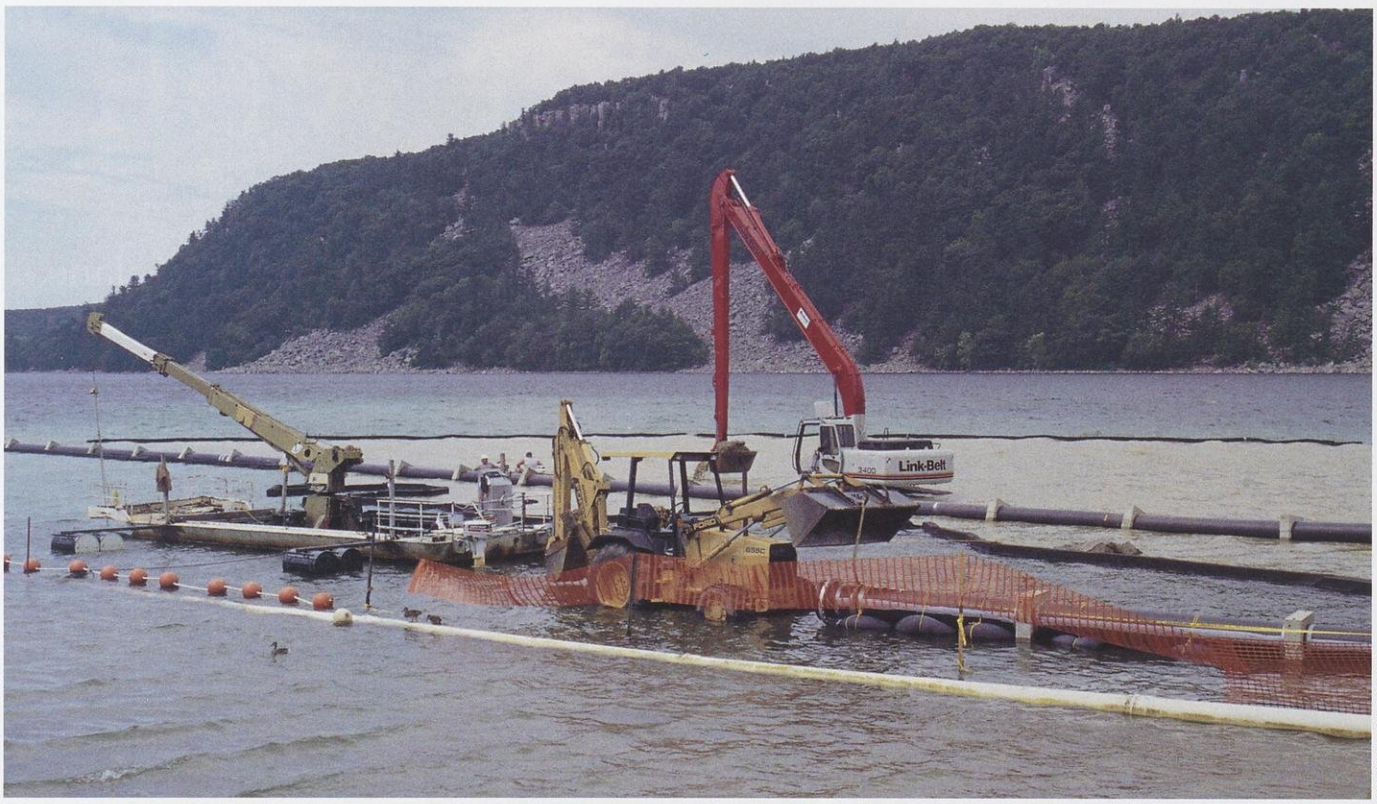
By mid-August the 1,350-foot land section of pipe was trenched and joined to the lake portion. On August 27, the flow meter was installed and the siphon was primed. On August 29, we opened the main valve and the lake's bottom water started pouring out. The only things that were noticeable were the sound of gurgling water in the stream plus a slight sulfur smell next to the siphon discharge point. The average flow rate for the 2002 withdrawal period was 5.3 cubic feet per second, a brisk 2,380 gallons per minute during the seven-week run until we shut down for the season when cooler weather naturally turned over the lake water on October 17th. By then we had removed 981 pounds of phosphorus from the lake, far exceeding our initial goal of about 400 pounds. Since the lake levels were really high in 2002 and the phosphorus concentrations were higher than expected, we had decided to let the system run a little longer than planned for subsequent years.



RICHARD C. LATHROP

On the morning of pipe sinking, the nearshore lakebed was trenched inside a silt curtain and then the intake was floated out to the middle of the lake for attachment.

Contractors spent a week and a half attaching blocks as 4,150 feet of pipe was extended into the lake.

RICHARD C. LATHROP

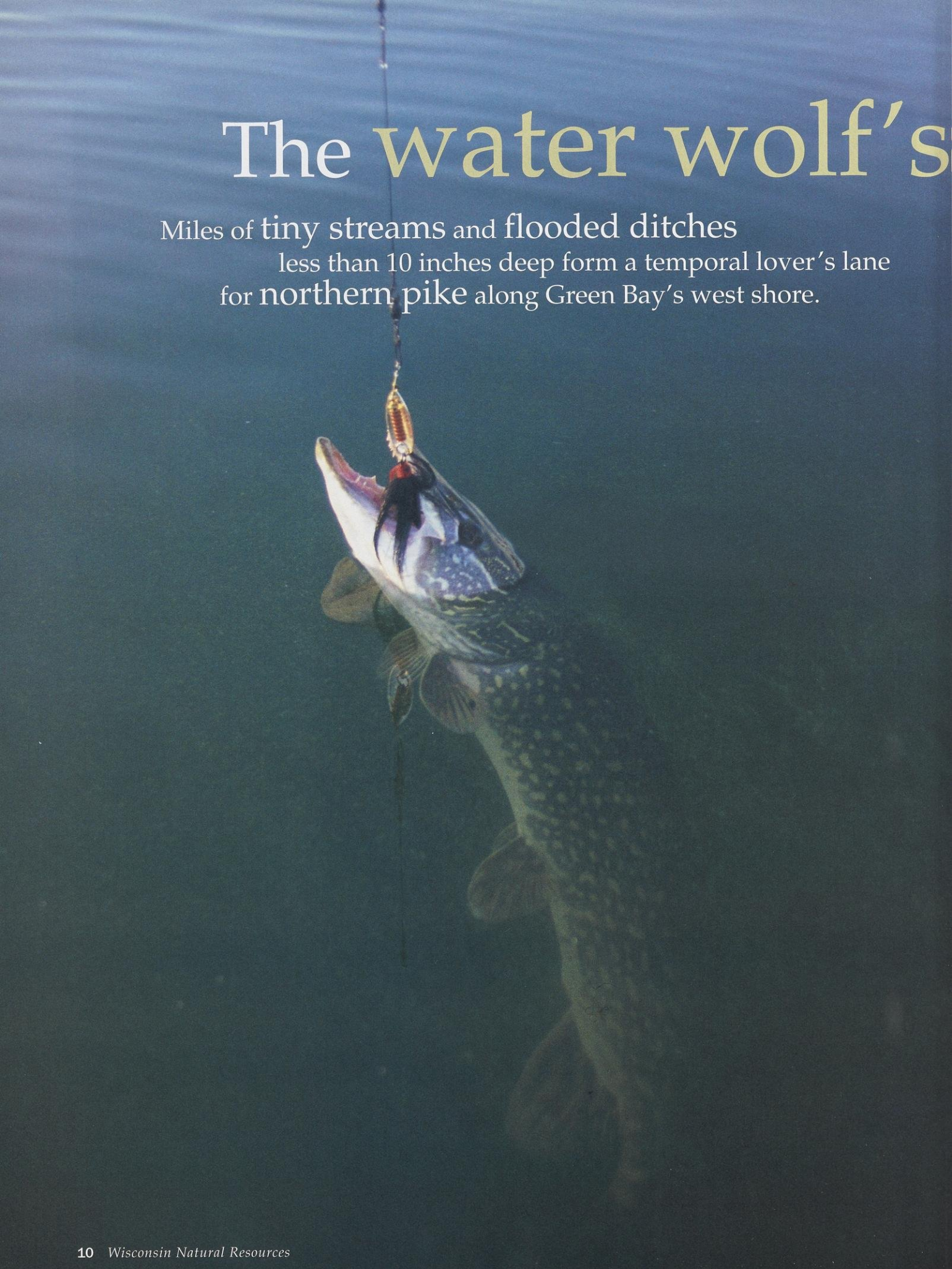
Holes in the 50-foot intake were aligned horizontally before it was sunk to the lake's deepest spot. The pipe now draws water just above the lake sediment.

So far, so good

In 2003 the withdrawal system was used less extensively following a prolonged drought, but we still removed 377 pounds of phosphorus. One of our goals was to draw down the lake a bit by October so the contractor could rebury the lake pipe near shore so it wouldn't be exposed on the shoreline or be an underwater obstruction during normal lake levels. The water levels were so high when the pipe was initially installed in 2002 that the contractor couldn't trench in as far offshore as originally planned. Repairs in 2003 also included replacing the small broken section of the water diversion pipe near the lake. By early November clean runoff water from Babbling Brook was diverted into Devil's Lake to begin replacing the water withdrawn in September and early October. Even greater amounts flowed into the lake from rainfall and snowmelt runoff during the late winter and spring months this year.

Now that the bottom withdrawal siphon system is installed, the work of restoring Devil's Lake is just beginning. DNR staff expect to operate the withdrawal system each September and early October for 15 years or so. During fall through spring months, withdrawn water will be replaced each year by diverting water from Babbling Brook. The lake will be monitored for signs of improvement. With any luck the lake will experience better water clarity, fewer phytoplankton blooms and other forms of noxious algae growth, less frequent bouts of swimmer's itch, and lower fish mercury levels. Our goal is to return Devil's Lake to its original pristine state so that future generations will be able to enjoy this truly outstanding resource gem.

Richard C. Lathrop is a PhD research limnologist for the DNR and manager of this Devil's Lake restoration project. Civil Engineer Timothy J. Astfalk of Mead &Hunt, Inc. was responsible for engineering services in designing and installing the withdrawal pipe system. DNR Water Resources Engineer John C. Panuska and DNR Water Resources Specialist David W. Marshall assisted on the project.



The water wolf's

Miles of tiny streams and flooded ditches less than 10 inches deep form a temporal lover's lane for northern pike along Green Bay's west shore.

invisible nursery

Richard Rost and Lisa Gaumnitz

DON BLEGEN

Thousands of wetland acres and hundreds of stream miles along Green Bay's western shore lie dry and invisible most of the year. These ditches, intermittent streams and grassy areas form ephemeral wetlands and waterways that are only soaked in springtime when they are full of spring rainfall and snowmelt. For a short time the shallow, flooded landscape creates watery pathways that connect with each other and eventually with Green Bay. During this short high-water period, northern pike migrate miles up these small streams and wetlands to lay eggs.

Northern pike are sometimes called "water wolves" due to their aggressive behavior, torpedo-like bodies, long snouts and rows of razor sharp teeth that keep them near the top of the aquatic food chain. Northerns provide fine eating, great sport and they control large numbers of unwanted prey species, including several exotic species that are now found in Green Bay. They are an important component of the Green Bay ecosystem and have been evolving with the system for the past 10–12,000 years. Ironically, northerns don't get much respect and are the Rodney Dangerfields of the piscine world.

In 1988, DNR fisheries personnel started noting a gradual decline in the commercial catch of northern pike and an apparent decline in the number of adult pike in Green Bay. That population drop combined with continued loss of wetland acres caused great concern and warranted studies to examine northern pike spawning behavior. Our intent was to protect the spawning habitat northerns were using and to find areas where spawning habitat could be restored.

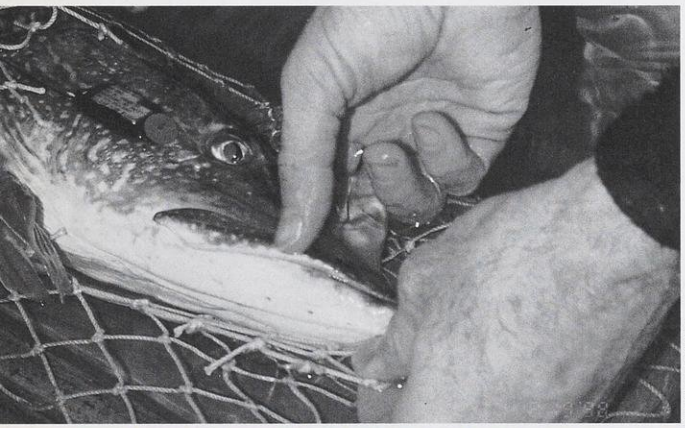
Most northern pike that reside in Green Bay travel inland to spawn. Most spawning takes place on the west shore of the bay that slopes gradually inland for 40–50 miles. The Niagara Escarpment, a layer of really hard rock forms the steep, precipitous east shoreline whose rocky coast has few wetlands. We suspect pike have followed this behavior since glacial times more than 10,000 years ago almost perfectly matching their spawning and rearing runs to the springtime formation of these shallow waters in late March and early April.

Radio tracking studies demonstrated that northern pike sometimes travel great distances on these inland spawning runs. They initially move from the bay in larger streams then progressively into smaller and smaller waterways. Regardless of how far they travel, they almost always end up spawning in shallow waters 10 inches deep or less in ephemeral streams or wetlands. We've caught young of the year in traps as far as 45 miles inland and our radio-tracking studies have followed spawning adults 15 miles inland. We know some of the Green Bay pike travel at least that far and we suspect these fish travel to the very headwaters of the west shore watersheds.

In the spring of 1998, our crews implanted radio transmitters in 22 northerns caught in the mouth of the Pensaukee River. We followed the fishes' movements every day and documented them. Road culverts that were too high for the fish to jump into posed the biggest obstacle to migrating fish. In some areas sediment and algae caused by runoff from agricultural operations

(left) **Adult northern pike stalk and attack prey or lures by cruising shallow weeds and weedline edges. In truth, the pike's "formative years" are even more dependent on really shallow waters.**
(below) **Tributaries and streams along Green Bay's western shore lead to intermittent streams, ditches and wetlands that form shallow nurseries each spring.**

RICHARD ROST



RICHARD ROST

RICHARD ROST

(top) **Radio transmitters were attached to 22 northerns to track routes, distances and locations of spawning grounds. Almost all the fish spawned in ephemeral wetlands.**
(above) **Northerns spawn over shallow vegetation where dense grasses and other plants can keep the fertilized eggs suspended in well-oxygenated water.**

coated spawning beds and made it difficult for the eggs to attach to the vegetation.

The formative weeks in shallow waters

As they travel, adult pike form spawning groups that usually consist of one or two relatively small males and a larger female who is full of eggs. Suitable vegetation provides all the stimuli they need to prompt the simultaneous discharge of eggs and milt. The vegetation may be true wetland plants or even submerged terrestrial vegetation, but it must be clean and have plenty of places for the adhesive eggs to attach. The vegetation also must be sturdy and dense enough to keep the fertilized eggs off the bottom in well-oxygenated water for two weeks until the fry hatch. Sedges and other true wetland species were used historically, but submerged grasses including the persistent exotic reed canary grass will do.

Newly hatched pike are only about a quarter-inch long. They swim very actively for a day or so then, remarkably, these tiny fish secrete a mucous-like substance from specialized epithelial cells on their foreheads. This material forms a globule, and the fry bump into clean stalks and *re-attach* to vegetation by means of a mucilaginous "sucker." The fry then back off a quarter-inch or so to form a thread-like strand between the vegetation and their heads. They remain attached to vegetation for four to five days while absorbing their yolk sacs. Thereafter the small fry break off the attachment and begin to feed voraciously on zooplankton they find in the warm shallow water where they were born. Shortly afterward they begin to feed on insects and fish.

When they reach about 20 millimeters (¾ inch) in length, the young northern pike are physiologically prompted to emigrate back to the body of water that their parents came from — in this case, Green Bay. The fry drift very slowly downstream with the current. It can take weeks or even months for the young to reach Green Bay.

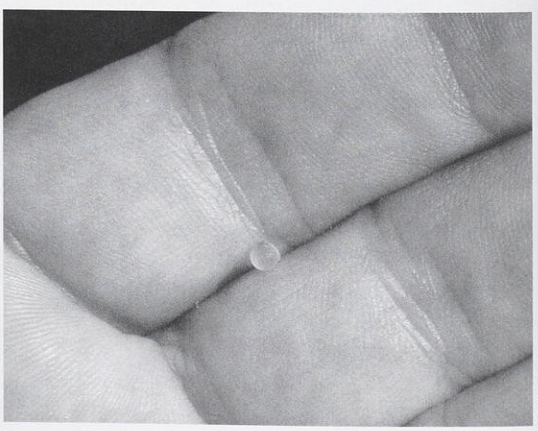
To a certain point, a slower trip is better because the young pike can spend a long time in this shallow nursery. It provides the same comforts as any good nursery — it's warm (as compared to Green Bay), there's plenty of food, and plenty of protection from predators. Submerged grasses, sedges, other vegetation, and leafy detritus form great cover with many places to hide. The warm, shallow water produces large numbers of zooplankton and insects and the young pike grow very rapidly. By the time they reach Green Bay in the middle of June, the ephemeral streams and wetlands have dried up. Before the end of their first summer, well-fed northern pike may be 10 inches long, a size that makes them competitive with the larger fish in Green Bay proper...if they survive.

Green Bay proper is a hostile place for young northern pike. In smaller inland lakes, young pike usually find cover in the shallow littoral habitat along the shoreline. In Green Bay, there isn't much of this weedy habitat. The shorelines are windswept and very turbulent. It's difficult to hide from predators, and the huge mass of water is slow to warm. So pike learned over millennia that survival meant staying in the shallow wet areas of the bay's western shore until they were big enough to fend for themselves in the open waters.

