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| |  |  |  | | --- | --- | --- | | 15,081 Jewels  The lure and history, threats and solutions, killers and saviors of our beloved lakes - one of the world’s most intense concentrations of fresh water. A Special Report. by Mary Van de Kamp Nohl  | Monday 7/27/2009   |  | | --- | | [0](http://www.insidemilwaukee.com/Article/242011-15081Jewels#comments) | | Comments | | |  | | Photo by Bob Israel/MKEimages  Delavan Lake was dying.  A thick green scum covered the lake, an hour’s drive southwest of Milwaukee, turning it into a giant bowl of pea soup. Beneath the 2,072-acre surface, only carp and buffalo fish survived.  Over geologic time, all lakes ultimately become bogs, but humans had hastened Delavan’s demise. As the blue-green algae rotted, filling in the lake, it gave off the unmistakable odor of death. Animal carcasses littered the shore. Mysterious maladies struck children and pet dogs that ventured into the water. When the wind carried the fetid odor, windows slammed shut. It was the summer of 1984.  All of that was difficult to imagine last April, looking at Delavan Lake glistening like a jewel. As a brisk breeze rippled its steel-blue surface, you could see game fish flicker 10 feet beneath the surface. A $47 million, 10-year restoration effort had transformed the lake. One of the most ambitious lake rescues ever attempted, it’s inspired others as far away as Europe and Asia, says Mary Knipper, former president of the Delavan Lake Improvement Association.  The fruit of the effort is apparent in 15,000 annual boat launches from the public landing – craft carrying water skiers, kids in fancy inner tubes and fishermen plumbing Delavan’s 57-foot depths. On the north end is the sprawling Lake Lawn Resort, which will soon boast new villas, 200 boat slips and a new water park.  Delavan Lake’s entire 13-mile shore is intensely developed. Lawns run to the water nearly everywhere. More than 60 percent of the lake residents are seasonal. Most are from Chicago, says Knipper, a Chicago transplant herself.  Delavan’s main water sources are streams that drain the surrounding 10-municipality watershed. Nearby Geneva Lake drains an area twice its own size, but Delavan’s watershed is 13 times its size, so keeping out potential pollutants is far more daunting.  As with all drainage lakes, a river runs through Delavan Lake, and area streams feed that river. The curious thing is that Delavan’s inlet and outlet are located on the same end of the lake. That’s rare, but then, every lake is a one-of-a-kind ecosystem.  Delavan’s outlet, more of a canal than a river, is thick with docks and boat slips and a shoreline practically paved with blacktop. By last spring, a green scum had begun to form on the water’s surface, a warning that despite the rescue effort, Delavan Lake is still endangered.  In many ways, Delavan is a proxy for all of Wisconsin’s lakes – loved and lusted after, yet often taken for granted; a haven for family time, a community focal point and a natural resource vanishing across the globe.  With 1.2 million acres of inland lakes – more than every state but Alaska, Florida and Michigan – Wisconsinites know what it means to love a lake. They’ve shaped our culture and history since the last glacier rolled through 10,000 years ago. They’re recreational assets, nature preserves and incredible amenities that lure transplants and generate tourism, a $13 billion annual industry supporting 310,330 jobs.  “Wisconsin’s lakes make us who we are. They are part of our fiber, our very being. We have a culture of people who are used to being near the water,” says Robert Korth, director of the University of Wisconsin-Extension Lakes Program in Stevens Point.  Indeed, in the 1980s, UW-Madison offered a short course called Water and the Thirsting Spirit that described how Wisconsinites, forced to relocate to dryer environs, ache for their lakes with a nagging emptiness that inevitably brings them back, if only for summer vacations.  The good news is that most Wisconsin lakes are now clearer than they were a generation ago. But they also face new threats, some more ominous than ever. The truth is that our lakes are complex and ever-changing. The more closely you observe them, the more fascinating they become.  -----------  In 1950, Minnesotaaddedthe slogan “land of 10,000 lakes” to its license plates, raising the obvious question: How many lakes did Wisconsin have? The legislature eventually ordered an inventory, but it wasn’t published until 1991, says James Vennie, who currently oversees the Wisconsin Department of Natural Resources lake index.  Minnesota defined a lake as an “area of open, relatively deep water, large enough to produce a wave swept shore,” but Vennie says Wisconsin used a more inclusive definition: a body of water that’s there most of the year, has aquatic plants and a recognizable bed and bank.  