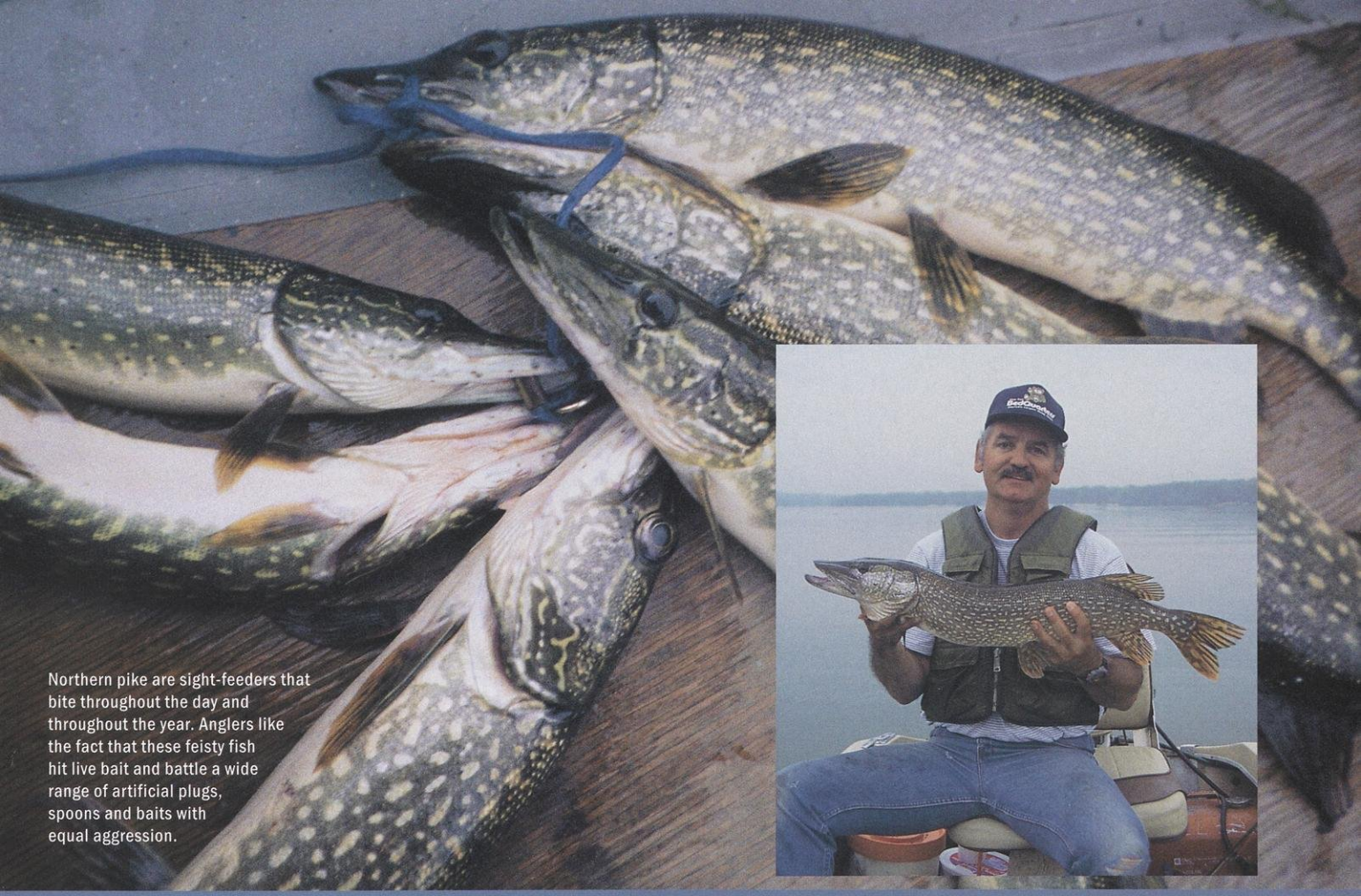
A need to protect seasonal wetlands

Ephemeral wetlands receive little legal protection. Since these shorelands and uplands only remain saturated with water for a few months, they often do not develop the soil characteristics necessary to be classified as wetland according to current state and federal standards. Likewise, many of the streams young northerns use as migration routes are not considered navigable by current standards. As a result, they are not afforded the same protection as

(below) **A northern egg normally hatches in two weeks. Fry swim free for a day or so then re-attach to vegetation for four to five days to absorb yolk sacs.**
(right) **Small northern fry drift slowly downstream toward Green Bay feeding and taking shelter in submerged vegetation. By summer's end a young northern may be 10 inches long.**



RICHARD ROST



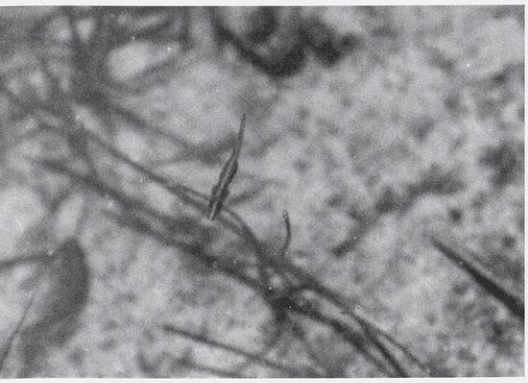
Northern pike are sight-feeders that bite throughout the day and throughout the year. Anglers like the fact that these feisty fish hit live bait and battle a wide range of artificial plugs, spoons and baits with equal aggression.

Putting a price on pike

Northern pike fishing and their spawning habitat are undervalued commodities. If you consider the money spent on fishing equipment, motel rooms, food, gas, bait and other supplies for a fishing trip, each harvestable pike may be worth $143. In 1993, a five-acre spawning marsh of intermittent streams and wetlands produced approximately 67,000 young of the year northern pike. Figuring that roughly 10 percent survive to a catchable size, the 67,000 pike in that small watershed were worth roughly $960,000. Production isn't always that high and, in fact, good year classes are produced on the average only once in every four to five years. Nevertheless, the fish and their habitat are worth a lot as potential income producers.

A quality fishery can keep those fishing dollars in local communities. "I've probably spent more than $10,000 going to Ontario fishing, but why should I do that when pike fishing is just as good on Green Bay," said Scott McGee, PikeMasters member and avid northern pike angler. "Both of my boys, ages 13 and 15, are big pike fishermen and they'd just as soon spend their time fishing as traveling. And all that money spent traveling could buy a pretty nice boat!"

McGee and the PikeMasters volunteer hundreds of hours and raise funds to improve pike habitat, promote catch-and-release angling and promote the notion that management might provide a world-class trophy pike fishery in Green Bay.



RICHARD ROST

navigable streams. That makes these lands more prone to development and alteration during drier months.

Wisconsin has lost about half of the 10 million acres of wetlands it had before statehood as residents and governments filled in or drained them for agriculture, development and highways. Green Bay has lost about 70 percent of its wetlands. Beyond their value as northern pike nursery, these lands mitigate flooding, help maintain surface and groundwater quality, recycle nutrients and provide habitat for a variety of plants and animals.

There are some hopeful signs. We're defining and ranking the spawning grounds and migration routes that need to be saved. Already, a few projects are underway to save some of these vital spawning grounds. For example, bulldozers contoured portions of a 40-acre field about a mile from Green Bay so

(BOTH PHOTOS) RICHARD ROST

(top) **Northerns float downstream toward Green Bay from April through early summer. Timing is everything. The Bay offers fewer protective plants and small fish are vulnerable. On the other hand** *(left)* **if pike wait too long to spawn or migrate, they can be stranded as shallow waters dry up.** *(above)* **To help people recognize what they are seeing, a sign marks important spawning habitat that is dry most of the year.**

that during spring snowmelt the field resembles a five-acre pond with hummocks that form fertile spawning grounds. Across the road from that site, pike are already benefiting from a spawning ground restoration project DNR fisheries technicians designed and the Department of Transportation created. In Brown County, the Department of Natural Resources, the Brown County Parks Department, the U.S. Environmental Protection Agency, Wildlife Forever and the U.S. Fish and Wildlife Service combined efforts to create an eight-acre spawning marsh site on the Barkhausen Waterfowl Preserve. In nearby Outagamie County and a portion of Brown County, the combined efforts of the Outagamie County Land Conservation Department, Brown County Planning Commission, USDA-NRCS and the Oneida Tribe created more than 12 miles (over 80 acres) of streamside buffer to provide northern spawning habitat. This protected area gives young pike a place to hang out while they grow.

Other supporters of "the people's fish" are also making a difference for the Green Bay population. PikeMasters is one such sportfishing group that has helped me out on several occasions. For instance in the dry spring of 2003, I feared adult pike would not be able to make it upstream to their spawning marsh at Barkhausen Waterfowl Preserve. I set fyke nets in the Suamico River and asked the PikeMasters for help. At their cost and on a weekend we lifted nets, removed the ripe northern pike and transported the fish to the spawning marsh. Fortunately, we got lots of precipitation later in spring and more than 50,000 very robust young pike migrated from the marsh back to Green Bay later that year. Given support, we'll continue restoring spawning habitat parcel by parcel to help sustain these magnificent fish.

Though we've lost many acres of wetlands from the Green Bay ecosystem, we're fortunate that, to a degree, northern pike have been able to adapt to habitat created by man. Such habitat restoration, however, is very expensive and its success isn't guaranteed. Our first goal remains protecting the ephemeral wetlands nature provides each spring and restoring other areas to ensure that healthy, diverse aquatic ecosystems on Green Bay's west shore include peaceful backwater nurseries for the water wolf.

Richard Rost is a DNR fisheries habitat and management technician based in Peshtigo. Lisa Gaumnitz is public affairs manager for DNR's water programs.

A growing thirst for groundwater

Where water demand outpaces supply, times warrant a fresh look at a resource considered unfathomable and unending.

Lisa Gaumnitz, Tim Asplund and Megan R. Matthews

It's hard to conceive that Wisconsin groundwater, long viewed as a bottomless well, could run dry in some places.

"With 1.2 million billion gallons of groundwater, as well as the Mississippi River and two Great Lakes, there isn't any other state that has anything like it," says Jill Jonas, who directs the state's drinking water and groundwater program. "It's not that we don't have enough water, but in a growing number of places, we're pumping groundwater faster than it can recharge. There are areas in the state where streams aren't running and where springs aren't flowing because the groundwater that feeds them is being drawn dry by people."

Humans have interrupted the water cycle. It's creating a vicious circle in some parts of the state and a cautionary tale in other places that still have a favorable water balance.

In the last century, pumping has reduced groundwater levels by 450 feet around Milwaukee and Waukesha, by more than 300 feet in the Green Bay area, and by about 60 feet in Dane County. These long-term drops in groundwater levels affect the quantity and quality of water available to communities, private well users, and in some cases to the lakes, rivers, wetlands and springs that depend on them for year-round flow.

The search for new water supplies and technological fixes is compounding these problems, revealing weaknesses in state laws that govern the siting and operation of wells. It's also pitting communities and residents against one another and the natural resources they adore.

For example, in southeastern Wisconsin, Waukesha County is pumping 25 percent more groundwater than in 1979, contributing to a dropping water table and drawing water from rock layers that liberate naturally-occurring radium into drinking water, which must be treated.

New Berlin has limited future planned industrial, commercial and residential growth to stay within the capacity of its existing shallow water wells.

And the Village of Mukwonago, despite an exhaustive search for a new source of drinking water, is siphoning water away from a rare Wisconsin wetland that harbors endangered plant species dependent on a constant supply of high quality groundwater.

But there are signs that Wisconsinites are starting to see the connection between groundwater, surface water and the need to better manage water uses.

• Legislation passed in late March for

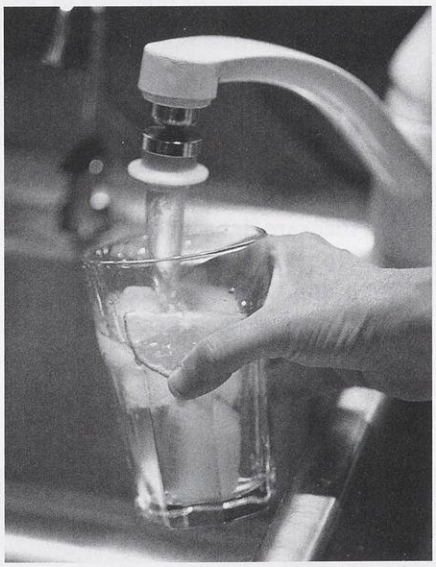
We often fail to appreciate the interconnected nature of natural springs, surface water and groundwater. Moreover, we don't see that continued groundwater depletion has consequences for more than people.

the first time addresses groundwater quantity issues and seeks to control well location and pumping rates to prevent harm to trout streams and other nearby sensitive surface waters.

- A regional effort to assess, coordinate and manage drinking water supplies is underway in southeastern Wisconsin, where the state's deepest drawdowns have occurred.
- This year the Great Lakes governors and their Canadian counterparts are expected to update the agreement that protects Great Lakes waters and seeks to limit exports of waters to communities outside the basin.

"We're beginning to realize what we've been taking for granted for a long time," says Ted Wysocki, New Berlin's mayor. There has to be stewardship of groundwater and it's more than what we thought 30 years ago, (which was) "let's protect it and keep it clean."

"The fact is that there are places where obtaining a ready supply of water is already a challenge. Matters will only worsen unless we make changes," says DNR Water Administrator Todd Ambs. "We need to make a conscious choice to deal with these issues. The alternative is to let a crisis or circumstances beyond our control dictate how we manage water."



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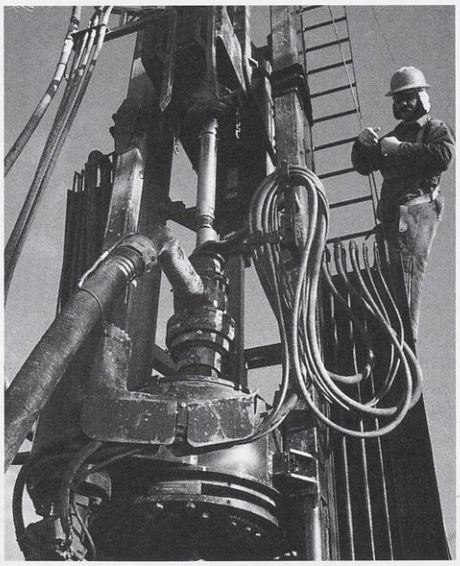

ROBERT QUEEN

As per capita water use rises and communities continue to grow, pressure mounts to keep drilling wells to supply more water. We're not running out of groundwater, but it isn't equally distributed statewide. Aquifers vary in quality, treating water is costly and we're concerned that drawdowns in some areas could affect streams, wetlands and other surface water.

A legacy of protecting groundwater quality now addresses quantity

Wisconsin led the nation in crafting laws to protect groundwater quality and provide safe drinking water. State regulations from the 1930s governed well construction, pump installation and set the nation's standard for providing safe, sanitary drinking water. Laws to limit groundwater contamination and require corrective cleanups were crafted 20 years ago as Wisconsin faced concerns from potato pesticides, spills and potential mining wastes, but a regulatory framework to protect groundwater *quantity* did not receive much public attention until recently.

Public interest and policymakers' attention bubbled to the surface in 1999–2000 when a proposed water bottling plant in Adams County showed that state laws didn't address whether nearby springs, wetlands or trout streams might be harmed if the wells were constructed to provide the water. The case served to make people much more aware of the connections among groundwater withdrawal, surface water and human activities.

The earliest guidance on quantity came through the courts in 1903. The State Supreme Court, in *Huber v. Merkel*, interpreted the State Constitution to mean a landowner could use as much groundwater as wanted, regardless of how it affected adjoining property owners. In 1974, the State Supreme Court overturned *Huber v. Merkel* and ruled in *State of Wisconsin v. Michels Pipeline Construction* that the state regulates groundwater for the common good of all citizens. A property owner is only entitled to "reasonable use" of groundwater, and is potentially liable for impacts on other users. However, damages could only be prevented or recovered after-the-fact through civil lawsuits, and what was considered "reasonable use" might vary.

Laws passed in the post-war building boom of 1945 tested whether communities could protect drinking water supplies by requiring approvals before sinking high capacity wells near any municipal well. These private "high cap" wells — capable of withdrawing more than 70 gallons a minute or more than 100,000 gallons a day — were seen as potential threats to the public drinking water supplies serving growing cities. There was clear intent to ensure a safe drinking water supply and to separate subdivisions from enterprises like vegetable canneries, papermakers and breweries that might vie for the same water. Today, more than 9,500 high capacity wells are in service statewide providing water for agricultural irrigation, municipal drinking water, industries, schools, institutions and mobile home parks.

Some other states — Florida, Minnesota, Oregon and Washington — have modernized their statutes to recognize that surface water and groundwater are hydraulically connected and ought to be legally linked for their mutual protection.

The Groundwater Protection Act passed last March expands DNR authority over groundwater wells by requiring advance notice before any wells are constructed. The law directs DNR to review environmental consequences of proposed high capacity wells in certain situations:

- within 1,200 feet of any surface water identified as an Outstanding Resource

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REACH the BEACH
Treasures and challenges on
Wisconsin's sand and rock shores.

Natasha Kassulke

A summer beach forecast.

TUNE IN

This summer, millions of people in the Great Lakes region will pack up and follow the sun in search of nature's nirvana – a perfect beach getaway.

They'll resurrect the Dick Dale surf-guitar songs – this time, maybe on iPod or CD, and re-discover the "Beach Blanket" antics of Frankie Avalon and Annette Funicello on DVD. But what these modern dune explorers will find when they unfurl their bright SpongeBob SquarePants beach blankets will vary.

Some will discover "no swimming" signs due to elevated *E. coli* levels crushing hopes of cooling off at the water's edge. Others will find dunes and pristine sandy stretches prime for playing in and out of the water. Still others will skip stones and photograph brilliant sunsets.

About 190 public beaches align Wisconsin's Great Lakes coasts. Despite their magnetism to those in search of sun and fun, beachfronts are under stress. Efforts underway pinpoint the problems as well as stave off dune mining, erosion and exotic species invasions.

Several Lake Michigan communities have monitored water quality at their beaches for decades.

Dave White is director of Keep Our Beaches Open, a grassroots organization in Racine raising awareness of beach water quality and concerns through stormwater drain marking, educational fairs and more.

In 2003, the Wisconsin Department of Natural Resources, in cooperation with local, state and federal authorities, began implementing the federal BEACH (Beaches Environmental Assessment and Coastal Health) Act to develop programs that effectively monitor water quality and notify the public of beach health at coastal beaches. Thanks to the group's efforts, Wisconsin beach visitors can expect to find more useful information on beach water quality, including signage in English, Spanish and Hmong.

White says misconceptions about beach closings remain and the public may still be afraid to visit their community beaches.

"There have been enough beach closings that it doesn't even occur to some people that they can go to the beach," White says.

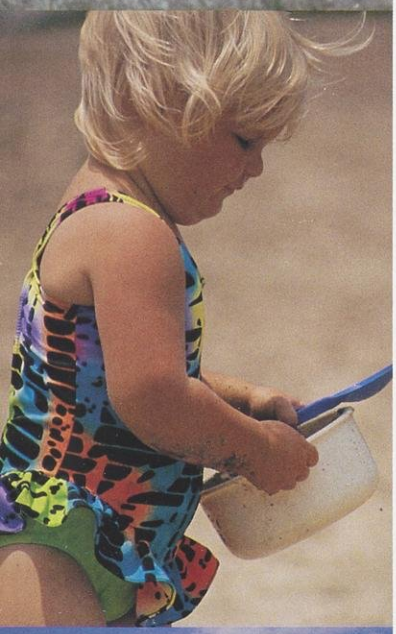
Wisconsin's coastal beaches are revered as a summer playground, but fewer people appreciate the beach as a unique community, a frontier for land colonization, a nursery for plant and animal species, a battleground for public and private access, a way station for migrating species and an environmental contamination indicator.

"Going to a pool rather than your community beach is one more disconnect between us and the natural world," White says. "Beach pollution affects our drinking water, wildlife and aquatic species that live in the lake. This is not just about a beach closing ruining my day."

So, gather the sunglasses and sunscreen. Kick back with the sound of waves in the background and explore this ever-changing shoreline and efforts underway to help people reach the beach.

Natasha Kassulke is associate editor of Wisconsin Natural Resources *magazine.*

CHRIS MATTISON



ROBERT QUEEN

ROBERT QUEEN

DAVID CREHORE

Keep our beaches open

Public participation in the Wisconsin beach program.

Benjamin Vail

Wisconsin is a national leader in implementing a coastal beach-monitoring program, and a big reason for this success has been public participation during all stages of developing and implementing a program.

"In all counties we have worked, people really want to know what is happening in their communities," says Dr. Gregory Kleinheinz of the UW-Oshkosh Biology and Microbiology Department, which contracts with several coastal health departments to monitor beaches on Lake Michigan and Lake Superior.

The DNR strives to involve as many stakeholders as possible as it works on two related missions: establish statewide standards to test for health risks, and find ways to effectively communicate beach health risks to the public.

Program development

Congress passed the BEACH Act in 2000 to ensure nationwide consistency, but each state was left to implement its own plan. Early on, the Department of Natural Resources created a workgroup and in 2001, all coastal counties, along with several municipalities, water scientists, state agencies and environmental groups were invited to join in.

Public meetings, social surveys, direct contact with stakeholders, an Internet survey and other tools were used to learn public concerns regarding beach water quality and shape a monitoring program to respond to these needs.

Monitoring

As recommended by EPA, Wisconsin tests coastal beach water for *E. coli* bacteria that can indicate the presence of harmful organisms such as viruses and bacteria. The workgroup specified how water samples would be collected and analyzed.

The workgroup representing coastal health departments, the state Department of Health and Family Services, the State Laboratory of Hygiene, the Racine-based environmental group Keep Our Beaches Open, the UW-Milwaukee WATER Institute and state parks had insights into which beaches to test and how. But the workgroup was not certain where all the Great Lakes beaches are located.

Public input helped pinpoint beaches and determine how they should be monitored. People at the beach pointed out public access areas and gave information about how often beaches are used, which helped health departments rank beaches for monitoring.

Given limited funds, health officials want to target monitoring to the most widely used beaches and those that may have physical features that can lead to high *E. coli* levels. For example, beaches that are near parking lots or sewer and street drains may experience higher levels of *E. coli* after rainstorms, as garbage and street debris are washed into the surf.

Beach locations became clearer during public meetings in the winter of 2002–2003. Seventy-one visitors also filled out surveys suggesting how to make the program work.

Public notification

Surveys of beach visitors in the summers of 2002–03 gauged attitudes about beach water quality and public health issues.

In the Southeast Region, where beach monitoring has been routine for many years, survey results suggested the public is more likely to obey health advisories than in other parts of the state. Where beach monitoring practices were less developed or nonexistent, the public was less likely to obey warnings. One-time tourists are least likely of all to read and heed posted beach warnings.

Survey respondents also described what kinds of advisory signs they want to see, where signs should be posted, and through which media they want to get beach information.

Health officials are targeting beach monitoring to beaches that are widely used and have features that may lead to high *E. coli* levels. Seagulls, sewage, diapers, trash, runoff from parking lots and ill swimmers are among the potential sources of health concern at beaches.

For more information on monitoring results

Updates on daily water quality conditions for the Great Lakes beaches in Wisconsin are found at infotrek.er.usgs.gov/pls/beachhealth>/.

The beach condition hotline number hosted by UW-Extension is (800) 441-4636, ext. 1460.

The U.S. Environmental Protection Agency features a Beach Watch page at www.epa.gov/waterscience/beaches/ with beach survey overview, beach reports, beach links, volunteer opportunities and grant information.

ROBERT QUEEN

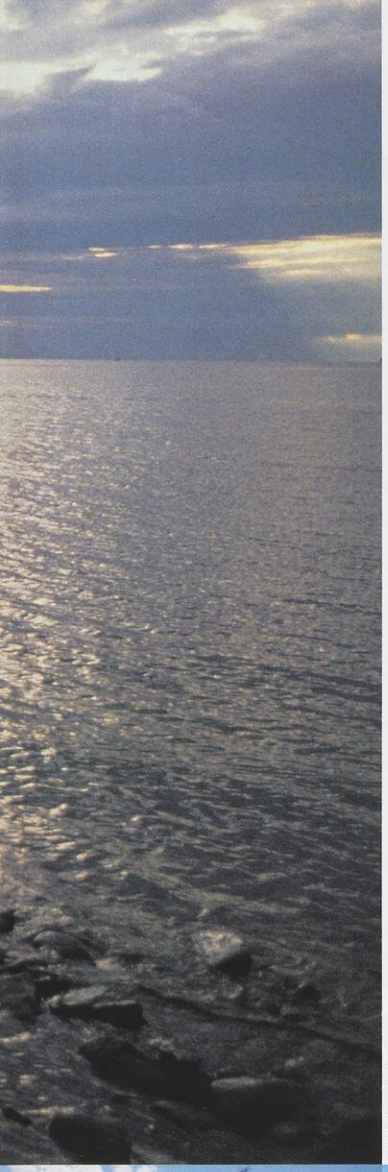
(above) **Swimming isn't the only reason people visit beaches. In fact, skipping stones is a treasured activity at Schoolhouse Beach in Door County.**
(right) **This summer many beach visitors can expect to find more useful information including signage on beach water quality.**

Toni Glymph, a DNR microbiologist directing the monitoring program says, "We are living in a society that is more conscious about what we eat, how we exercise, and about our overall health and well-being. The public wants to know what has the potential to affect their health. Ignorance is not bliss."

Public notices follow the survey results. Signs inform beach visitors about current conditions. A website announces daily updates on water quality conditions at beaches around the state. A brochure was designed for state park visitors. And in 2004, a toll-free hotline carries daily information about each beach and the public can sign up for daily e-mail alerts about beaches of their choosing.

The Department of Natural Resources continues to solicit ideas from local chambers of commerce, state tourism officials and local citizens groups. Continued advice from beachgoers will improve the programs. The guiding principles continue to promote providing useful, timely health information for beach visitors to make their own choices about when to enjoy the beach.

Benjamin Vail is project coordinator for the Wisconsin BEACH Program.



A geological wonder

Dunes, spits and swales.

Natasha Kassulke

Heather Kelley doesn't like to play favorites, but admits a fondness for Seagull Bar State Natural Area in Marinette.

"It isn't developed and is still wild," she says. "It's an important beach for shoreland and migratory birds."

Two years ago, Kelley, a BEACH Act geographic information system coordinator for the Wisconsin Department of Natural Resources, was part of a team that traveled Wisconsin's Great Lakes coast to identify and map public beaches.

The EPA uses this beach mileage to allocate funding for water quality monitoring and education.

Sixty public Great Lakes beaches were referenced in literature and online. By project completion, the team had found 190 public beaches of varying geologic formation and accessibility — some reachable only by boat. Each beach was mapped and over 100 are being monitored.

"The results surprised a lot of people," Kelley says. Many of the public beaches were not posted as public. "Beaches aren't all sandy, white and pristine. Some are comprised of gravel and/or larger rocks."

The beaches also vary in size. Some are more than a mile long. Others are small sandy spaces next to boat ramps. Door County had the most beaches by virtue of having the most shoreline.

"We've now extensively mapped 56 miles of public beaches and we're focusing our monitoring in those areas," Kelley says.

Using GPS (global positioning system), GIS (electronic mapping), aerial photos and parcel data, Kelley delineated beach size and indicated where public beaches started and private property stopped.

ROBERT QUEEN

(below) **The mouth of the Brule River is home to a beach formation know as a sand spit.**
(inset) **Wave action is one of several natural forces with a hand in forming and shaping beaches.**

ROBERT QUEEN

A beach is born

The sand your feet sinks into today, is largely the product of glaciers that covered the Great Lakes basin over one million years ago. Wind, waves and erosion work in concert to produce beaches of varying size and shape. Beach color varies according to the sand's mineral content.

Beach formation begins as eroded material — sand, gravel and rocks — deposited on shore by waves. The continual onshore-offshore movement of waves and tides gradually pushes the sand along the beach edge.

"Wisconsin beaches are comprised of sediment from glacial deposits, limestone, sandstone and granite," Kelley says.

Among the beach types Kelley discovered were sand spits, rocky beaches, beach ridges, barrier beaches with lagoons, sand dunes and urban beaches.

Sand spits

Sand spits are found at Long Tail Beach in Brown County and Seagull Bar in Marinette

County. These beaches feature long sandy stretches continuing into the water even where the shore ends.

Long Tail Beach on the west shore of lower Green Bay is a narrow sand spit. The size and shape of the peninsula, combined with fluctuating water levels result in diverse wetland plants and animals. During high water time the point becomes a series of small islands.

Black willow and cottonwood are found on high ground, grading to reed grass and marsh dominated by cattails and bulrush. A sedge meadow houses bluejoint grass and cattails. Invasive exotics such as purple loosestrife threaten native species here. There is a sandy beach along the point's east side.

Erosion from dredging and poor water quality in Green Bay has destroyed some wetlands, but this site still provides important habitat for shore birds, gulls and terns. It is an important migratory bird stopover.

Seagull Bar at the mouth of the Menominee River on the margin of Green Bay features a shallow bay with marsh vegetation that expands or recedes with lake level changes. The eastern edge of Seagull Bar forms sand beach ridges and low dunes.

The dunes support marram grass, Canada rye, beach pea, and several rush species in low, wetter areas. In spring and fall, shore birds by the thousands congregate at the sand beach. The federally endangered piping plover has attempted to nest here in recent years. Seagull Bar was designated a state natural area in 1962.

Rocky beaches

Schoolhouse Beach in Door County on Washington Island is one of Wisconsin's great rocky beaches. The beach is named for the log schoolhouse built there in 1850. The beach is comprised of large round and smooth stones.

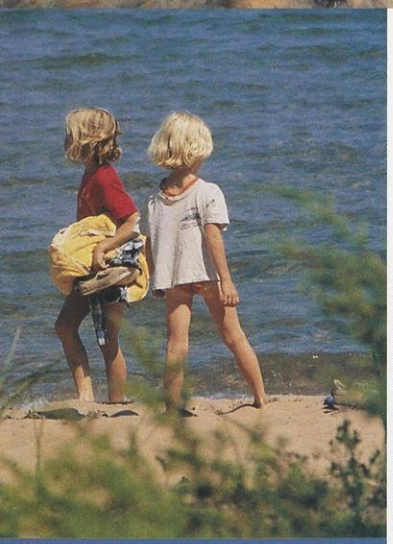
Local laws prohibit taking the rare rocks, but this is the place if you like to skip rocks.

Ridges and swales

The Ridges Sanctuary in Door County is on the eastern edge of the Door Peninsula on Lake Michigan. The peninsula features a ridge of dolomite limestone, which is part of the Niagara Escarpment that passes through east central Wisconsin. Much of this area is made up of low, sandy ridges, alternating with wet areas called swales.

ROBERT QUEEN

The Ridges Sanctuary in Bailey's Harbor, Door County contains rare plants and insects. About 30 ridges have formed parallel to the shore here over 1,200 years.



ROBERT QUEEN *(ABOVE)* JEAN MEYER

KEVIN COLLISON

(above) **Not all beaches are sandy. Some are comprised of gravel and large rocks.**
(left) **Big Bay State Park is home to an example of a barrier beach type.**
(below left) **The Carolina puccoon thrives in the dunes of Lake Michigan.**

The ridges parallel the shore and extend inland about a mile. Spring wildflowers — hepatica, trilliums and trout lilies — bloom from mid-April to the end of May. The sanctuary's symbol is the showy and rare lady's-slipper orchid. Twelve endangered or threatened plant species are protected within the sanctuary.

Beach ridge formation at The Ridges Sanctuary started 1,200 years ago when Lake Michigan extended a mile farther inland than it does today. Sand deposited during the last glacial advance was carried by longshore currents and slowed by the shallow U-shaped harbor building ridges.

Fluctuating water level is another important ridge former. When lake levels are high, waves push the sand into a low ridge along the shoreline. As lake levels drop, the ridge is exposed and sometimes capped by wind-blown sand. One by one, the ridges form.

Plants stabilize each new ridge — first sedges and grasses, followed by shrubs and a few tree species. Gradually other trees and plants move in, finally becoming a boreal forest.

About 30 crescent-shaped ridges of sand and soil have formed parallel to the shore. The ridges closest to the shoreline are the youngest. Since it takes 30 to 40 years for each ridge to form, older plant communities are found on each succeeding ridge.

Point Beach Ridges is another such beach, located within Point Beach State Forest in Manitowoc. It has 11 ridges and swales paralleling Lake Michigan that formed through the protracted lowering of glacial Lake Nippissing. The ridges and swales are actually old beaches deposited during the last 8,000 years.

Except for a strip of dunes and beach along the lake, the area is forested. The beach harbors several uncommon plants including dune thistle, clustered broom-rape, thick-spike wheatgrass, prairie sand-reed, and dune goldenrod, which all are state-threatened. The endangered sand dune willow is found here at its only known Wisconsin location.

Barrier beaches

Barrier beaches feature sand in front of lagoons. Examples include the Big Bay State Park and Big Bay Town Park on Madeline Island in Ashland County.

The 2,350-acre state park houses sandstone bluffs and caves. Bird watchers are intrigued to find that 240 bird species use the park. At Big Bay Town Park, a wooden footbridge crossing the scenic lagoon is popular for canoeing and fishing.

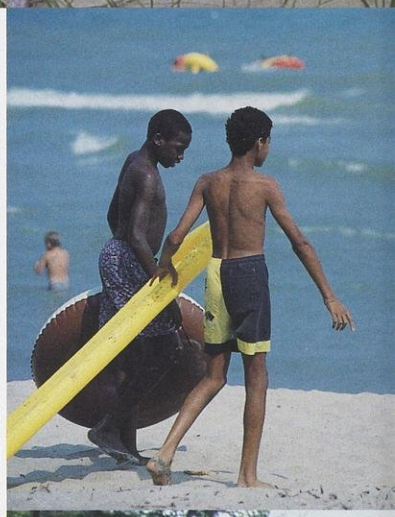
Coastal fen, coastal bog, shrub swamp and tamarack swamp border the lagoon. A floating mat around the lagoon is composed of native sedges, sweet gale and buckbean. Further away, a coastal bog mat consists of sphagnum mosses, shrubs and sedges.

Sand dune areas

Great Lakes sand dunes comprise the most extensive freshwater dunes in the world — so large they are visible to astronauts in outer space.

Here, the piping plover nests in shoreline sand. Houghton's goldenrod, pitcher's thistle and the dwarf lake iris are threatened plants that thrive in Great Lakes dunes, according to the Wisconsin State Herbarium.

(above) **Sand is constantly in motion due to wind action at this beach. In dune areas, grasses spread their roots under the sand to form a web to hold the sand in place and withstand the wind.**
(right) **Kohler-Andrae State Park in Sheboygan County houses miles of beaches including sand dunes and also is home to a rich maritime history.**



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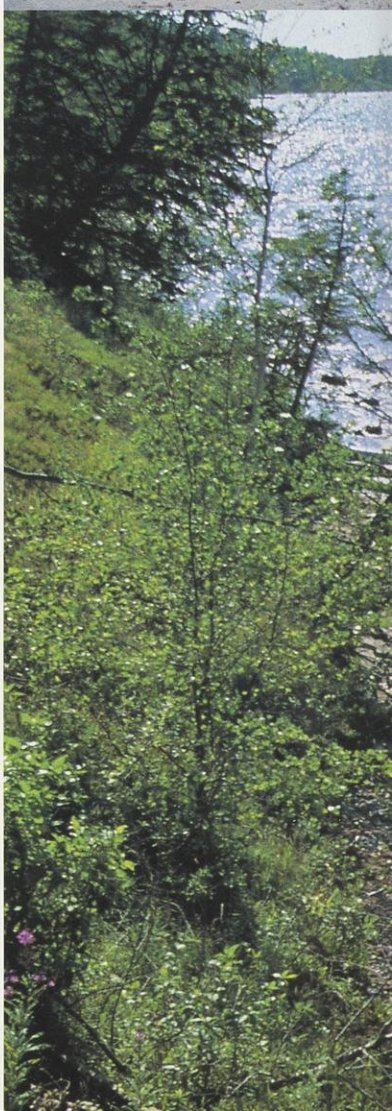


Whitefish Dunes State Park in Door County is Wisconsin's best example of a large sand dune area. Established in 1967, this 865-acre park has a three-mile coast, composed of sandy shoreline and rocky bluffs. Exposed dolostone is a clue that a shallow warm sea once covered the area 425 million years ago during a period known as the Silurian Sea. Fossils and seashells are exposed here and in rock throughout the Door Peninsula.

Push a magnet into the sand and magnetite, an iron mineral found in the Lake Superior basin, will cling to it. These sand grains are debris that glaciers eroded from the bedrock of Canada and dumped into Lake Michigan.

The beach at Whitefish Dunes State Park is constantly reshaped by wind. Wind blowing over Lake Michigan hits the shore hard, picking up sand grains and pushing them inland. As the wind velocity slows over land, sand drops to the earth, and in time a pile forms.

These piles grow into dunes. Once cresting the top, the wind moves down the steeply sloping backside, which creates momentum to pick up sand grains and continue inland. The wind speed slows again as it heads inland, sand drops to the ground and the process starts over. Younger dunes block the wind and allow plants to establish on the older dunes. These plants live and die over hundreds of years, creating sandy soil.

Wind-formed dunes consist of medium to fine sand grains. As the wind blows, a process called "saltation" moves the majority of the sand. Saltation is a bouncing of the grains across the beach. Coarse sand is too large to be moved by this process and moves short distances by rolling along the surface. Fine silt particles are carried in suspension by the wind for long distances.

Between the water's edge and dune's beginning, dry sand is constantly in motion, which makes it a tough place for plants to root. One kind of plant that does live here is marram grass. Its roots spread just under the sand surface to form an underground web that helps hold the sand in place. Though marram grass stabilizes the sand for its own survival, as a side effect other vegetation can take hold.

Frogs and toads, salamanders, turtles and snakes live here too.

Kohler-Andrae State Park in Sheboygan County also features sand dunes, miles of beach and rich maritime history. Over 50 vessels have sunk in this area alone, including an 87-foot schooner, the *Challenge*, built in Manitowoc in 1852. In 1982 a section of this ship's keel washed ashore at Kohler-Andrae and is now on display outside the Sanderling Nature Center.

Some Great Lakes dunes are threatened by mining. Sand is used to make foundry molds for cars, trains and airplanes as well as glass and concrete products. The Sand Dune Protection and Management Act was passed in 1976, but the Great Lakes region continues to lose dunes.

Urban beaches

In cities, beaches are a respite from pavement and offer free or cheap family recreation.

Bradford Beach on Lincoln Memorial Drive in Milwaukee is the city's most popular beach for swimming and sunbathing. Amenities include sand volleyball courts, a bathhouse and concession buildings. Water temperatures fluctuate from the 50s to upper 60s throughout summer and on a warm weekend day, 900 to 1,500 people enjoy the beach.

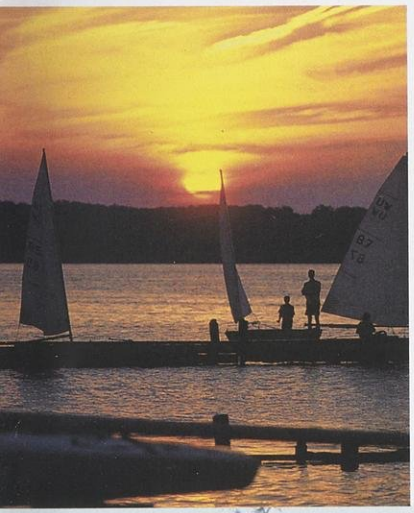
Deland Park Beach located on Lake Michigan in downtown Sheboygan is another popular urban beach and offers a bathhouse, shelters, public boat launch and is the home of the Sheboygan Yacht Club and Youth Sailing Center.

Natasha Kassulke is associate editor of Wisconsin Natural Resources *magazine.*

Finding equilibrium

Beaches as an engineering challenge.

Lisa Gaumnitz



DNR FILE PHOTO

Shifting sands and advancing science are spurring a sea of change in how Wisconsin protects its Great Lakes beaches.

Where experts once urged coastal property owners to use gigantic boulders, cement walls and other heavy-duty structures to stem erosion and stabilize bluffs, they're now counseling them to let nature take its course.

(left) **Sailing and boating are popular Great Lakes sports. But increased boating activity translates into a need for additional boat storage including piers, marinas, docks and harbors that can disrupt nature's course.**
(below) **Erosion is another factor effecting beaches. Storm waves can carve sand from Wisconsin's highly erodible coasts.**

ROBERT QUEEN

"We've come to realize that we can't always engineer a solution to many processes, like erosion. We can only live with them," says Gene Clark, a University of Wisconsin Sea Grant coastal engineering specialist based in Superior. "The brute force approach seldom works."