Wisconsin counted all named lakes – regardless of size – and all unnamed lakes 20 acres or larger. That included even tiny, named lakes like the 1-acre North Oakwood Golf Course Pond No. 1 in Milwaukee County. It gave the state 14,973 official lakes; Minnesota’s definition gave it 11,842. (But because the two states used different definitions, bragging rights were never awarded.)  The most important Wisconsin lakes are the 3,620 that cover 20 acres or more, accounting for 93 percent of the surface area of the state’s inland lakes. Lakes dot the path the glaciers carved across Wisconsin. Eighty percent lie north of Highway 29, which connects Green Bay to Eau Claire. There, one of the world’s most intense concentrations of fresh water is found in Vilas (1,318 lakes) and Oneida (1,129 lakes) counties. Southeastern Wisconsin has just 101 lakes of at least 50 acres, the minimum size for motorboat use.  The index lists lakes with depths ranging from a golfer’s calf to the 236 feet of Green Lake, home to a rare three-story freshwater fishery, which has three distinct levels of fish habitat (Big Cedar Lake in Washington County and Trout Lake in Vilas County also have them). The state’s largest inland lake, 137,708-acre Winnebago, has 85 miles of shoreline, but its maximum depth is just 21 feet.  Counting lakes is surprisingly difficult. Between 1991 and 2005, when the DNR’s second inventory appeared, the state gained 108 lakes. There were also lakes with multiple lobes, each with a different name, which meant some lakes were counted three or four times. “The second inventory tried to correct that,” says Vennie. Still, he notes, “when we say we have 15,081, we really don’t know how many more lakes exist.” In fact, another 1,000 have been discovered via satellite and digital maps, but they’re not on the list.  In the 14 years between inventories, Vennie says, “lakes were dug or filled in, farm ponds were dynamited, new dams were built [creating lakes], others were removed [eliminating lakes].” About 13 percent of Wisconsin’s lakes are man-made “impoundments” created by a dam or similar structure. One, Lake Delton, vanished famously on June 9, 2008, as heavy rains washed away an 81-year-old dike. As the lake drained away, again and again on CNN and *YouTube*, the official count dipped, temporarily, to 15,080.  People like George and Martha Watts, the Milwaukee china merchants, have created new lakes. In 1946, the newlyweds moved into a shack without running water on a 110-acre property in Ozaukee County. The sandy, rocky desert-like parcel – bordered on two sides by the Milwaukee River – was bought 10 years earlier by George’s parents, who began planting pine and maple. As the trees matured, George and Martha built a permanent home. “The only thing missing was a lake,” Martha recalls George saying.  In 1978, George hired a bulldozer, had the ground scraped down 15 feet to limestone, and “springs just came bubbling up,” Martha says. The couple named their 6-acre creation Lang Lake in honor of friends, but so far, it hasn’t made the official DNR list.  The most detailed accounting of Wisconsin lakes is by the U.S. Geological Survey. It maps even unnamed lakes less than 1 acre in size, which would vastly increase the number, but it would probably be even more provisional.  Natural lakes, which account for 87 percent of the state’s total, fall into four categories. Most common are seepage lakes, where water levels vary with rainfall and groundwater. Middle Genesee and Silver lakes in Waukesha County and Crystal Lake in Sheboygan County are examples.  Spring lakes, the second category, get their water from deep underground springs that bring water from inside and outside the lake’s immediate drainage area. Spring lakes are often the headwaters of streams and are prevalent in northern Wisconsin, but Pine, Beaver and Ashippun lakes in Waukesha County, Geneva Lake in Walworth County and Big Cedar Lake are spring lakes, too.  Drainage lakes – like Delavan, Waukesha County’s Lac La Belle and Washington County’s Friess Lake – have inlets and outlets, and tend to have higher nutrient levels and less water clarity than seepage or spring lakes.  The fourth type – drained lakes – is the least common. They have no inlet, but have outlets that run at least intermittently, driven by precipitation and drainage. Benedict Lake in Walworth County is an example.  Lakes are also classified by trophic state, the stage of their life cycle. The youngsters are oligotrophic lakes – clear, deep and free of weeds. Many northern glacial kettle lakes fall into this category. Middle-aged, or mesotrophic lakes, tend to have more native plants, but support healthy fisheries. They’re common in southern Wisconsin.  Like Delavan Lake in 1984, eutrophic lakes are becoming bogs. Lake Erie was one of them in the 1970s, but great progress has been made in reviving it.  “To a certain point, we can turn back the clock,” says Jeffrey Thornton, principal environmental planner for the Southeastern Wisconsin Regional Planning Commission. “We have done that on Delavan, Big Muskego, Nagawicka and other lakes. We have brought them back from algae bowls of pea soup.”  -----------  Early native Americans,the old Copper Culture people, hunted and fished in the Oconomowoc lakes area around 7,500 years ago. Fox and Sauk tribes followed, building animal-shaped burial mounds around the lakes. When Peter Juneau, the son of Milwaukee founder Solomon Juneau, arrived in the 1830s, he found them selling muskrat, mink and otter pelts from Lac La Belle, Oconomowoc and Okauchee lakes.  Black Hawk’s tribe camped on Oconomowoc Lake, but following the famous Sauk chief’s defeat, the government sold the land for $1.25 an acre, and in 1837, the Milwaukee *Advertiser* published glowing accounts of Oconomowoc’s beautiful lakes. By 1854, The Milwaukee & Watertown Railroad stopped in Oconomowoc. With it came Chicagoans like Increase Lapham, a scientist who conducted experiments on his Oconomowoc Lake farm that helped make Milwaukee the world’s wheat capital.  By 1870, the state’s southern lakes were magnets for the wealthy. More than 100 stores and homes were built that year in Oconomowoc, as Chicago investors opened seven luxury hotels. Delavan Lake’s first resort, Lake Lawn Park, opened later that decade. It was perfect timing. The Great Chicago Fire had sent thousands north for fresh air and water beginning in 1871.  The grand Victorian mansions of 30 millionaires dotted Oconomowoc lakes by 1880. Fowler Lake was also home to Draper Hall, a refined establishment located conveniently across from the men’s “clubhouse.” With a boxcar full of 6,600 fish, its owner stocked the city’s lakes, assuring the region’s reputation for fine fishing.  A dam on Okauchee Lake gave the city electric lights 40 years before neighboring towns, adding the aura of glamour that lured high society. When President Ulysses S. Grant dined at Draper Hall, 65 of Milwaukee’s wealthiest men paraded in his honor. John Irvin Beggs, president of the Milwaukee Electric Railway and Utility Company, built the interurban line that doubled Waukesha County’s population in 1899, then built himself a status-symbol estate on an island in Lac La Belle.  On Delavan Lake, so many prosperous Chicago residents built retreats that by 1900, six daily trains imported visitors and 10 lakefront ballrooms entertained them.  Oconomowoc’s wealthy invited their Lake Geneva friends to spend a week at their “cottage,” though they were mansions by anyone’s reckoning, as Jean Lindsay Johnson observes in her book *When Midwest Millionaires Lived Like Kings.* One such “cottage” was a replica of English Queen Anne Boleyn’s castle, built by her descendant George Bullen. Geneva’s even grander estates belonged to renowned families, like that of chewing gum magnate William Wrigley Jr., winning it the title of “Newport of the Midwest.”  Oconomowoc townsfolk resented their gentry “super-snobs,” with their sable coats and Riviera vacations, Johnson writes. But the wealthy “also patronized local dentists and merchants who … became rich and took up residence on the lakes, too.”  Yet the wealthy couldn’t own the lakes. Early 20th-century state Supreme Court rulings declared that under Wisconsin’s “public trust doctrine,” all lakes must belong to and be protected for the public. The doctrine, however, didn’t give the public access to any lake, the Court explained in 1923. To provide that, state or local governments had to acquire lakefront land. So, the upper class still dominated the lakes. Theatrical producer Flo Ziegfeld and his famous “Follies” dancers summered on Lauderdale Lakes. President Grover Cleveland fished in Oconomowoc. Hollywood’s Barrymores and Annie Oakley vacationed at Draper Hall. Violinist Isaac Stern stayed nearby.  Department store royalty Louis Gimbel and Mary Fields lived on Oconomowoc’s lakes. Harry Hart (of Hart, Schaffner & Marx) bought an Oconomowoc Lake estate and hired famed landscape architect Jens Jensen to create a sunken garden with 1,000 blue plantain lilies that rippled like waves when the wind blew – this in the middle of the Great Depression. Ole Evinrude developed the first outboard motor on the same lake, while brewery heir Gustav Pabst built his own empire of 15 dairy farms. Later entrepreneurs included Sam Ruby, the Milwaukee and Chicago Chevrolet dealer. In the 1950s, he built the 750-acre “Ruby Acres” at Lauderdale Lakes, with a Georgian mansion, cattle farm, golf course, lighted tennis court, arbor, formal lighted gardens, Swiss-chalet boat house with a bar, glass-enclosed pool, fishing ponds, stone barbecue house, waterfall and airstrip.  Meanwhile, the middle class had begun to arrive. Eager to escape the factories, smokestacks and office buildings, the new tourists took up camping and headed Up North, *The Wisconsin Magazine of History* noted in 2006. By 1900, northern Wisconsin had been turned into a stump-filled wilderness by the lumber industry, but as the forests recovered, tourism grew. In 1923, 700,000 tourists visited Wisconsin’s resorts, auto camps and summer homes.  On Swan Lake near Portage, the Watson family used dismantled World War I barracks to construct a cottage on land that their forefathers – who ran Graham Drug Co., the state’s first pharmacy – used for picnics in the 1850s. On Lake Delton, countless cottages sprung up, renting for $2.50 a day. Hayward, Minocqua and Eagle River blossomed as vacation destinations.  “As more Americans received vacation time,” the history magazine noted, “tourist interests marketed North Woods vacations as a means of improving health and productivity.” So many Milwaukee, Chicago and Twin Cities residents responded that by 1932, Vilas and Oneida counties had 221 resorts, 3,995 summer homes and 73 camps or clubs.  Private lake clubs became stealth land barons. In Marinette County, families from Milwaukee and Chicago formed an exclusive hunting and fishing retreat on 2,400 acres near Athelstane. Called the Wausaukee Club, it continues today with its own private lakes, trout ponds, tennis courts, golf course and rustic lodge where meals are still served. Most of the club’s 35 full members are descendants of the founders. Now spread cross-country, they jet in. Members own their own cottages, but the club’s board must approve any would-be buyer.  Dairymen’s Inc. is even bigger. Founded in 1925 as a fishing lodge for families in the dairy industry, it included wealthy Wisconsin and Illinois farmers, truckers, bottlers and suppliers. “In recent years, it has taken on more of a golf resort atmosphere and become more and more Chicago people,” says Milwaukeean Sandy Mueller, an ex-member who vacationed there for 20 years.  Operated out of Palatine, Ill., the club is Vilas County’s largest taxpayer, owning nearly 5,000 acres with a fair market value of $66 million. Holdings include six pristine lakes, parts of others and an 18-hole golf course. Strictly secluded, the grounds are patrolled for poachers and the uninvited. One ex-employee, who cleaned fish there in the 1970s, recalls celebrity guests Johnny Carson and “Doc” Severinsen. Guests rent one of approximately 45 basic cottages and take meals at the lodge, Mueller says. Once, when she got stranded sailing, she was surprised to be rescued by two Miami Dolphins football players.  Other secretive groups appeared during Prohibition – gangster speakeasies on Okauchee and Oconomowoc lakes, with gambling, drinks and “women entertainers.” More lay hidden on northern lakes.  By midcentury, the grand old estates were declining. Gustav Pabst subdivided Pretty Lake and carved his Genesee Lake hunting lodge into 34 lots. The daughter of John Irvin Beggs entertained her grandkids at the family’s Lac La Belle mansion in the 1940s, but by the ’50s, it lay shuttered. She saved the grandfather clock Thomas Edison had given her father, then had the mansion razed and sold Begg’s Isle as 10 lots.  A religious conversion was also underway. The Catholic Order of Redemptorists Fathers paid $33,000 for a Lac La Belle estate with 2,000 feet of frontage. Gustav Pabst’s sons sold his 35-acre, 45-room chateau on Otis Lake (now Upper Genesee Lake) to St. Monica’s Seminary. Brewery heir Fred Miller bought the Draper Hall Hotel for $85,000 and donated it to the Racine Dominicans. On Lauderdale Lakes, the Evangelical Lutheran Church purchased 18 acres for a camp welcoming 3,000 visitors a year by 1954.  More notable was a huge, 4,400-acre Vilas County estate with some 30 lakes. It was first purchased in 1914 by UW-Madison graduate and attorney Martin Gillian, who served as undersecretary of agriculture under President Woodrow Wilson. Gillian befriended some University of Notre Dame priests, who used his land as a summer retreat, and when the lifelong bachelor died in 1943, he left the property and a sizable trust fund to Notre Dame.  In the post-WWII era, Delavan Lake and Lauderdale Lakes hotels followed common practice and dumped their trash into their lakes’ lagoons. Sewage treatment plants poured partially processed waste into Nagawicka, Big Muskego, Lac La Belle, Mendota, Pewaukee and other lakes. Three sewage plants operated on Delavan Lake.  Nature’s filtration system was already compromised. Tamarack swamps, cranberry bogs and cattail marshes had been filled for farmland and cottages. Ironically, prominent early environmentalists shared responsibility. Frederick Pabst planted 1,000 pine trees, while his wife, Ida, gave mulberry trees to grade-school graduates to create a haven for birds and lobbied legislators for a $100 fine for destruction of endangered plants. But her husband created a 50-lot subdivision on Lac La Belle by filling in a cattail bog.  Lauderdale Lakes grew from a handful of residents in 1902 to 950 in 1991, helped by developers who drained a swamp. Such practices stretched into the 1970s, when the state legislature broadened the public trust doctrine to include protecting shores and wetlands. It also enabled residents to form lake protection and rehabilitation taxing districts. And the Wisconsin Lakes Partnership, a national model, was born, helping lake associations, the DNR and UW-Extension Lakes Program work together.  “We finally started to take more care of our lakes,” says Thornton, the environmental planner. As the waters cleared, the lakes again began attracting the wealthy. By the 1990s, cottages fell three at a time to make room for the massive year-round homes of vitamin kings, entrepreneurs and financiers.  “The price of our lakefront property, and property taxes on it … eliminated most of the working- and middle-class owners from the lakes in southeastern Wisconsin,” says Thornton. But unlike the old cottage owners, who came to swim, fish and motorboat, the new mansion owners preferred more passive pastimes: pontoon boating, bird-watching, scenic viewing.  With the lakes’ water quality improved, property values soared. Vacant lots in Waukesha County with 100 feet of frontage on 90-acre lakes started selling for $1 million. Up North there were still many middle-class cottages left. But even on remote northern lakes like Noquebay in Marinette County, retirees paid $200,000 for a wedge of lakefront with a cottage they’d bulldoze to build a year-round home. As the lakes became primary residences, the number of lake associations grew – from 500 in 1991 to more than 900 in 2006. They became active in protecting the lakes.  -----------  Lake associations began fighting threats as early as the 19th century. One of the first appeared on Delavan Lake in 1895, as residents united to buy a controlling interest in a mill that had lowered the lake level at the dam it controlled. On Lauderdale Lakes, residents organized to purchase a newfangled paddle-wheeled boat in 1902 to cut aquatic weeds.  By 1960, the chief threat was phosphorus washing into the lakes from farms, lawns and treatment plants. “One pound of phosphorus can produce 500 pounds of algae,” says Delavan Lake’s Knipper, an Abbott Labs water scientist before her retirement.  Just one property owner using phosphorus lawn fertilizer along a small 5- or 6-acre lake can kill it, causing a state of eutrification “that’s hard to ever reverse,” says Tim Kratz, director of the Trout Lake Station in Vilas County, part of UW-Madison’s Center for Limnology (the study of freshwater lakes). But the biggest culprit is agricultural runoff, says DNR paleolimnologist Paul Garrison.  Southern Wisconsin lakes started with bigger phosphorus problems than northern lakes because the glaciers dragged most of the state’s fertile soil there, encouraging the growth of agriculture, which in turn washed fertilizer into the lakes.  Examining lakebed core borings for clues about the past, Garrison found agriculture is a key contributor to lake degradation. Big Cedar Lake’s water cleared, he says, after residents bought out one farmer with “a significant barnyard input,” helped another limit runoff and convinced a third to take land bordering the lake out of production.  The conventional wisdom is that development causes water quality to decline, but Ashippun Lake’s core borings showed the opposite. Water quality declined significantly when agriculture expanded in the 1940s and ’50s. As development sped up in the 1990s, 200-foot lots replaced one large farm, which had cows that wandered into the lake, fertilizing it as they went. By 2008, Ashippun’s average water clarity, 11 feet, was twice what it had been in 1990.  Nor has development caused a phosphorus problem Up North, where all but the smallest lakes are now fully developed. “We’re beginning to think the biggest impact [of development] isn’t phosphorus runoff,” says Kratz, who monitors 2,500 northern lakes. Instead, it is residents cleaning up their shoreline, removing fallen trees and anything else that “looks messy.” This directly affects bluegills and largemouth bass: They grow three times slower in lakes without woody habitats.  Phosphorus became less problematic as soaring fertilizer costs, contour-farming and no-grow programs decreased runoff. Sewers replaced leaky septic systems and treatment plants modernized. “Most ecological systems recover if you stop the things hurting them,” says Wisconsin DNR Lakes and Wetlands Section Chief Jeff Bode.  Using satellite data and water clarity readings collected on 2,467 state lakes, UW-Madison researchers Scott Peckham and Thomas Lillesand found the water clarity of state lakes increased an average of two feet between 1980 and 2006. It didn’t matter whether the lakes were large or small, north or south, impoundments or spring-fed, surrounded by development or virgin forest.  Other lake threats have come and gone. In the mid-1970s, it was acid rain. Caused by utilities burning high-sulfate coal, it destroyed forests and fisheries in New York’s Adirondack Mountains. Wisconsin’s northern lakes were supposed to be next. To mimic the potential effect of acid rain, UW-Madison scientists pumped sulfuric acid into Little Rock Lake in Vilas County. “The pH decreased pretty quickly, and at a pH of 4.5, the bass stopped reproducing,” recalls DNR researcher Carl Watras. Perch vanished at a pH of 3.5. At 3.0, lake water became toxic to all fish.  But acid rain had little impact here. Wisconsin mandated a cut in sulfur emissions in 1986, four years before the federal Clean Air Act. Within eight years, even Little Rock Lake was back to normal.  