He and other experts are not only converts to the idea that "hard armoring" with cement and boulders is futile in many cases, but that some beach erosion is necessary and fighting it can backfire.

"You want a little bit of erosion because that supplies the sediment needed for the system to be healthy," says Alberto Vargas, who coordinates an interagency Coastal Hazards Workgroup for the Wisconsin Coastal Management Program. "Nature tries to find an equilibrium, so sand will come from one place and be deposited in another. It cycles and it circulates.

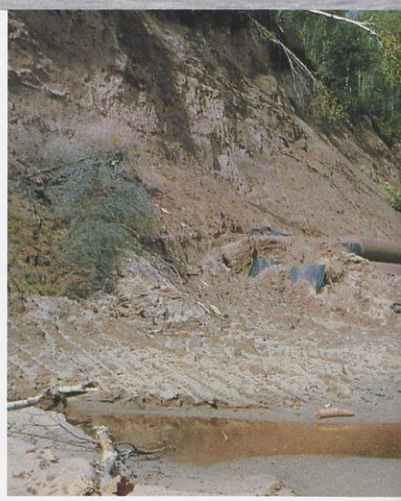
"The problem occurs when you change one of the elements in this equation. Sand supply is one of the elements, and we have a sand-starved coastline in Wisconsin."

That paucity of sand results from Wisconsin's highly erodible coast — 80 percent is comprised of highly unstable materials and so are erosion prone. Human actions exacerbate the erosion.

Erosion

Addressing erosion starts with understanding how Great Lakes and Wisconsin beaches formed. This story was laid out in "Living on the Coast," a 2003 Sea Grant and U.S. Army Corps of Engineers publication that describes how glaciers entered the region about two million years ago, forming, advancing and receding as many as 15 times until the last glaciation 25,000 to 10,000 years ago.

With each cycle, the glaciers carved the lake basins deeper and as they melted, left behind till, a mixture of sand, silt and clay. Each layer was composed of different materials, with sand and gravel deposited between them. Surface water and drainage between these layers makes them very unstable, and they are exposed in eroding banks and bluffs as high as 100 feet in



(top) **Breakwaters, seawalls and groins may be built to stabilize a beach area by holding sand in place. But these structures come with a price in terms of cost and potentially starving other coastlines of sand.**
(above) **About 80 percent of Wisconsin's coast is comprised of unstable materials and is erosion-prone.**
(right) **Development can exacerbate erosion and bluffs have been known to give way sending homes built too close to the edge sliding into the Great Lakes.**

many places along the shore.

Storm waves carve sand from beaches, ridges and banks. In Wisconsin, the bluffs have eroded about a foot a year in some places, so that in the last 10,000 years, they've eroded miles.

"That's what feeds the beaches," says Al Lulloff, a DNR water management engineer. "But people have been putting in hard armoring and cutting off the supply of sand."

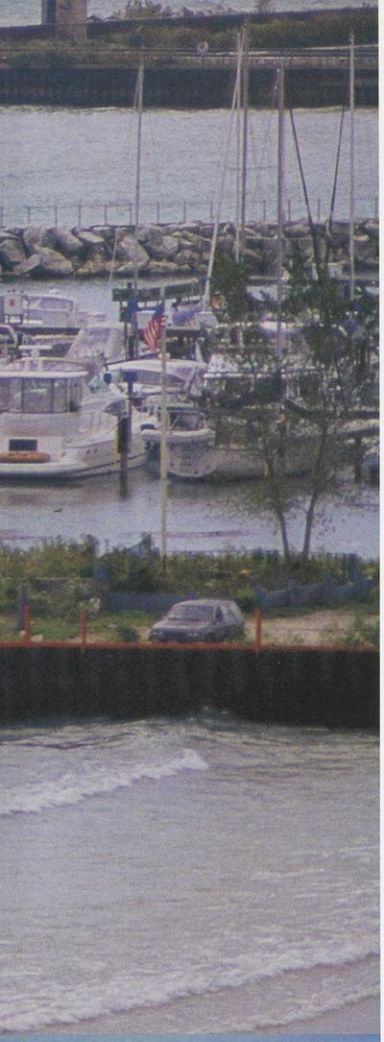
Historically, and into the present, people wanted ports, cities and homes on the water, but Wisconsin has few natural harbors. So communities created manmade harbors by filling in lakebeds, building on them and protecting them with hard armor such as breakwaters, seawalls and groins (structures built perpendicular to the shore to stabilize a beach by holding its sand in place).

The number of groins and other armored shore protection along Lake Michigan's coast has grown significantly in recent decades as demand for coastal property has grown. The shore along Racine and Kenosha counties is peppered with groins as property owners vie for scarce sand. Proposals from developers farther north seek to erect structures that create "pocket beaches" along Port Washington's sand-starved coast.

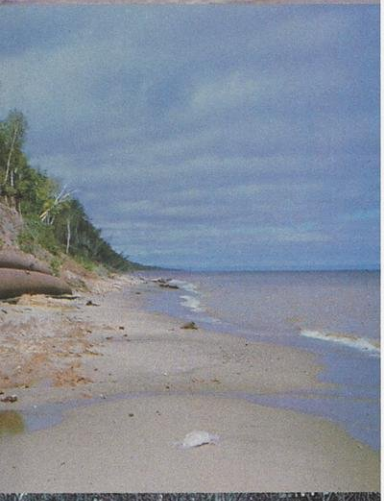
Structures like groins placed perpendicular to the shorelines trap sand that would otherwise drift down the shoreline. Milwaukee, where a wastewater treatment plant and other facilities protected by hard armoring are stockpiling sand, is starving the Racine and Kenosha coastline areas of sand. That in turn has spurred an armor buildup.

Consequently, beaches that once provided some natural protection by dissipating the energy of storm waves are now starved of sand. As a result, the lakebed is more exposed than ever to wave energy and erosion that accelerates, undercuts and undermines even large expensive structures.

This consequence of armored shore protection really hit home for scientists and some homeowners in the mid-1980s. High water levels in the Great Lakes and other U.S. coastal waters caused huge chunks of bluff to give way and homes slid into the water. These eye-opening examples started to turn the tide against structural shore protection — at least among those who have made their careers out of mitigating coastal hazards.



ROBERT QUEEN



SIGURD OLSON INSTITUTE

DNR FILE PHOTO

From "Help Yourself" to "Living on the Coast"

That shift in mindset is apparent in differences between "Living on the Coast" and the Corps of Engineers publication it replaced, "Help Yourself," published in 1978. Implicit in the title was the idea that individual property owners could protect their shoreline. The message made clear with "Living on the Coast" is that you need to look beyond your individual property and often work together.

Old shoreland protection manuals promoted structural solutions to beach erosion. "Now we stress natural practices first and structural methods only as a last resort," says Clark.

Natural practices begin with staying out of nature's way — not building on erosion prone property. Other natural practices include restoring native vegetation to the shoreline to stabilize bluffs or banks and managing stormwater runoff so it doesn't run over the edge of a bluff and down the face of the slope.

Clark counsels figuring out why a bluff or beach is eroding. Do waves, high water levels, vegetation removal, poor stormwater drainage practices, poor siting of septic system fields, or a combination, cause their problems?

"Once they realize that the bluff instability may be from their actions, they realize that restoring vegetation and managing stormwater may slow the problem," Clark says.

Armoring the shore can be appropriate when it would be very expensive or impossible to relocate buildings vulnerable to falling into the water, or when climate changes bring high water, intense storms or more frequent storms.

Mike Friis, manager of the Wisconsin Coastal Management Program (WCMP), says there are public settings where traditional shore protection can be necessary and appropriate.

Part of this program's mission is to provide public access to Wisconsin's coastal resources, a mission that can help communities offer marinas, boardwalks, public beaches and other facilities that might require armoring to protect the community's investment.

"You have to weigh offering those recreational opportunities with any potential impacts," Friis says. Without access to the waters, people don't develop an appreciation or an understanding of its importance.

But Friis stresses that the grants WCMP provides to help pay for public access projects are reviewed by technical experts to weigh public benefits, environmental impacts and costs. "We make sure the public entity understands the consequence of its activity."

Looking ahead by stepping back

Wisconsin is improving its ability to predict where erosion will occur and how fast through research funded by the WCMP's interagency Natural Hazards Workgroup. For the last decade, that group, which includes DNR, Wisconsin Emergency Management, the State Cartographer's Office and UW Sea Grant, has worked to minimize damages due to coastal hazards.

"We're trying to determine the easiest, most affordable way to track erosion so we can plan for the future and give good advice to people who live on the shoreline or want to live on the shoreline," Vargas says.

One research project that's wrapping up involves Lulloff's work to use aerial photos of the coastline taken every decade over the last 50 years to help build a model that more precisely predicts erosion rates at different stretches of the coast.

"Erosion is sporadic. Our estimate that the Lake Michigan shore is eroding one foot a year doesn't mean it erodes one foot a year every year — it could be that a 40-foot chunk falls off after one big storm — and the rate will be higher or lower in different spots."

The project will result in maps that define risk areas, and can help guide how far buildings need to be set back from the water to be on stable ground, Lulloff says. That distance could be as far as 250 feet along some highly erodible bluffs, and much less in other areas.

Lulloff and other coastal experts hope the results can increasingly steer development along the Great Lakes shore and help the property owners learn to live with the coast, not manipulate it.

"Recognize that your property encompasses an eroding bluff. Stay back and let it do its thing," Lulloff says. "It's really, really expensive to stop the erosion process, it's a long-term investment, and you may be causing a problem for yourself and your downdrift neighbors."

Lisa Gaumnitz is a public affairs manager for the DNR's Water Program.

A playground for all ages

Rediscovering fun in the sun.

Natasha Kassulke

The battle that is waged here is not between armor-plated armies, but castle creators and the wind and waves that sweep in to storm the castle. Inevitably, nature will rule and memories of the sandcastle will only live on in photos.

While some only need a bucket, plastic shovel and beach to create rudimentary castles, others take a more serious architectural approach.

Whether your passion is sandcastle creation or freshwater surfing, Wisconsin beaches are all-ages playgrounds. Beach recreation in Wisconsin runs the gamut from beachcombing to kite flying, sunbathing, swimming, Frisbee tosses, picnics, volleyball, boating, kayaking, surfing and more.

Sandcastles and sunset strolls

Carolyn Rock, a natural resource educator at Whitefish Dunes State Park in Sturgeon Bay, invites visitors to explore the park beach by day and night.

On the last Saturday in July, Whitefish Dunes State Park hosts a Sand Sculpture Contest from 1 to 3 p.m. Last year, 42 groups entered — maximum five people per group.

"We had everything from a sand Lambeau Field to a cherry pie, hammerhead shark and even a nude artistically displayed on the beach," Rock recalls.

On the third Saturday in August, Whitefish Dunes features its annual Candlelight Beach Walk from 7:30 to 9:30 p.m. As the sun sets over the dunes, candles are lit on the sandy beach. Part of the trail is handicap accessible. Stroll with family, friends or your sweetheart on a quiet one-mile walk. Enjoy the sounds as the dunes and beach awaken for the night. The park will be open past its usual time of 8 p.m. as the naturalist leads short hikes.

Last year, the night hike attracted 350 people.

"One year we saw lightning over the lake, and another year saw an almost full moon," Rock recalls. "We've had marriage proposals made and anniversaries celebrated during the hike."

Many visitors plan vacations around these events at Whitefish Dunes. The park Friends group provides refreshments. For more information call (920) 823-2400.

During afternoons in July, Whitefish Dunes also houses the Big Red Tent on the beach — an educational program on invasive species such as zebra mussels, as well as an area to check out sand tools, Frisbees, balls and other beach toys.

On the last Sunday of August, Harrington Beach State Park located on the shoreline of Lake Michigan in northeastern Ozaukee County also hosts a sand sculpting competition. De-

JOHN BAIRD

(LEFT, RIGHT) ROBERT QUEEN (MIDDLE) DNR FILE PHOTO

Beach recreation in Wisconsin runs the gamut from swimming to beachcombing for rocks and other treasure as well as windsurfing. In Sheboygan, some thrillseekers even surf waves that can reach 24 feet.

signs have included a giant squid attacking an ill-fated ship.

Beachcombers

As any dedicated beachcomber can tell you, the best treasures are discovered ashore after a big storm.

In Wisconsin, beachcombers will find driftwood, shells, unusual rocks, fossils, remnants of boats, and if you're lucky, a message in a bottle.

Much of the fun of beachcombing is finding a mysterious piece of something manmade or natural. Or you may spy animals on or near the shoreline. Evening is an ideal time to spy on critters. Animal tracks captured in the sand tell a lot about shoreland inhabitants.

While studying tracks and treasures, look closely at a handful of sand. The colorful specks are minerals and mineral combinations. You may find traces of copper, silver, and gold, especially in Lake Superior beach sand. On stony beaches, flattened, rounded rocks are formed by tumbling waves.

Some might even find a more unusual treasure. In 1990, a storm knocked containers off the deck of a ship traveling from South Korea to Washington State and 80,000 athletic shoes were lost at sea. That winter, hundreds of the shoes landed on the shores of Washington and Vancouver Island. Beachcombers found the flotsam sneakers and attempted to pair unmatched shoes.

Curt Ebbesmeyer, an oceanographer in Seattle, was one of those interested in the "sole" survivors. While he normally studies ocean currents with drift bottles, Ebbesmeyer says the shoe study provided information about currents in the Pacific Ocean.

Ebbesmeyer founded the nonprofit Beachcombers' and Oceanographers' International Association to document spills of everything from onions to hockey gloves.

He says the best story of following currents by tracking a lost or discarded item is the wonderful children's book "Paddle-To-The-Sea" by Holling Clancy Holling (1941). The book tells the story of an Indian boy landlocked in central Canada. The boy carves a small Indian man in a canoe, and places him on a snowy hillside with a message on the canoe identifying him as "Paddle-To-The-Sea," pleading with anyone who finds him to put him back in the water so that he can complete the journey that the boy cannot make himself. In spring, the tiny canoe slides down the mountain and into streams and eventually the Great Lakes and the St. Lawrence Seaway. Paddle encounters many threats and adventures. People discover and help him along his mighty journey.

Ebbesmeyer recalls a chap who released a bottle in Lake Cayuga that made its way down the St. Lawrence, across the Atlantic, over the top of Siberia and across the Pacific to San Diego, California.

"One of the most incredible bottle drifts on record," Ebbesmeyer recalls.

While combing the beach for natural treasures, look for a Petoskey stone, a favorite among Great Lakes rock collectors. The stones are fossilized coral that resemble gray honeycombs. The Petoskey is most commonly found on Northern beaches of Lake Michigan in the Western Lower Peninsula.

Surf's up in Sheboygan

In Wisconsin, most people surf on the Internet, rather than "hanging-ten" on killer ocean waves.

The exception, however, is the Surf Riders in Sheboygan who consider their home one of the best surf spots in the Great Lakes with waves that can reach 24 feet.

For much of the year, these Great Lakes surfers wear wet suits to stave off hypothermia. Their prime surfing season starts in the fall, as the weather turns cold and waves build. Two challenges to surfing the Great Lakes are that the water is less buoyant than saltwater and the waves usually break more frequently than in the ocean.

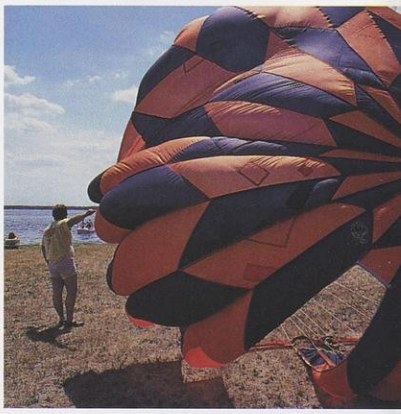
The Sheboygan surf scene was captured on film in the 2003 surfboarding documentary, "Step Into Liquid." Among the surfers featured were twins Lee and Larry Williams.

Larry Williams founded the Dairyland Surf Classic, held annually on Sheboygan's lakefront. The DSC features surfing and paddling competitions, a surfboard show and surf party. The tournament attracts about 100 surfers Labor Day weekend. Call (920) 457-1209.

For information on The Great Lakes Surfing Association visit www.greatlakesurfing.com.

Kitesurfing is similar to wakeboarding or surfing. The surfer uses a kiteboard and kite to ride over the land or water and out of the waves. Accessories include a wet suit, booties, lifejacket and helmet. Kite flying skills are an important aspect of the sport and lessons are recommended.

Some popular Wisconsin kite surfing beaches include Bradford Beach in Milwaukee, Lake Koshkonong outside Madison, North Point Beach in Racine, and Alford Park in



ROBERT QUEEN

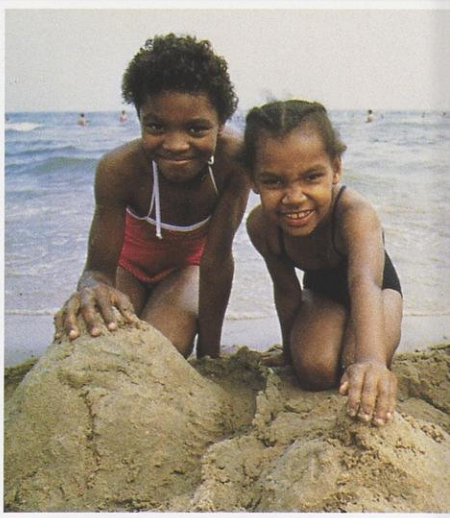
Wind and water combine for an extra sporting thrill on some Wisconsin beaches as some try sports such as parasailing behind a boat and kiteskiing, which is similar to wakeboarding.

ARCHITECTS ON THE BEACH

Sandcastle building tips

While it is tempting to dive in hands first, if you want to be successful making a sandcastle, gather the following materials:

- Sand
- Water
- Pail
- Shovel or spade
- Plastic knife and spoon (optional)
- Spray bottle (optional)
- Soft-bristle brush (optional)
- Plastic tubing (optional)



LISA THASS

Whitefish Dunes State Park is home to an annual sandcastle contest. Water is the essential ingredient in sandcastle construction, so find a place near the water but not too close or waves might crush your castle before you've had a chance to finish.

Prepare the location

Water is essential for every good sandcastle because it binds the sand grains. Find a level area to work, sandy and not too far from the water, but not so close that incoming waves will wipe away your work before it's finished.

Prepare the location by dumping buckets of water over it. On that wet spot, create a sand pile a few feet high and soak it with several buckets of water. Pack firmly. Nearby, dig a hole and fill with water to act as your reservoir for sand as you build. Like a front-end loader, you can scoop out large handfuls of this super wet sand and start building.

Most people construct a central tower. For a high tower to be strong enough to support its weight, the sand needs to be very wet and compacted. Instead of using buckets of sand, you can use your hands to pack very wet sand until you've reached the desired height. The tower should have a wide base and narrow top.

ROBERT QUEEN

Kenosha. To learn more, visit www.chicagokitesurfing.com.

On-shore sporting

For those more attracted to sand than surf, the beach offers plenty of heart-pounding, down and dirty recreational options.

Volleyball spikers find several sand beach volleyball courts along Wisconsin coasts. Beach volleyball is similar to playground basketball. The good players show up at certain spots at specific times for pick-up games.

If you are lucky, as the sand turns griddle hot, you'll hear the midday relief of an ice cream truck's canned calliope. And as the sun sets, eventually everyone hears the same sounds as waves mix with the clapping of sand from shoes signaling that it is time to go home.

Natasha Kassulke is associate editor of Wisconsin Natural Resources *magazine.*

Basic shapes

Most sandcastles have two basic shapes: towers and walls.

Towers may be built around the central tower and become anchor points for your walls. Walls connect towers giving the castle a classic appearance.

The tower is nothing more than sand patties piled on top of each other. Use smaller handfuls as you reach the top so that the tower doesn't become top-heavy and collapse. The bigger your initial base, the taller you are likely to be able to build.

Using both hands, scoop up as much wet sand as you can hold, gently press your hands together to squeeze out excess water and place the resulting sand clump where it's needed.

To create your walls, use a similar patty process. Walls grow higher as you stack one sand clump atop another and lay these patties as bricks end to end for the desired wall length. High walls need to be thick at the base and should narrow as they rise together. Arches are walls with openings tunneled through them. After building a wall, gently tunnel your way through at the base. Then enlarge and shape the opening into the form of an arch by shaving off thin layers of excess sand.

Ramps can be shaped from walls and may be designed as staircases. Steps may be carved into a ramp's surface by using a straight edge tool to remove excess sand.

Use a plastic knife and spoon to give texture and detail to your castle, and a spray bottle to mist the castle walls and fine details. A few timely squirts can keep your work from crumbling.

A soft-bristled brush will erase the knife marks and brush away loose sand. Plastic tubing can be used to gently blow away loose sand. Trowels and other tools may be used to scoop out doors and windows and provide details such as bricks.

Rocks, shells and more may be collected to decorate your castle.

Step back. Enjoy your creation. And take a picture before the wind and waves carry it away.

Footprints in the sand

Family Fun magazine offers some online advice for another creative sand activity – plaster casting footprints.

You will need the following materials:

- Plaster of Paris
- Small bucket
- Water

Expect this project to take an hour. Begin by finding an area on the beach that is moist, yet hard packed such as near the water. Press your feet firmly into the sand creating prints that are ½-inch to two-inches deep. You may use your finger to dig into the print and make it deeper.

Mix the plaster as directed on the package and pour it into the footprint.

After 25 minutes you should be able to gently dig the footprints out of the molds and brush away the excess sand. Let the print dry in the sun for about an hour to harden. Decorate footprints by adding seashells and rocks.

–Tips compiled from Family Fun magazine, SandCastleCentral.com, Sons of the Beach Sand Castle Wizards and the Family Education Network.

SAFETY IN SUN AND WATER

(BOTH PHOTOS) ROBERT QUEEN

Having fun in the sun also means taking precautions before you reach the beach. Apply sunscreen with a SPF rating of 15 or higher 20 minutes before you go outside, wear a hat, sunglasses and other protective clothing, and find a safe beach to swim.

Sunshine feels good, but also soaks skin in ultraviolet (UV) radiation.

The U.S. Lifesaving Association reports another danger on the beach – drowning. Always obey signs that warn of unsafe water conditions. Here are additional tips for keeping safe in the sun and surf.

Sunscreen

Limit the amount of direct sunlight you receive between 10 a.m. and 4 p.m. and wear a sunscreen with a sun protection factor (SPF) containing a high rating – 15 or above.

The American Cancer Society suggests "Slip! Slop! Slap!"

Slip on a shirt. Slop on sunscreen about 20 minutes before going outside. Slap on a hat to shade the sensitive skin on your face, ears and neck. Reapply sunscreen after swimming, sweating or toweling. Don't be fooled if the sky is overcast – most UV radiation penetrates clouds.

Hydration

Drink plenty of water and drink it regularly even if you do not feel thirsty. Your body needs water to keep cool. Avoid drinks with alcohol or caffeine.

Heat stroke

Heat stroke occurs when the victim's temperature control system, which produces sweat to cool the body, stops working. The body temperature can rise so high that brain damage and death may result. Signs include hot, red and dry skin; changes in consciousness; rapid and weak pulse; rapid and shallow breathing. If you suspect heat stroke, call 911 and move the person to a cooler place. Cool them by wrapping the person in wet towels and fanning them. If you have ice packs or cold packs, place them on the victim's wrists and ankles, in the armpits and on the neck to cool the large blood vessels. Make sure their airway is clear.

Eye protection

Excessive exposure to UV radiation can cause a painful corneal burn. Chronic eye exposure to UV may increase incidence of cataract (clouding of the eye lens); pterygium (a fleshy membrane covers the eye); and macular degeneration (spots that could result in blindness).

Wear sunglasses with labels that indicate that they absorb at least 90 percent of UV sunlight. Ultraviolet rays reflect off water and sand and reach below water's surface.

Find a safe area

When possible, select a supervised area with trained lifeguard who can help in an emergency. Never swim alone. Strong currents and big waves can turn an event that started as fun into a tragedy.

Make sure the water is deep enough before entering headfirst. A feet first entry is safer than diving in headfirst.

Don't rely on flotation devices as a substitute for supervision. Such devices can suddenly shift position, lose air or slip from underneath a child.

Feet

Wear foot protection and beware of broken glass, sharp rocks and litter. A solid pair of shoes or sandals is good. Wearing shoes on the beach also protects against scalding your feet on hot sand and shoes protect the top of your feet from burning sunlight.

—Information compiled from The American Red Cross, National Safety Council, American Cancer Society, American Academy of Ophthalmology and U.S. Lifesaving Association.

Produced by the Wisconsin Department of Natural Resources

Design: Moonlit Ink

FUNDED IN PART BY THE WISCONSIN COASTAL MANAGEMENT PROGRAM.

Financial assistance for this project was provided by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration pursuant to Grant #NA17OZ2357 and the WISCONSIN COASTAL MANAGEMENT PROGRAM.

The WISCONSIN COASTAL MANAGEMENT PROGRAM, part of the Wisconsin Department of Administration, and overseen by the WISCONSIN COASTAL MANAGEMENT COUNCIL, was established in 1978 to preserve, protect and manage the resources of the Lake Michigan and Lake Superior Coastline for this and future generations.

Publ-CE-4011-2004

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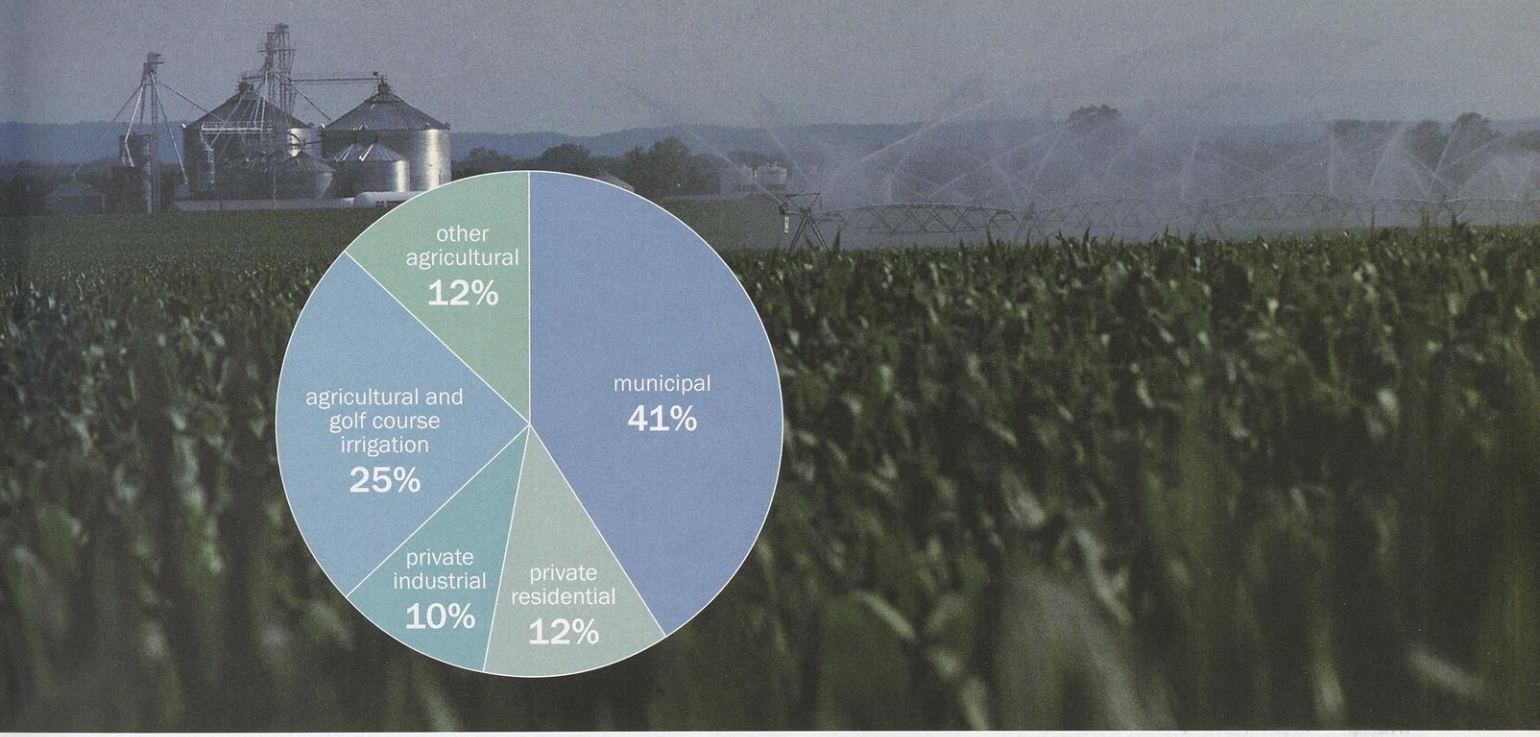
Cover photo by: David Larson



Industrial development in cities, city dwellers, suburban home development, rural irrigation systems and businesses are all substantial groundwater users. The new Groundwater Protection Act allows for environmental reviews of future high capacity wells. An advisory committee will recommend options where groundwater levels are dropping most quickly.

continued from page 16

Water (like a pristine lake), an Exceptional Resource Water (like a wild river) or trout stream.

- a well that has a water loss of more than 95 percent of the water withdrawn (like a beverage bottler).
- any well that may significantly affect a spring that has a minimum flow of one cubic foot per second for at least 80 percent of the time.

This gives the Department of Natural Resources the authority to deny well applications, yet flexibility to allow wells in whole or part if the environment is not threatened.

Importantly, the law also creates a committee that will recommend what ought to be done in larger drawdown areas by the end of 2006, and will review how the law is working by the end of 2007. If the group doesn't provide substantive recommendations, the law gives DNR authority to write rules making needed changes, Ambs says.

The law doesn't protect all of the water resources that need protection, "but it's a start," Ambs says, and it's one that enjoyed broad, bipartisan support: the bill passed 99–0 in the Assembly and 31–1 in the Senate.

"The Governor and legislative leaders recognized the importance of protecting our groundwater supplies with this legislation," Ambs says. "It was a significant first step, but much more work needs to be done."

Concerns rise as the water table drops

The strains of meeting growing water demand from a sprawling population are starting to show. Statewide water use has increased 33 percent in the last 15 years and water tables are plummeting in many urban areas as our thirst for more water outstrips our ability to provide it.

Perhaps no region faces this wellspring of challenges like southeast Wisconsin, where populations grew by 212 percent, 181 percent and 255 percent respectively in Ozaukee, Washington and Waukesha counties from 1950–90. In these suburban areas, groundwater use rose 29 percent from 72 to 93 million gallons a day.

Milwaukee draws its water from Lake Michigan, but the bulk of the communities and industries farther inland from the coast tap into a shallow aquifer, a deep sandstone aquifer or both. Both aquifers are being pumped heavily, but the deep aquifer is being depleted far faster than percolating rain or snowmelt can replace it.

"There are quantity issues from declining water levels and overpumping," says Steve Schultz, a water supply department head at Ruekert & Mielke Inc., a consulting engineering firm in Waukesha. "That forces communities to look at other sources of supply, including shallow aquifers and surface water from Lake Michigan. Many communities in southeastern Wisconsin also use deep wells that have a problem with radionuclides. It's very costly to treat this contamination, and in many cases it's cheaper to look for alternative sources," Schultz said.

Mukwonago and New Berlin are among several communities facing a December 2006 deadline for reducing radium levels in their drinking water below a five picocuries per liter limit. Their proposed solutions illustrate the complexity of resolving the economic, environmental, public health and political issues that come into play.

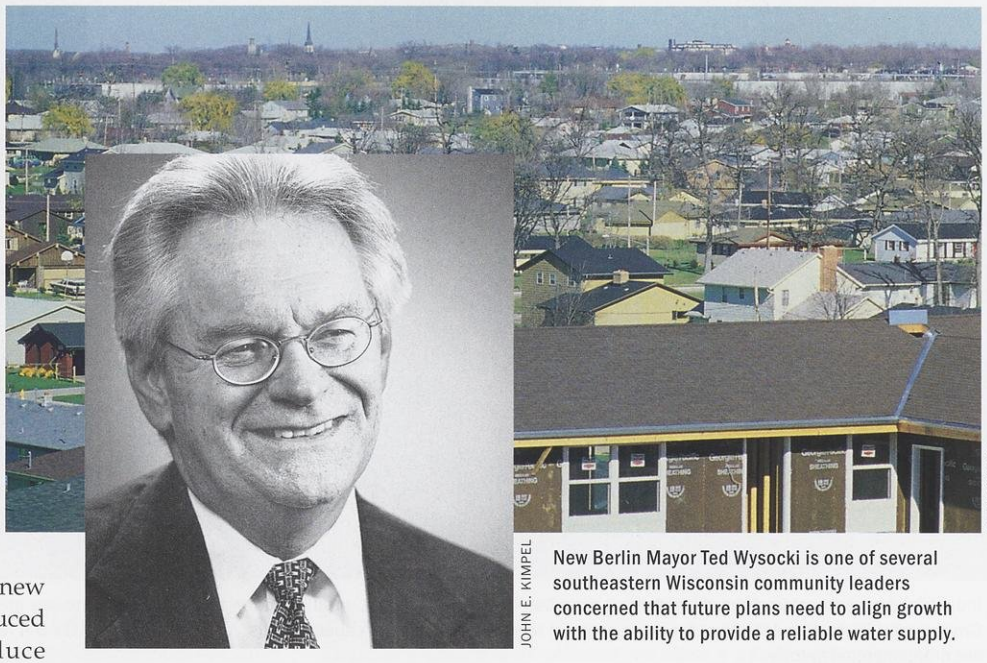
The Village of Mukwonago sought to solve its radium problem by drilling shallow wells. An extensive search revealed that the most productive zone was right next to the Vernon Marsh State Wildlife Area, raising concerns that long-term pumping might affect several fens and one calcareous fen — a rare wetland type. Current laws would not prevent the well siting, so DNR water supply staff negotiated with the village to voluntarily keep its pumping

to a minimum and to install monitoring wells. "We are very fortunate that Mukwonago has been willing to work with us," says Sharon Schaver DNR Southeast Region hydrogeologist. "This is the best we can do with the laws we have."

The Village of East Troy needed more capacity and couldn't drill a deep sandstone well due to radium, so it looked for a shallow gravel aquifer. A consultant found a site about a quarter-mile from Lake Beulah in the Town of East Troy. The local lake management district objected, citing that Lake Beulah and a cattail marsh on shore would be dried-up by the new well. DNR was concerned that reduced flow into Lake Beulah could reduce flow into the Mukwonago River and affect prime fish habitat.

In response to these concerns, the village conducted extensive groundwater monitoring that showed minimal effect on the marsh and lake. The village also offered to compensate private well owners that may be affected by the well. Negotiations continue.

At 37 square miles, New Berlin is Wisconsin's sixth largest city. It's cleaved by a subcontinental divide – some water runs toward the Great Lakes and the other part of town drains toward the Mississippi River. The city — overcoming initial reluctance from Milwaukee Common Council members who had hard feelings over jobs and residents being lured to the suburbs — successfully contracted to obtain Lake Michigan water for that portion of the city within the Lake Michigan basin.



JOHN E. KIMPEL

DEAN TVEDT

New Berlin Mayor Ted Wysocki is one of several southeastern Wisconsin community leaders concerned that future plans need to align growth with the ability to provide a reliable water supply.

"We began to realize that as we continue to develop, access to drinking water becomes an economic interest. It makes good business sense to keep an asset you need to continue developing."

Wysocki hopes that New Berlin can receive permission from Great Lakes charter members to divert lake water to serve the other portion of the city as well.

"All of our sewage goes back to Milwaukee Metropolitan Sewer District and the basin, so we believe we have a legitimate claim that we are returning substantially the amount of water we use to the basin itself," Wysocki says. The final portion of the city would be served by existing shallow wells. The master plan for future growth aligns development with the water resources below.

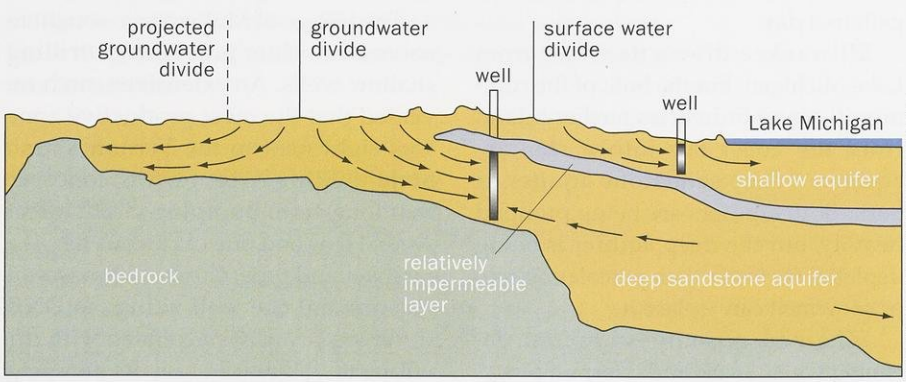
"We began to realize that as we continue to develop, access to drinking water becomes an economic interest. It makes good business sense to keep an asset you need to continue developing," Wysocki says.

In all three cases — Mukwonago, East Troy and New Berlin — the communities voluntarily went beyond what state law requires to protect surface waters and other water users. Such regard for the common good isn't mandatory, and that's one reason why business, agriculture, environment and others are coming together to back changes in how Wisconsin manages its water.

"We hope to have a regional approach to managing groundwater to avoid fights in adjoining communities for limited supplies," says Chad Czarkowski, DNR drinking water and groundwater expert in southeastern Wisconsin.

States have to plan rather than react

Some southeastern Wisconsin communities draw well water from shallow aquifers and some from deeper sandstone layers. While surface water and shallow water still flow toward Lake Michigan, some of that water is drawn into wells before it reaches the lake. There's also evidence that waters from much deeper sandstone layers are very slowly being drawn toward wells 60 miles or more inland. Continued community growth and water demand west of Milwaukee are moving the groundwater divide westward.



MAP BY MOONLIT INK FROM WGNHS DATA

when regulating groundwater use, Schultz says. Many Western states buy and sell water rights. Those rights become a commodity to be traded rather than a shared resource for public betterment. "We hope Wisconsin won't go down that path," Schultz says. "When people can own water rights, they stop working for the public interest and start looking out for their pocketbooks."

Protecting Great Lakes waters from overuse

The Great Lakes shoreline remains another frontier for defining collective rights to water.

As growing communities look for new sources of water, it's only natural that those near the coast view tapping those massive waters as a solution.

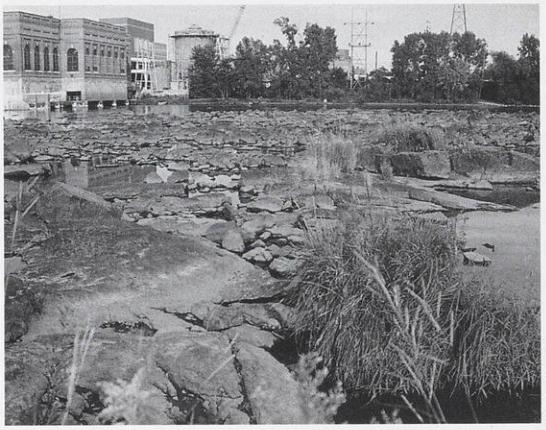
Drawing water from the lakes brings its own environmental and engineering challenges. Nearshore waters on the Great Lakes are susceptible to contaminants in runoff, untreated stormwater, atmospheric pollutants and the byproducts of wastewater treatment.