Today, the biggest threat to northern glacial kettle lakes is declining water levels. “We’re at the lowest level since we started keeping records in the early 1980s,” says Kratz. In parts of Barron, Burnett, Marquette and Marinette counties, lakes have been dropping since 1998.  Possible explanations include overdevelopment (sucking too much water from the water table) and global warming. John J. Magnuson, past director of UW-Madison’s Center for Limnology, says ice cover on the state’s northern lakes has decreased two to three days per decade for the past 30 years, increasing evaporation. But if shorter ice covers are to blame, southern lakes should face the same problem. They don’t.  Low water levels may be a natural fluctuation. “Changes in groundwater are very slow, so effects we’re seeing today could be related to weather many decades ago,” says UW-Madison limnologist Stephen R. Carpenter. A hopeful note comes from Dane County and Waukesha County’s town of Summit, where lakes that suffered from low water levels for years are now at record highs after several extremely wet years.  PCBs were another threat to the lakes – until the makers of electrical transformers switched to different insulating materials, says Thornton. Now, the new demon is invasive aquatic species. “Public enemy No. 1 for the state’s southern lakes is Eurasian Water Milfoil (EWM),” says lake expert Bode. Others say it could threaten all state lakes.  EWM is the kudzu vine of the water. A submerged aquatic plant with featherlike leaves, it forms dense canopies, shading out native plants that aquatic animals rely on for food. Its thick mats make swimming and boating difficult. Chemical killers of EWM also destroy native plants. Mechanical harvesting is a last resort because EWM fragments become new shoots. Native weevils that attack the plant can take a decade to reach effective numbers, if ever.  The DNR’s early references to EWM likened it to an incurable cancer. Residents on Little St. Germain Lake have spent six years and more than $300,000 fighting EWM, says Ted Ritter, Vilas County DNR aquatic invasive species coordinator. And they’re not done yet.  Many invasive species reach Wisconsin via the bilge water from Great Lakes ships, but theories about EWM’s arrival range from a home aquarium dumped into a lake to a government experiment gone wrong. Sandy Engel, a retired DNR biologist, says EWM was first confirmed in the state in 1956 in the lower Fox River near Delavan, but it came to the U.S. in the late 1930s via the U.S. Department of Agriculture, which added it to carp ponds in Washington, D.C., for an experiment on whether the fish could become a food source for soldiers. When the experiment ended in 1942, the carp and EWM were dumped into the Potomac River. From there, EWM spread along the East Coast and into the Ohio River Valley, where it was further spread by boaters or birds.  “We know who’s spreading this now,” says DNR’s Bode. It’s fishermen who take their boat from one lake to another, carelessly transporting invasive species on their trailers, motors, boats and bait buckets. Fear of those fishermen has spurred lake associations to ask the DNR to close public launches. Citing the public trust doctrine, it has refused.  In 1979, EWM affected 75 state lakes. By 2008, it had spread to 479, but it’s a myth that only lakes with public access get aquatic invasive species, Bode says. Marinette County lakes with no public access have EWM, and Waukesha County’s Beaver Lake has no public access, but still has both EWM and another invasive species, zebra mussels.  A study by UW-Madison professor David J. Lewis done in Vilas County found that EWM decreased lake property values 13 percent. But veteran Waukesha County appraiser Rick Larkin says he’s seen no impact on prices in Southeastern Wisconsin due to either EWM or zebra mussels. In fact, even prestige lakes like Pine, Beaver and Oconomowoc have both, he notes, and are still setting price records.  Likening EWM to a fatal cancer “is way overstating it,” says Susan Knight, an aquatic biologist at Trout Lake Station. Scientists have learned EWM severely impacts only genetically predisposed lakes: shallow, mucky ones with heavy boat traffic and lots of nutrients flowing into them: lakes like Delavan, Pewaukee and those along Madison’s Yahara River chain.  Like EWM, zebra mussels affect lakes in different ways. “They hit Nagawicka much, much worse than Lac La Belle and we don’t know why,” says Bode. Okauchee Lake residents were in tears when they learned their lake had been invaded, he says. Once that happens, there is no way to stop it. The mussels attach to all hard surfaces, cutting swimmers’ feet, adhering to boats and docks and suffocating native clams. Zebra mussels may also promote toxic blue-green algae by eating its competitors.  But many lakes are unaffected. “People cried ‘wolf’ just as they did with acid rain,” says Thornton. “Zebra mussels haven’t been the harbinger of doom we once thought.”  