Treating Great Lakes water to make it potable is expensive. Keeping the intakes free of zebra mussels and other organisms is surmountable, but requires constant maintenance. Moreover, despite the vastness of the Great Lakes, water demands are increasing from every community on its borders in the United States and Canada.

To better manage the lakes collectively, governors from the eight states and premiers from the two Canadian provinces bordering the Great Lakes signed a Great Lakes Charter in 1985 setting guidelines and principles for managing Great Lakes water. The Charter sets a communal pledge to protect, conserve and restore the waters and the natural resources that depend on the Great Lakes. A key provision of the Charter aimed to regulate large water withdrawals and diversions from metropolitan centers bordering the lakes. A supplementary agreement, called Annex 2001 includes proposed provisions clarifying how, where and when water can be removed or diverted from the lakes, or from groundwater that feeds them. These provisions are scheduled for public review this summer.

In spite of their vast size, both water quality and water levels can change quickly and unpredictably on the Great Lakes. Natural weather variations and long-term water level cycles compound water diversions by shoreland cities. Low lake levels the last few years left bluffs, shorelines, docks, piers and harbors high and dry.

Inland wells are taking their toll too. A recent study by the Wisconsin Geological and Natural History Survey and the U.S. Geological Survey shows that in the last 60 years well water withdrawals throughout southeastern Wisconsin, Illinois and Michigan were substantial enough to slow and reverse groundwater flow in some areas. In the region between Milwaukee and Waukesha County, groundwater models show that pumping water from the deep aquifers has begun to alter groundwater flow patterns extending to Lake Michigan, the Illinois border and western Waukesha County. Indeed, about 7.5 percent of the groundwater that used to flow toward Lake Michigan never reaches the coast; it's drawn into wells. Most of that water eventually reaches Lake Michigan through storm sewers and as treated wastewater, "but the location, timing and quality of the return flow is different than what it was under natural conditions," the USGS report concludes.



DNR PHOTO

This river was intentionally drawn down to do dam repairs. While we would not expect such dramatic reductions from increasing groundwater use, there's concern how increased demand for well water might lower water levels in small streams and wetlands.

In an era when human demands can change the flow of groundwater from the Great Lakes toward inland communities, each state and Canadian province bordering the Great Lakes must consider what sorts of water diversions should be allowed to provide water for drinking water, agricultural and industrial uses.

Costs drive community searches for options

Some communities are looking to technology to reduce costs of providing water. One method public water utilities are considering is a system called ASR (Aquifer Storage and Recovery). The communities of Green Bay and Oak Creek have both tested ASR as a response to increased demand for water and dropping water tables.

Essentially, ASR occurs in "cycles." Rather than storing water in reservoirs or towers, drinkable water is injected into underground wells, stored until needed and then drawn from the aquifer for public use in each cycle. Costs to construct an ASR well can be about half the traditional costs to build water reservoirs or elevated water towers, but they are still substantial — $200,000–$800,000 for each million gallons per day of storage capacity. Costs are less to convert existing unused wells than to drill new storage wells.

Until now, Wisconsin's policy has been that groundwater should remain untouched — the idea of injecting water, wastes or any other substances (including the chlorine in treated drinking water) into an aquifer was not an option. As a consequence, state drinking water regulators took a go-slow approach to such proposals. Still, given added costs to meet additional Safe Drinking Water Act (SDWA) standards, some public utilities are looking for new ways to manage their water supply. In order to consider ASR, communities must prove three things: first, that the water they are putting into the aquifer meets drinking water standards and comes directly from a municipal

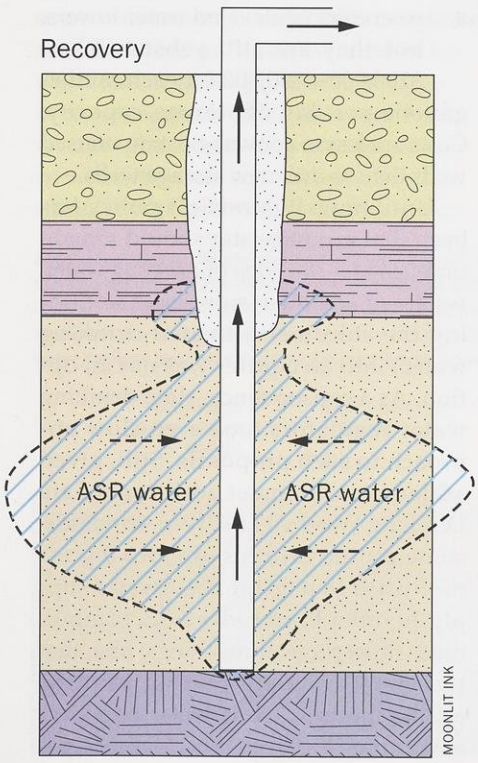
system; second, that the water they take out of the aquifer meets drinking water standards before it is distributed; and third, that they can comply with state groundwater standards. By state statute, no new chemicals can be introduced into Wisconsin's groundwater.

Results are mixed. Both communities successfully stored and recovered water; however, monitoring showed elevated levels of substances that may eventually violate drinking water standards.

With stricter drinking water requirements coming in the near future, will the Department of Natural Resources allow systems to use new less-tested techniques to provide reliable drinking water supplies?

"We give them the opportunity to try new technologies and methods where there is ample scientific and practical evidence that they meet drinking water standards," says Don Swailes, chief of DNR's Drinking Water Quality Section. "If they want to try something that does not have a proven track record, they have to prove in a number of ways that it will protect public health, and protect the resource."

Aquifer Storage and Recovery (ASR) intends to pump and store drinking water underground between confining rock layers. Thus far, this technology has not provided a reliable alternative to water towers and reservoirs where tested in Wisconsin.



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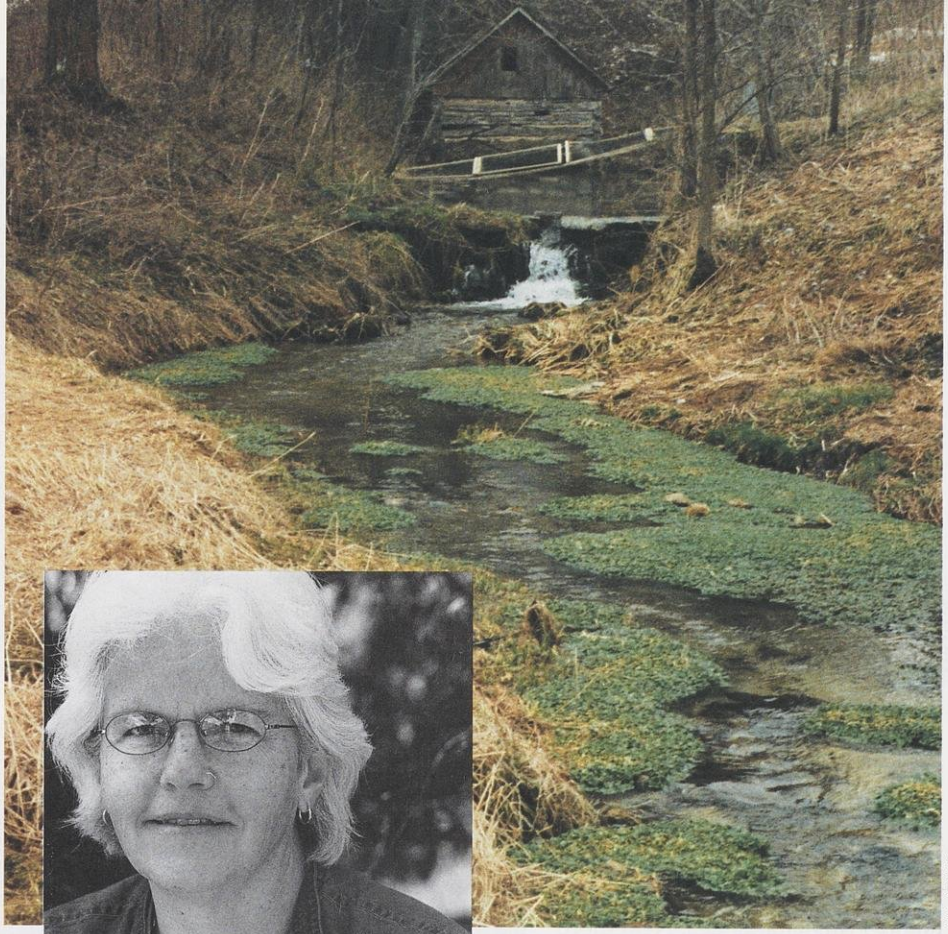


ROBERT QUEEN

JILL JONAS

Jill Jonas and the spring house near the watercress filled stream of her youth, when people were more connected to their source of water.

"We have to start asking ourselves, is it that important to have green lawns when we're pumping water so hard that it's getting contaminated with radium and arsenic? "

Jonas sympathizes with communities facing the considerable expense of treating drinking water, but she doesn't think cost should trump all other concerns. "We have to start asking ourselves, is it that important to have green lawns when we're pumping water so hard that it's getting contaminated with radium and arsenic? If we want to have quality springs, streams and drinking water, we have to start using water responsibly rather than hoping there's some technological fix. We're wasting water and we have to have greater respect for it.

"My grandmother never had running water in her home," Jonas said. "For drinking water, she filled a bucket from a hand pump that sat on the kitchen counter. People knew how deep the water was then. They thought about where they were putting their wastes. I wonder if as a society we've lost some of our appreciation of where our water comes from."

Jonas, who grew up on a farm in southwestern Wisconsin, cherishes the memory of sipping water from a metal cup that hung in the spring house, cutting watercress just below the springs and directly sipping from Castle Rock Springs. "These are precious resources that we should hang onto," she says. "People in the future deserve a chance to see and experience these same plentiful resources."

Lisa Gaumnitz is public affairs manager for DNR's water programs. Tim Asplund is a DNR water resources specialist. Megan R. Matthews writes for DNR resource and environmental programs.

Boaters can unintentionally carry aquatic invasive species from one water to another. Simple steps can reduce the chance of transporting Eurasian water-milfoil that can grow quickly, as shown below.

Rallying the water brigade

It takes people, patience and time to recognize and prevent the spread of tiny aquatic invaders.

Mandy Beall

You're back at the dock after a good time fishing. The boat slides onto the trailer, the winch line is cinched, straps are in place, taillights are plugged in and the gear is stowed — but you're not ready to go just yet. While the last of the water runs out the boat drain, remove any bits of lake weeds caught on the prop or lower unit. Clean any plants from the deck and anchor lines. Drain your live well. On the way home, consider stopping by a self-service car wash and rinsing the hull thoroughly with a high-pressure hose.

These few simple steps can dramatically reduce the chance that your *SS Minnow* might unintentionally give invasive fish, plants, mollusks and aquatic insects a free ride from one lake to another.

Community volunteers have been working with the Department of Natural Resources and lake associations to inform power boaters, canoeists, kayakers, sailors, sailboarders and even sea plane pilots about actions they can take to avoid transporting invasive species between waters. Other volunteers have joined the battle by forming groups to physically uproot the offenders, or by enlisting the assistance of insect allies.

Invasive species established a beachhead in Wisconsin waters decades ago, but the number of new species, the invasion routes and the rate of spread warrant a fresh counterattack. Some species were intentionally introduced, like the common carp; others arrived accidentally, such as zebra mussels carried in the ballast water of ocean-going ships. Some species were originally seeded in gardens or were dumped when exotic "pets" outgrew their aquariums.

Invasive aquatic species threaten the diversity and abundance of native species. They alter ecosystems, harm tourism, and put a damper on outdoor recreation. While the talk surrounding invasives is often negative, more people are taking positive action to protect our waters. One early action is learning to recognize invasive species and realizing how people unwittingly can carry these species from one lake to another.

Meet the inspectors

State crews started inspecting watercraft for signs of invasive plants and animals two years ago. This summer trained volunteers will also be stationed at boat landings throughout the state to share information about invasive species, show pictures of our lakes' "Least Wanted" and review the simple steps to prevent transporting unwanted hitchhikers.

Boaters at a launch site might meet a watercraft inspector, like Erica King of DNR's Waukesha office. Erica and the other inspectors provide boaters with Watch Cards — small ID cards highlighting species of concern, with tips on how to properly identify the troublemakers, prevention steps and phone numbers to report new sightings.

King will point out places, like the motor, the trailer bunks and rollers, and even the wheel axles, where aquatic plants can become entangled. She'll mention that live wells, bait buckets, and the motor, if not drained, can carry water from one lake to another. Because

SANDY AND FRED ANDERSON

Volunteers living near 75 lakes in 25 counties post signs and staff boat landings at busy times to alert boaters to preventive steps for reducing the spread of exotic organisms.

it is important to avoid transporting plants and animals, as well as water, from one waterbody to another, anglers will be asked to dispose of unwanted live bait in the trash.

If a boat was moored in zebra mussel-infested waters, King might ask the owners to run their hands over the hull. If it feels grainy, there may be young zebra mussels attached. All visible mussels should be removed and disposed of in the trash. The boat hull should be washed with hot water or a high-pressure hose, or left to dry thoroughly for five days before taking it to another waterbody. Finally, King will present the boat owner with a handy reminder sticker to place on the boat trailer post that outlines prevention steps.

These prevention steps protect against zebra mussels, Eurasian water-milfoil and other organisms — including the spiny waterflea, which was found for the first time in a Wisconsin inland lake last fall.

"The most common question I get is, 'What can I do to help?'" King says. "Getting into the habit of taking these precautions can protect the resources people care about. It's rewarding to go back to a landing and see people who you've talked to before inspecting their boats. Overall, the response has been very positive."

Inspectors have posted thousands of signs at boat landings, alerting boaters where invasive species are present and reminding them of the prevention steps. During the off-season, inspectors spend time talking with boaters at sport shows, contacting area boat and bait dealers, visiting classrooms and helping to schedule volunteer workshops.

Strength in numbers

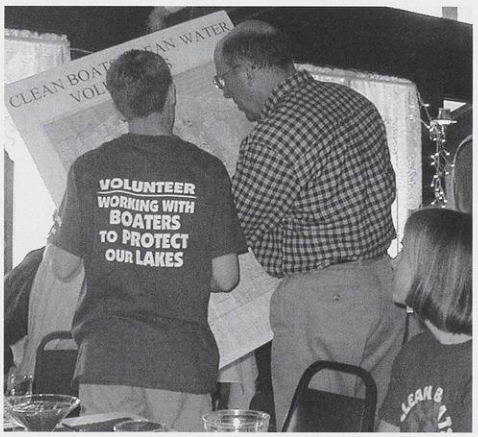
Organized groups are putting their collective muscle into fighting invasives.

"When I attended an invasive species session at the 2003 Wisconsin Lakes Convention, I came away with the strong feeling that DNR resources alone were inadequate to do all that was needed to prevent the spread of exotics to inland lakes in Northwest Wisconsin," says Roger Dreher, president of the Bayfield County Lakes Forum (BCLF). "Immediate action needed to be taken to prevent zebra mussels, Eurasian water-milfoil and other species from invading county lakes, and all who use the lakes or whose businesses depend on lakes needed to join the fight."

BCLF volunteers and employees of the U.S. Forest Service and County Land Conservation Department are posting DNR signs at boat landings, starting with those that are most heavily used. News releases published in local papers last summer promoted these efforts and raised awareness about the issue.

The lakes forum also asked resorts, campgrounds and marinas to post or distribute information on invasives. These businesses gave near unanimous support. This summer flyers will be distributed at area businesses and the Bayfield County Zoning Office will insert flyers in their informational package for shoreland owners.

(below) Governor Doyle sees and hears where volunteers are making a difference.
(bottom) Volunteers on Montello Lake inspect and help clean watercraft of plants, insects and mollusks at boat landings.



LAURA FELDA-MARQUARDT

MONTELLO LAKE DISTRICT

Milfoil Masters

Youth are on the frontline, too. In 2002, seventh and eighth grade students at Minocqua/Hazelhurst/Lake Tomahawk Middle School received a $25,000 grant from the Christopher Columbus Foundation to launch the Milfoil Masters program, which offered workshops and materials for volunteers to spread the word about preventing the spread of Eurasian water-milfoil into their favorite lake.

"The students' goal was to hold workshops, then saturate all of the boat launches on Opening Day of the fishing season," says Lisa Ahlers, teacher and coach for the Milfoil Masters. "Eurasian water-milfoil has the potential to totally overtake a water, block fish movement and hamper boating and fishing. In communities where the economy is so heavily based on outdoor activities and tourism, the idea of doing something to prevent the spread of Eurasian water-milfoil really struck a chord."

The Milfoil Masters drew participants from 75 lakes in 25 counties, including Sandy and Fred Anderson of

VIC RAMEY, UNIVERSITY OF FLORIDA

ROBERT QUEEN

the Whitefish Lake Conservation Organization (WLCO) in Douglas County. The WLCO sponsored two teams of young adults to inspect boats and talk with boat owners at landings on most Fridays, Saturdays and Sundays last summer. The group coordinated weekly inspections of the water near the boat landings to detect early signs of infestation. The group also published newsletter articles and invited guest speakers to the annual meeting of lake property owners. Two local TV stations featured the monitoring at public landings and aired public service announcements that reached thousands of people.

"Momentum is building, and more and more people are starting to agree that problems will develop if we stand idle," say the Andersons. "Hopefully many more will join in the mission to preserve natural resources, the Northwoods atmosphere, and 'cabin living.' "

The Milfoil Masters energized and enlisted enough volunteers to carry over to another project. The Clean Boats, Clean Waters program debuts this summer statewide offering training on how to organize a watercraft inspection program, how to inspect boats and equipment, and how to interact with the public at boat landings. Workshops sponsored by the DNR, UW Extension, and the Wisconsin Association of Lakes are open to adults and youth; adult groups are encouraged to work with local youth partners. Contact Laura Felda-Marquardt, Volunteer Coordinator for the Invasive Species Program, UW Extension-Lakes Program at (715) 365-2659 for details.

Patience to control the "purple peril"

Groups hoping to combat pesky purple loosestrife have found small but powerful allies in beetles that feed only on this invasive species. The Lake Pewaukee Sanitary District in southeastern Wis-

(top) Where purple loosestrife takes hold, community volunteers try to loosen its grip by hand-pulling it or treating it with beetles that eat only the invasive plant.
(left) Zebra mussels likely reached the Great Lakes in ship ballast. Now we're challenged to prevent their spread to inland lakes.

consin started its biological control program in 1999 by raising *Galerucella* beetles with a sixth-grade class from Pewaukee Middle School. The district later teamed up with the Lake Country Rotary Club and the Women's Club of Pewaukee to continue the campaign. Their story reveals the power of patience and persistence.

Beetles were released along the Pewaukee River in 1999. Inspections the following spring didn't show any evidence of beetle or larval activity. Volunteers assumed the project had failed, and they selected a new release site. Results in the summer of 2001 were the same — no improvement where beetles had been released.

"In the summer of 2003 we were looking for a good location for the Women's Club beetle release upstream of the 1999 site," says Charlie Shong, superintendent of the Lake Pewaukee Sanitary District. "We found what looked like a good site — and there were already beetles there! Since no one else had released in the area, we were sure that these had come from our 1999 release. We went back and checked the original site and found many loosestrife plants damaged by numerous beetles."