Another Great Lakes import, Viral Hemorrhagic Septicemia (VHS), a fatal fish disease, nearly did close public boat launches, but it, too, is failing to measure up to early fears. VHS appeared in Lake Winnebago in 2007. The disease kills a wide variety of fish, but doesn’t harm humans.  “VHS galvanized people, because it seemed so immediate and so invisible,” Bode says. After considering closing landings, the DNR posted signs to educate the public instead, and so far, there are no indications VHS has spread. There were also no big fish kills in Lake Winnebago in 2008.  VHS inspired the DNR and lake associations to start a statewide campaign telling boaters to clean their boats. Some 54,000 inspected boats and 113,000 contacts later, “90 percent of Wisconsin boaters know it’s the law,” Bode says. A pending DNR rule, NR 40, “will have real specific language for the other 10 percent,” he promises.  There’s no end to the list of invasive species. The Great Lakes harbor 185 more, Bode warns, “including Quagga mussels, which rob lakes of their productivity.” Up North, rusty crayfish, used as fishing bait in the 1950s and ’60s, are now wiping out native crayfish and decimating weed beds that fish need in 456 state lakes. Rainbow smelt, a northeast coast native brought to the Midwest in the 1920s as food for game fish, is eliminating native yellow perch – and even walleye – by eating their young. Even worse are Asian carp, which are now in the Mississippi and Fox rivers. “They wipe out entire fisheries,” says biologist Neal O’Reilly.  But there’s good news, too, says UW-Madison Center for Limnology researcher Jake Vander Zanden: “Generally, only a small fraction of our lakes are vulnerable to any one invasive species.” Rainbow smelt, for example, may only have a significant impact on 180, mostly northern lakes. Zebra mussels may hurt up to 1,100 of the state’s lakes, most of them in the south.  But there’s a wider cause for concern: climate change. In addition to global warming, there’s a rise in severe weather events that increase erosion and phosphorus runoff, warns Magnuson. Meanwhile, a measure intended to combat global warming is hurting the lakes. “Biofuel is one of the drivers of phosphorus pollution,” says Carpenter. The high prices it brings encourage farmers to grow corn, a crop that demands high-phosphorus fertilizer and exposes a lot of soil for potential runoff into lakes.  The USDA’s Conservation Reserve Program pays farmers to take land out of production and restore wildlife habitat, do erosion control and groundwater recharge. But as a result of the biofuel craze, farmers are taking land out of CRP to produce more corn, Carpenter notes. “The overall effect of biofuels is negative on the carbon cycle, climate, water supply, water quality, fish and wildlife,” he warns. Indeed, biofuel has already hurt one attempt to restore a lake.  -----------  Just after Labor Day in 1989,scientists adjusted the dam on Delavan Lake, drawing down the water level 10 feet. The plan was to kill the rough fish that had taken over the lake and destroyed the natural food chain and the plankton that keep algae in check. The preferred chemical was rotenone, the powdered root of a South American plant that kills fish. So many rotenone farmers had switched to growing cocaine that the chemical’s price doubled. Lowering the lake kept costs manageable.  “The lake was so degraded, we had no choice but to start over,” says Knipper, then president of the lake association.  Just before ice cover, scientists applied the chemical, hoping the fish would die and sink. But when the ice melted, “Oh my God, the flies were terrible and the smell!” Knipper says. Lake residents had to go without a boating season as nature slowly refilled the lake.  Lake rescues have been engineered a dozen or more times in Wisconsin, says O’Reilly, the DNR manager on the project. But never had one been done on a lake so large or politically complex as Delavan. Planning actually began in 1983. The first step was stopping the flow of phosphorus into the lake. The lake’s three wastewater treatment plants had to be closed and new plants opened downstream. A new $20 million sewer system replaced the lake’s failing septic systems.  The late Les Aspin, then U.S. Representative for Wisconsin’s 1st District, helped secure millions of dollars in federal funds. The town of Delavan generated a significant amount of money with its hotel tax, something few lakes could pull off, O’Reilly says. DNR kicked in a few million more.  Four municipalities in the lake’s watershed, the lake association, the U.S. Geologic Survey, Walworth County, the U.S. Environmental Protection Agency, local businesses, the Delavan Lake Sanitary District and 30 UW-Madison grad students rolled up their sleeves. “The project became contagious,” says O’Reilly, now vice president of water resource planning for Hey & Associates. “Everyone wanted to be a part of it.”  But as soon as all the sewage treatment plants were turned off, “the lake sort of went crazy,” he says. That’s when dead animals littered the lakeshore and people and pets began getting sick. A rare blue-green algae that gives off a poison toxin had mushroomed. “We’re just starting to understand how dangerous these algaes are. They’re like the red tides in the ocean,” says O’Reilly.  