Sites treated in 2000 and 2001 are now showing beetles and larval damage up to 800 feet away from the original release location. "The moral of the story is don't give up," says Shong. "It takes time for the beetle population to get to a level where you can find them, and more time for them to start putting a dent in the loosestrife population, but it will happen." Brock Woods, UWEX/DNR Purple Loosestrife Bio-control Coordinator at (608) 221-6349 or brock.woods@dnr.state.wi.us can help your group learn how to raise a beetle battalion.

Mapping other invasives

Unfortunately the list of aquatic invaders only continues to grow. Rusty crayfish, rainbow smelt and spiny waterfleas have attracted the attention of scientists at the University of Wisconsin Center for Limnology in Madison. Researchers are testing techniques to monitor these invasive species and developing models to predict where they would survive and thrive if introduced. Spiny waterfleas were found last fall in the Gile Flowage (Iron County); the Department of Natural Resources and university limnologists are expanding monitoring statewide and ramping up public awareness efforts, especially on lakes near the Gile.

Money to get going

To encourage more partners on the aquatic invader battlefront, counties, cities, towns and villages can tap into $500,000 in state grants to battle aquatic invasives. The deadline for applying for the next round of grants is August 1.

"Invasive species are a growing threat to our priceless lakes and rivers, so Wisconsin has decided to increase its support of local efforts to prevent their spread," says Carroll Schaal, DNR lake grant manager. "We've created the Aquatic Invasive Species Control Grants (AIS grants) to encourage local efforts to stem this growing threat."

AIS grants cover 50 percent of program costs that must be matched with cash or donated labor and materials. The grants can be used to prevent invasion into uninfested waters or to control the spread in infested areas. Maximum grant awards will be set in rules that are still being developed. Grants may range up to $75,000, but grant amounts are not firm and are subject to both public and legislative review. Weed harvesting, chemical treatments and other actions that provide only seasonal relief won't be funded.

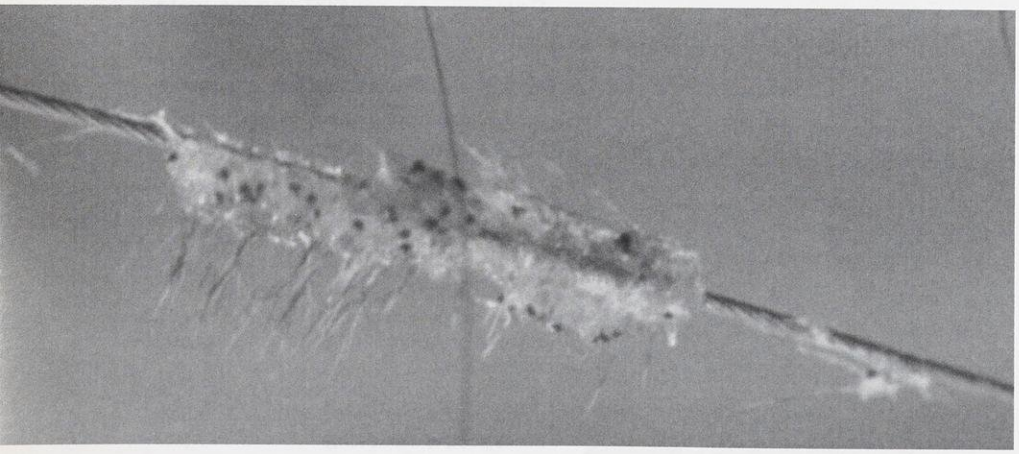
"Methods for preventing the spread of invasive species are well known and relatively inexpensive, while eradication can be expensive and risky, so we're funding prevention first," Schaal says. "Common sense tells us to first limit the size and scope of the problem and then ramp up efforts to remediate the infested waters."

Prevention plans, educational outreach and watercraft inspection programs will be the first priority for these funds. Grants for infestation control will be limited to lakes with approved management plans, in research areas and demonstration projects.

A new Governor's Council on Invasive Species will review grant rules when drafted. Until that time, interested communities can get information and get going by contacting DNR's Lake Planning and Protection program. Contact Carroll Schaal at (608) 261-6423 [carroll.schaal@dnr.state.wi.us] or visit www.uwsp.edu/cnr/uwexlakes for fact sheets describing the new AIS grants.

Mandy Beall coordinates educational outreach on aquatic invasive species for the Department of Natural Resources and UW-Extension.

Spiny water fleas build up on a cable that was submerged in an infested water. The invertebrate was found for the first time on an inland lake in Wisconsin last year on the Gile Flowage in Iron County.



J. GUNDERSON, MINNESOTA SEA GRANT

People want information to judge for themselves when beach water is clean enough for swimming.

Safer shores

Recent legislation helps states keep a close watch on beach water quality, but funding for continued monitoring may be at low tide.

Benjamin Vail

The thermometer's pushing 97°F, the central air unit unilaterally decentralized operations, and you can track your teenager like a wolf in snow by following his sneaker tracks in the sticky asphalt pavement. OK, so it's hot. What to do? Pack up the towels, swimsuits, flippers and kids, and hit the beach. And hope it will be open.

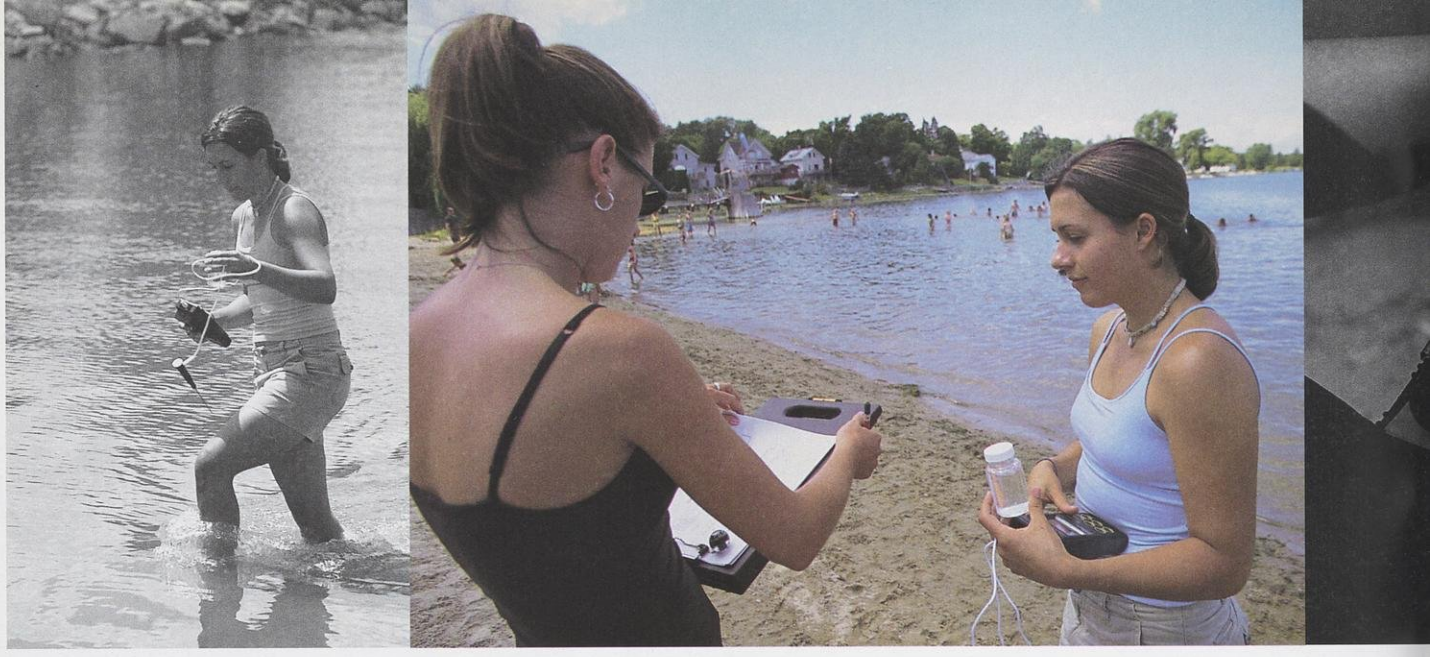
Although beach closings due to contaminated water are a relatively infrequent part of Wisconsin's summer scene, the beach water quality issue has attracted the attention of federal and state lawmakers.

In 2000, the U.S. Congress passed an amendment to the Clean Water Act called the Beaches Environmental Assessment and Coastal Health (BEACH) Act. This law requires all coastal states, including those along the Great Lakes, to adopt beach water quality standards and develop monitoring programs to protect public health. Congress appropriated about $10 million a year for five years to help states get their programs off the ground.

Cooperation between local governments and state agencies has made Wisconsin a national leader in implementing the BEACH Act. In fact, Wisconsin's program was up and running a year ahead of most other Great Lakes states. "As a result, the public is better informed of beach water quality at coastal beaches as well as the risks associated with swimming in contaminated water," says Chicago-based EPA Region V Beach Program Coordinator Holly Wirick.

Wisconsin's beach program

In 2000 the Wisconsin Department of Natural Resources convened a workgroup composed of experts and representatives from local governments, local health departments, state agencies such as the Department of Health and Family Services, environmental groups and others to design and run a beach monitoring program. Several counties, notably Kenosha, Milwaukee, Manitowoc and Racine, already had beach monitoring programs in place. Their experi-



How I spent my summer vacation: University of Wisconsin-Oshkosh students regularly monitored water quality conditions, took water samples and recorded conditions at public beaches along the Lake Superior coast as well as a few spots on Lake Michigan. Records of weather, water temperature, turbidity, and use by people and animals may provide clues of how and when beach water shows signs of contamination.

ences served as models for the statewide program.

Today all of Wisconsin's Great Lakes coastal counties are participating in the program except Oconto and Marinette counties, which have no coastal recreational beaches.

The DNR facilitates local beach monitoring by helping define state water quality standards, developing monitoring protocols, training samplers, designing public communication plans, and funneling federal grant money to local health departments. Local health departments have jurisdiction over water quality at their public beaches, while DNR has jurisdiction only over beaches within state properties such as state parks. Federal and tribal lands are not monitored under the BEACH Act.

In 2002, DNR staff drove the entire Wisconsin coastline and identified about 190 public beaches on Lake Michigan and Lake Superior, of which about 110 were monitored last year. Beaches were divided into high, medium and low priority for water testing. High priority beaches are popular with the public and may have physical features that can lead to higher risks of contamination, such as sewer or street outflows or parking lots nearby. Low priority beaches are the least-used beaches. The ranking process helps to target limited resources to the most-used and highest-risk beaches.

Testing the waters

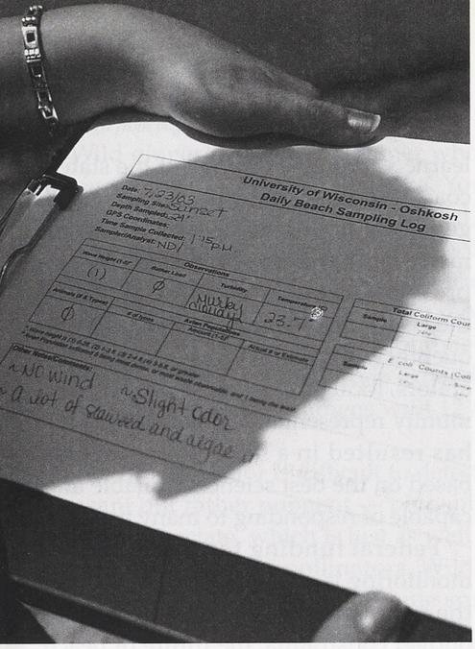
Water sampling is a straightforward procedure: The water sampler takes a sterile bottle and wades into the water at knee depth (about 18 inches), submerging a bottle to collect a sample. The beach workgroup selected the 18-inch depth as the typical depth that would be used by young children and wading adults near the shore. The bottle is capped and stored on ice until it is delivered to a certified lab for analysis. Local health departments usually collect the samples, but some health departments contract with outside help to run their monitoring programs. For example, researchers at the UW-Oshkosh Biology and Microbiology Department run the programs for several counties on Lake Michigan and Lake Superior.

Lab cultures of *E. Coli* growth from collected water samples determines which signs will be posted to advise visitors of beach water quality.

At high priority beaches, water samples are usually collected once a day, five days a week. Medium and low priority beaches are sampled less often.

The sampler also takes note of biological and physical conditions at the beach — weather conditions, water temperature, turbidity, wave height, and the presence of people, animals, algae and waterfowl on the beach. All this data is entered into a central database for reporting to the EPA, where it is used for research into the causes of beach water problems.

In the lab, the water sample is tested for the presence of *Escherichia coli (E. coli)* bacteria. EPA has recommended that states use *E. coli* as an indicator to assess whether bacteria, viruses and other threats to human health may be present in the water. This type of *E. coli* is not likely to make people ill by itself,



(THREE LEFT) ROBERT QUEEN

but if found in high quantities it suggests that fecal matter is present and thus other disease-causing agents may be at high levels.

EPA recommends that states advise beach visitors of possible health risks when *E. coli* counts exceed 235 colony-forming units per 100 milliliters of water. In Wisconsin, a yellow "caution" sign is posted at the beach when this standard is exceeded. The beach may be closed and a red "closed" sign posted when *E. coli* counts exceed 1000 cfu/100ml. Also, the local health department may close the beach at any time if conditions suggest a serious health risk may be present, such as after a heavy rainfall. Intense rain can sweep garbage and other waste from parking lots and streets into the beach surf.

Getting the word out

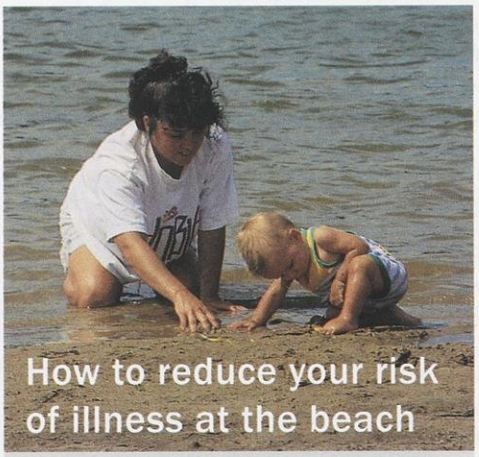
Posting signs at the beach is the most obvious form of notification about beach water quality, but naturally people want to know about water conditions before they leave home with slippery sunblocked toddlers and heavy coolers in tow.

In response to public surveys and comments in 2003, several improvements will be in place this year. The public asked health officials to post more information about water conditions at monitored beaches. In response, new signs were designed — a green informational sign when *E. coli* tests are low, a yellow caution sign to be posted when the health standard is exceeded, and red "stop" signs to be posted when beaches are closed. Local authorities can also choose to post a blue "good" sign either with or in place of the green sign when *E. coli* counts are low. Though this system was approved by the beach workgroup and will be adopted by most participating agencies, several local health departments have chosen not to post the green or "good" signs. They are concerned the signs may scare away tourists or will make authorities liable for illnesses that might occur when such signs are posted.

It's now easier to look up the current conditions at any coastal beach on the Wisconsin beach health website (www.wibeaches.us). The site contains information about the science and public policy issues surrounding beach monitoring. Site visitors can sign up to receive e-mail alerts with daily reports of beach conditions at specific beaches of their choosing.

A new toll-free hotline — (800) 441-4636, ext. 1460 — has been developed in cooperation with UW-Extension. People can call the beach hotline anytime for updates of beach conditions in each coastal county, and also listen to recorded messages explaining beach signs and information about the program and beach monitoring activities.

Brochures explaining the beach monitoring program will be distributed to the public at state parks, health departments, tourism offices, chambers of commerce and other locations.



ROBERT QUEEN

How to reduce your risk of illness at the beach

- Don't swallow water
- Shower after swimming
- Wash hands before eating
- Change baby diapers before allowing children in water
- Don't enter water if you are ill
- Dispose of litter in containers, especially diapers and pet waste
- Do not feed gulls and waterfowl
- Conserve water in your household
- Avoid using chemical fertilizers at home

Understanding the health risks

The notification effort aims to help the public understand beach health risks and make informed choices about how to use recreational waters. To put the risks in perspective, research has shown the rate of infection for recreational bathers in water with an *E. coli* count of 235 cfu/100ml is eight illnesses per 1000 bathers. At the 1000 cfu/100ml level of *E. coli*, the rate of infection rises to 14 of every 1000 bathers.

The point is not to be afraid, but to be informed. All natural bodies of water contain a range of microscopic organisms, and health risks are always present for recreational bathers — even in swimming pools. For instance, lake water may contain bacteria, viruses, worms and protozoa. If ingested or absorbed through wounds or mucous membranes, these pathogens may cause gastrointestinal diseases and illnesses like the flu and common cold.

Signs posted at the beach reflect *E. coli* standards set for visitors who are immersed in the water while swimming. Those who are wading or walking on the beach do not face the same risks from waterborne pathogens as bathers, but studies have shown the water and wet sand in the surf area can have higher *E. coli* counts than deeper water or dry sand.

Whether in the water or near shore, it's wise to take some precautions to avoid health risks. The primary risk is from ingesting lake water, so keep your mouth closed and avoid swallowing water when you're underwater. After a swim or playing in the surf, be sure to wash your hands before eating and show-

er if possible.

Beach monitoring in 2003 revealed that by and large Wisconsin's coastal waters do not contain high levels of *E. coli*. As expected, water quality varied greatly during the summer, and from location to location. In many regions 2003 was the first year beaches were systematically monitored, so it's too early to discern clear trends or patterns in the data. Scientists and community members hope continued monitoring will produce useful data over the years to better understand and respond to beach water issues.

The program faces constraints in researching possible causes of beach water contamination. The BEACH Act provided funds only for water quality monitoring and public notification, not for identifying sources of contamination or taking action to control contamination. However, the program's growing database of detailed information about beach conditions is helping researchers theorize possible causes and what to do about them. Many local governments, such as Door County and Manitowoc County, have created task forces to investigate the causes of high *E. coli* levels in their areas. The City of Milwaukee has developed a sophisticated model to predict when its beaches may have more health risks.

Theories abound about where high *E. coli* levels may be coming from. Possible contributors may include: algae, droppings from birds and other wildlife, rainstorms, lower water levels, higher water temperatures, zebra mussels, winds and currents, sewage spills, rainwater overflows, illegal boat dumping, dirty diapers, litter and the presence of ill swimmers. It's likely that weather and a range of biological, geographical, and social factors interact to produce higher risks of illness at the beach.

Taking the initiative inland

In 2004, several inland lakes will be monitored independent of the Great Lakes program using the same monitoring and notification procedures. In response to public demand, the Department of Natural Resources, Department of Health and Family Services, and the State Laboratory of Hygiene have pooled resources to fund daily monitoring at 10 state park beaches located around the state:

1. Governor Nelson State Park, Madison
2. Mirror Lake State Park, Lake Delton
3. Hartman Creek State Park, Waupaca
4. High Cliff State Park, Menasha/Sherwood
5. Pattison State Park, Superior
6. Big Foot Beach State Park, Lake Geneva
7. Kettle Moraine State Forest-Northern Unit (Mauthe Lake)
8. Kettle Moraine State Forest-Southern Unit (Ottawa Lake)
9. Lake Wissota State Park, Chippewa Falls
10. Willow River State Park, Hudson

The agencies pooled about $106,000 to pay for monitoring, laboratory analysis costs and grants to local communities for health-related programs. Many local governments around the state expressed a desire for state assistance in monitoring their local beaches, but it is unclear whether state funding will exist to expand the program in 2005.

The Wisconsin beach program continues to evolve. Every year more is learned about the ecology of the state's coastal waters, scientific research suggests new approaches to beach management, and the public demands improved information. To stay on top of the issues, the workgroup consults frequently with beach visitors, tourism operators, local business people and community representatives. This teamwork has resulted in a statewide program based on the best science available and capable of responding to many needs.

Federal funding for coastal beach monitoring is scheduled to expire after the beach season in 2005. Given state budget constraints, the future of beach monitoring in Wisconsin is not assured. But one thing is certain: The public will continue to demand safe, clean, swimmable beaches and the right to make informed decisions about when and where to swim.

Benjamin Vail works on Great Lakes beach quality issues for DNR's Watershed Management Bureau.

Theories abound for what is causing high bacterial counts in some places. Algae, stormwater runoff, bird droppings, spills, sewage seeps, litter and the presence of sick swimmers are all possibilities.

GREGORY T. KLEINHEINZ, UW-OSHKOSH

For more information

Wisconsin Beach Monitoring Program Website: www.wibeaches.us
Great Lakes Beach Association: www.great-lakes.net/glba/
WDNR: dnr.wi.gov
US EPA: www.epa.gov/ost/beaches/
Lake Michigan Federation: www.lakemichigan.org/
Lake Superior Alliance: www.superioralliance.org

continued from page 2

Wild ginger is an early bloomer whose burnt-red flowers are inconspicuous from a distance. You have to look really closely to see them. One grape-sized, bell-shaped flower grows per leaf pair between the stalks on a really short stem that nods so close to the ground that leaves often hide it. The flower has three flaring lobes, really sepals, that taper to long points. The interior is white. Compacted tightly into each flower, a pistil with a thick style expands at the tip into a six-lobed stigma. Twelve stamens with 12 anthers closely touch the style.

The flower's odor is difficult to detect — neither sweet nor pleasant but rather pungent — probably an odor that only a fly can appreciate, which is just as well since flies, gnats and beetles are the prime pollinators. Wild ginger can also self-pollinate. The mature fruit capsule splits in June revealing several large, egg-shaped, wrinkled seeds. Each seed is adorned with a fleshy appendage called an elaisome that attracts ants. The ants help expand the plants' range by carrying the seeds underground, eating the elaisomes, then discarding the seeds.

After experiencing winter's cold, the ginger seeds germinate the following summer. Typically a first-year seedling only bears two small cotyledon leaves. In its second summer, the first true leaves appear. If this young plant survives, it will start a new colony. This leads me to ponder how old the extensive blanket of plants before me must be.

Though the capsules release their seeds in June, the hairy leaves continue to grow into autumn when the deciduous leaves dry up. Unlike spring ephemeral wildflowers that only appear for a few fleeting days, wild ginger is visible for much of Wisconsin's growing season for as long as six to seven months. This plant is easy enough to recognize once you've discovered it. So take to the reawakening woods in late spring, watch for the warblers overhead, and mind the wild ginger underfoot.

Anita Carpenter walks and waltzes the wooded paths near her Oshkosh home.

Here's what wild ginger looks like when it first emerges in spring.

GOOD GROUNDS & GOOD READING

Living in the Midwest all my life, I was totally unaware of the agricultural needs of coffee growing ("Good grounds for conservation," February 2004) nor were we cognizant of the differences in the taste and quality of shade-grown vs. full-sun coffees. Considering that probably close to 100 percent of your subscribers are environmentally friendly and most likely to be sympathetic to the quandary migrating birds face in finding forested retreats, perhaps you might have provided names and addresses of some of the retail outlets where we can purchase some of this elusive brew. Creating a bigger market for shade-grown coffee and letting the market work would be the most efficient way to vote with our dollars for saving forested habitat in Central America.

Sandy Sawyer
Oak Creek

We considered listing coffee retailers offering shade-grown coffee (and cocoa), but backed off for a few reasons. We couldn't find a comprehensive list and the markets regularly change their suppliers. Coffee roasters and purveyors handle different coffees over time and many specialty coffee shops list for customers which of their products are shade-grown, fair trade and organically grown. We also discovered that many organizations that are securing brand names for specific coffee plantations and cooperatives are small businesses that only sell beans to small regions in our country. We gather there is something of a storm brewing among coffee importers to set standards that ensure everyone labeling their coffee, tea and cocoa as "shade-grown," "fair trade," or "organic" meets the same criteria before the products are certified.

We suggest visiting small coffee shops or searching the Web using key words like "shade-grown coffee retailers in Wisconsin." We found several vendors that retail their products at specialty coffee shops, neighborhood markets and some of the larger supermarket chains.

I consider your magazine to be in general of high quality, informative and attractive. On this occasion, I was especially interested in the article on coffee production and found "Good grounds for conservation" to be excellent.

I thought I had seen your magazine on sale at newsstands but could not find it at my local bookstore or other retail outlets.

Richard Kinch
Racine

We received many nice letters about the coffee story and will keep an interesting blend of issues on tap for readers. We encourage subscriptions rather than newsstand sales as a means of containing costs for all our readers. Newsstands are a good way to reach new customers, but the costs per copy for unsold issues are substantial. We're thankful to subscribers who have recommended us as a good read and a bargain. Readers might also find that doctors' offices and libraries would be pleased to share your old copies with an even wider group of readers.

BLUEBIRD PLANS

We read your past stories about bluebirds and would like the plan for the bluebird house that you described in the April 2001 issue. Is it still available?

Norbert and Theone Seipel
Mondovi

Those plans are still available. Diagrams and instructions were printed on our letters column in the August 2001 issue and we would gladly forward that diagram. Please include a stamped self-addressed envelope for each copy and mail your request to Bluebird Plans, WNR magazine, P.O. Box 7921, Madison, WI 53707.

COMMENT ON A STORY?

Send your letters to Readers Write, WNR magazine, P.O. Box 7921, Madison, WI 53707 or e-mail letters to david.sperling@dnr.state.wi.us

YOUTH CONSERVATION CAMPS

Just a note that the photo of a Youth Conservation Camp that appeared in the forest history piece in the February 2004 issue isn't that old. Though the YCC program lasted for decades, this picture was taken in the summer of 1981. The young man kneeling is Mark Randall, then a wildlife technician working out of the Plymouth office and now a DNR biologist in Oshkosh.

The youth camps were great educational programs that were victims of budget cuts. Summer banding of flightless young ducks was an education in itself, but lots of hard work. During the end of June and early July we would form lines and walk through potholes to drive the ducks into drive nets. Wood ducks were difficult to drive and typically dove under the water, usually escaping rather than swimming into the nets.

Dale E. Katsma
DNR Wildlife Biologist
Plymouth

THE EXOTIC BITTERSWEET

I read with interest the February article about bittersweet. Having recently moved from Wisconsin to Iowa, I have been excited to discover new trees, flowers and shrubs in the woods of northeastern Iowa. We have several areas of bittersweet in the fencerows of our 80-acre farm. Just down the road from us is Backbone State Park. Unfortunately bittersweet has virtually taken over several areas in the park. Its vines twist and spiral around immature tree trunks four to eight inches in diameter and literally choke them to death. It grows to the tops of some large trees that are 30–80 feet high and bushes out, blocking light from the leaves and needles of trees. It is a beautiful sight in autumn if you are a craftsperson, but demoralizes those of us who would like to see the trees mature. For that reason, the plant is well named: bittersweet! Hopefully those who manage the forests of Wisconsin will keep an eye on this beautiful, but potentially destructive, plant.

Harry Blobaum
Strawberry Point, Iowa

Bittersweet continues its spread here as well. In fact the specimen pictured on page 2 of our February issue was the non-native variety (Celastrus orbiculatus) *that is sold in nurseries and is now considered invasive rather than the native form* (C. scandens). *The native bittersweet only has berries growing on its terminal growth, not sprouting along the vine. Both are shown here. As our Native Plant Management Biologist Kelly Kearns notes, the non-native species is currently not widely known as an invasive, but where it has spread from ornamental plantings it can cover the forest floor, climb up and girdle trees, then continue climbing and shade out the trees from above and make them vulnerable to wind fall. This plant is frequently sold in garden centers, often just under the name "bittersweet," or sometimes mistakenly labeled as "American bittersweet."*

UPDATE

ELEVATED PBDE LEVELS FOUND IN MOTHERS AND INFANTS

Blood samples from 12 Indiana mothers and from the umbilical cords of their newborns found levels of PBDE (polybrominated diphenyl esters) at 20 times the levels found in Scandinavian women and babies tested as part of a long-term study. (See our February 2003 story, "A smoldering issue.")

"We've suspected that bloodstream concentrations of PBDEs have been going up," said Professor Ronald Hites of the University of Indiana's School of Public and Environmental Affairs, who led the research. "It's troubling. We're just not sure what it means yet for people's health."

Previous studies of Scandinavian mothers, babies and U.S. adult blood donors from the 1980s showed much lower PBDE levels in these groups and the discrepancy has not been explained. PBDEs were widely used as flame retardants in electrical circuit boards, furnishings and children's clothing.

While PBDEs have been shown to cause a variety of health problems in rats, no conclusive studies showing the chemicals' effects in humans have been conducted.

BENEFITS OF ENVIRONMENTAL REGULATIONS OUTWEIGH COSTS

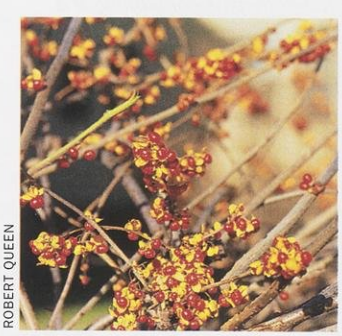
According to an October report from the Office of Budget and Management released by the White House, the amount of money spent by businesses and the public to comply with federal regulatory policies — especially environmental policies — is overshadowed by the economic benefits that result from those expenditures.

The OMB report estimated the total annual costs for complying with 107 major federal mandates over a 10-year period to range between $37 billion and $43 billion. The estimated annual benefits gained as a result of the rules ranged from $147 billion to $231 billion.

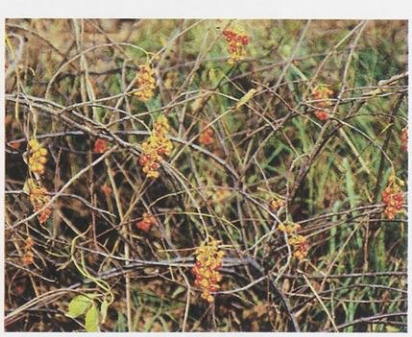
The report remains available online at www.whitehouse.gov/omb/inforeg/cbreport.pdf

SHARE YOUR HUNTING AND FISHING TRADITIONS

Remember to send in funny stories or favorite memories of the traditions and superstitions that make your deer camp, hunting group and fishin' trips fun. Send notes of up to 200 words by June 30 to: Outdoor Traditions, *Wisconsin Natural Resources* magazine, P.O. Box 7921, Madison, WI 53707.



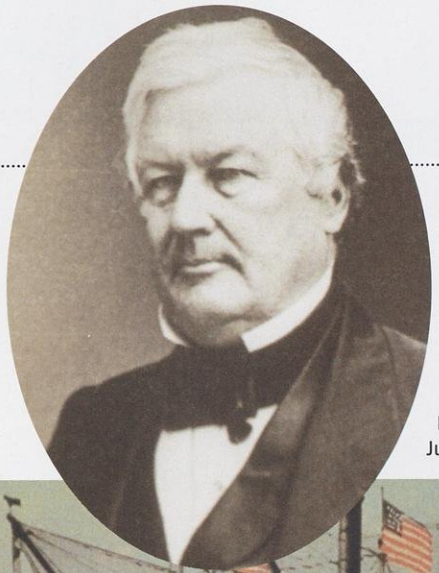
ROBERT QUEEN



DENNIS W. WOODLAND

(far left) **The non-native oriental bittersweet *(Celastrus orbiculatus)* grows capsules with fruits along the entire vine where leaves (axils) meet the stem. *(left)* The native American bittersweet *(C. scandens)* has dense clusters of capsules and fruits only at the terminal end of each branch.**

A grand event



President Millard Fillmore attended the Grand Excursion 150 years ago to tout river beauty and continuous rail service from the East Coast to the Great River. Enjoy paddlewheel rides, train rides and celebrations in 50 upper Mississippi River communities in June and July.

It was 1854 when the 13th president of the United States (a hot dog and a slice of apple pie for you if the name "Millard Fillmore" immediately came to mind) received an invitation from the Rock Island Railroad: *C'mon out West, Mr. President, and get a look at some of our country's most extraordinary human achievements and spectacular natural sights — on our dime!*

The company was referring to the completion of the first continuous railroad connection linking the East Coast to the Mississippi River — and of course, to the Great River itself. More than 1,200 dignitaries, politicians, journalists, business leaders and artists joined Mr. Fillmore on the celebratory junket known as the Grand Excursion.

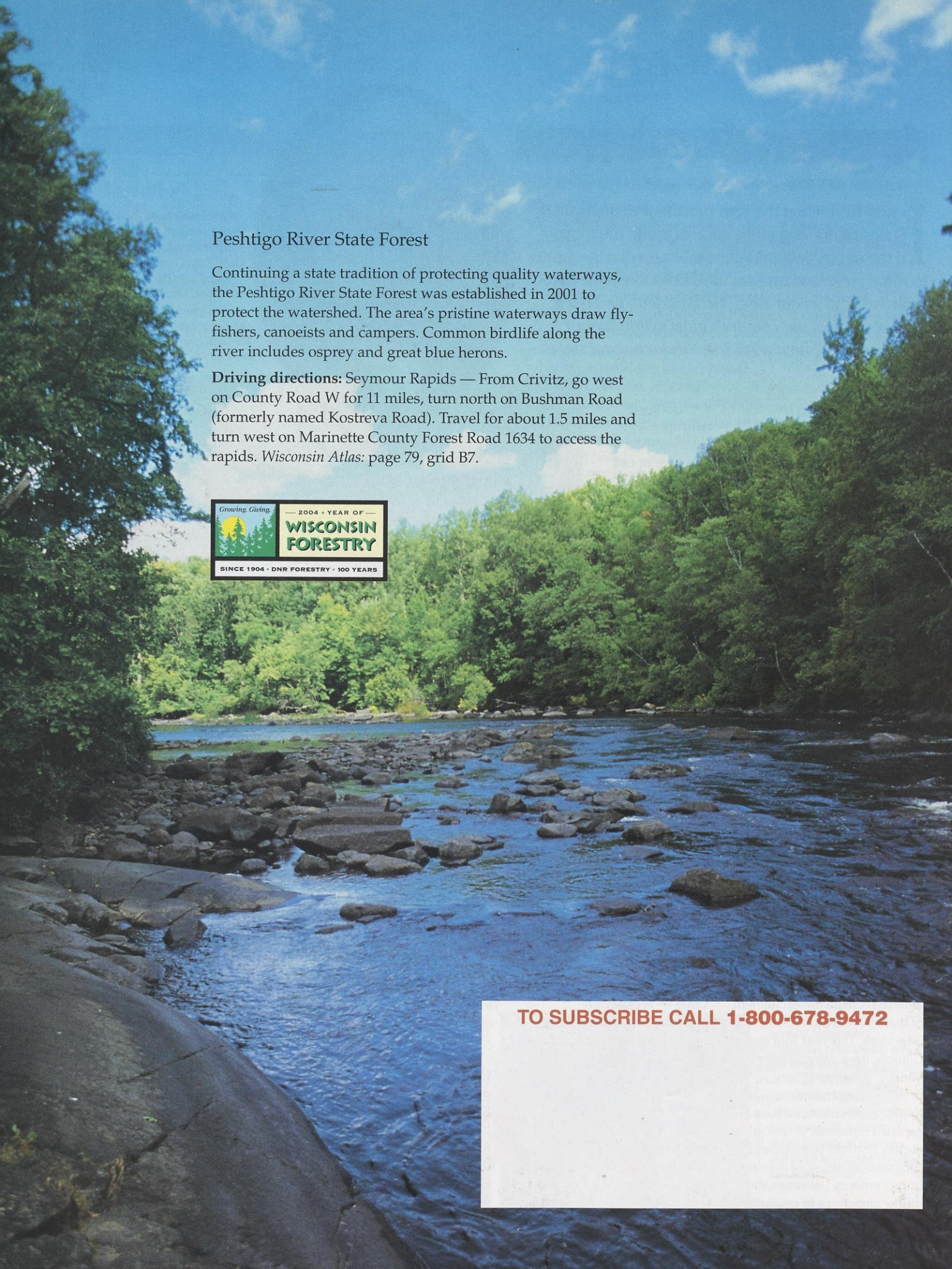
The revelers boarded a train in Chicago and traveled by rail to Rock Island, Illinois. They then walked the gangplanks to a fleet of steamboats and puffed up the Mississippi from Rock Island to St. Paul, Minn., and the Falls of Saint Anthony in Minneapolis, stopping at many riverfront towns en route. The ensuing publicity put the Mississippi's backwaters on the front pages of newspapers across the country, prompting investment dollars and thousands of new residents to flock to the area.

The **Grand Excursion 2004** aims to recreate the excitement of that 150-year-old rail-and-river adventure. This year, four states (Illinois, Iowa, Wisconsin and Minnesota), 50 upper Mississippi River communities, and scores of organizations have planned hundreds of special events, festivals, parades and programs showcasing riverfront improvements, pathways and tourist attractions to celebrate the region's renaissance. Visit www.grandexcursion.com or call (866) GEX-2004 for the complete schedule.

The event to cap them all will be the **Grand Flotilla**, June 25–July 5. This eleven-day trip — from the Quad Cities to the Twin Cities — is expected to be the largest steamboat flotilla seen on the river in more than a century. The *Delta Queen, Mississippi Queen, Julia Belle Swain, Spirit of Peoria*, and the good ship *Harriet Bishop* (named for Minnesota's first schoolteacher) are a few of the notable paddlewheelers that will churn those muddy waters. The flotilla will be attended by an armada of pleasure craft, and steam locomotives will chug along overland on special excursion rides. Breakfast, lunch, dinner, day, moonlight and other special cruises can be booked on the steamboats in different ports of call.

Prairie du Chien, La Crosse and **Pepin** are Wisconsin's ports of call for the Grand Excursion, but there will be plenty of events in other riverfront communities to enjoy as well — such as **Cassville's Flotilla Party** on June 29, which promises some of the best views of the big boats as they pass through the narrow channel below scenic Riverside Park. As the steamboats near the docks of **Prairie du Chien** on the evening of the 29th, they'll be greeted by an **Evening Glow** ceremony with illuminated hot air balloons and music. Another good viewing point: Lock & Dam #6 at **Trempealeau** on July 1. Upriver, **Pepin** plans a **Minnow Race** on July 1 and a **Street Dance** on July 2. An annual favorite, the **La Crosse Riverfest**, June 29–July 4, coincides with the Grand Excursion. You'll find plenty of food, entertainment, music and crafts — and you may even meet the Great River's most acclaimed scribe, Mark Twain, wryly commenting on the changeable nature of the Mississippi's currents. A grand excursion indeed!

PHOTOS COURTESY OF THE GRAND EXCURSION 2004



Peshtigo River State Forest

Continuing a state tradition of protecting quality waterways, the Peshtigo River State Forest was established in 2001 to protect the watershed. The area's pristine waterways draw fly-fishers, canoeists and campers. Common birdlife along the river includes osprey and great blue herons.

Driving directions: Seymour Rapids — From Crivitz, go west on County Road W for 11 miles, turn north on Bushman Road (formerly named Kostreva Road). Travel for about 1.5 miles and turn west on Marinette County Forest Road 1634 to access the rapids. *Wisconsin Atlas:* page 79, grid B7.