Years of accumulated phosphorus still sat in the lake, feeding the algae. The next spring, scientists applied aluminum sulfate to the lake. Alum combines with phosphorus, inactivating it. The precipitate settles on the lake floor like a blanket. Delavan’s clarity went from 3 inches to 30 feet overnight.  “Because the fish were all gone, there was nothing to eat the zooplankton,” O’Reilly says. And the zooplankton ate all the algae.  The DNR usually stocks muskie and walleye because fishermen love catching them, but on Delavan Lake they serve another purpose. They control the number of panfish, which would consume the zooplankton needed to eat the algae. As the algae disappeared, the lake went from two types of aquatic plants to 22. Some had been dormant for 30 years.  On the lake’s north end, a 95-acre wetland was dredged and reconstructed. Three ponds were built to filter water coming into the lake and retain the sediment. The restoration team recruited a local soil conservationist who enrolled farmers upstream in the Conservation Reserve Program. The lake’s drainage area is 67 percent agricultural, and the federal program paid them to stop farming in sensitive spots of the watershed. But the lure of biofuel’s big money was too much and they eventually dropped out of the program.  The 10-year restoration project was completed in 1993, but by the mid-1990s, water quality began to drop. EWM appeared in 1998, spreading aggressively. Zebra mussels followed. In February 2003, the town of Delavan passed the state’s first ban on phosphorus fertilizers, but by the next summer, Delavan Lake was pea soup again. “It was a wake-up call,” says Knipper.  Now, the lake needs another alum treatment. The fishery needs to be restocked. Muskie and walleye don’t reproduce in the lake, so the panfish are eating all the zooplankton needed to eat algae. The three retention ponds filled in quickly and had to be dredged. Still, O’Reilly says, Delavan is a success story about people working together – one that taught many valuable lessons.  The restoration paid big dividends. Three UW-Whitewater economists found the average Delavan Lake owner experienced a “windfall return of $176,818” in increased property value. The aggregate $99 million increase in value reduced taxes for off-lake residents by 14 percent. Business benefited, too. “If the water quality were to return to prerestoration levels,” the researchers wrote, “economic activity would be reduced 8 to 13 percent.”  To Knipper, who will spend her Fourth of July educating boaters about the importance of clean boats, the lesson of the restoration is simple: “Everyone benefits when the water quality is good and everyone pays when it’s not.”  -----------  Until he died, George Watts swam regularly in his little lake. For two grandsons, it became a magic fishing hole for northern pike. “It’ s just a piece of heaven,” says Martha.  It was George’s idea to put a conservation easement on the property. The Ozaukee Washington Land Trust will make sure it’s preserved for future generations. Four of the couple’s five children live out of state. “They all say ‘they’ll never sell this land,’ but in reality, now, when I go, they can sell it, but no one can ever develop it or subdivide it,” says Martha.  Watts’ neighbor, philanthropist Michael Cudahy, also put his land in trust, as did Mequon biologist Cheryl Brickman and her husband. Their 15-acre parcel, with its 5-foot-deep, 2-acre pond, could have been subdivided into three residential lots. Now, if none of Cheryl’s three grown children want the property, she notes, “it will be referred back to the land trust’s list of conservation buyers.”  Over the past 15 years, the land trust movement has grown dramatically in Wisconsin, says Bryan Pierce, executive director of the Northwoods Land Trust, which protects 18 miles of northern lakefront. The state now has more than 50 active land trusts collectively protecting more than 200,000 acres.  “Generally, it’s small lakes and properties surrounded by development being put into conservation easements today,” says Pam Foster Felt, outreach director for Gathering Waters Conservancy, which promotes Wisconsin land trusts.  A conservation easement provides financial benefits – decreased estate taxes and a charitable deduction on income taxes for the value of the easement; it may also save on property taxes. But the prime motivation for donors, says Foster Felt, “is that they love their land and the lake they’ve grown up on.”  Many counties are also putting the brakes on lake development. Marinette County is typical. It ranked its lakes and then set the most stringent development standards for the smallest, most sensitive lakes: a minimum lot size of more than 2 acres and 300 feet of frontage.  Meanwhile, the DNR is advancing new shore land zoning rules. “If you want something – like an addition or a garage – there will be a trade-off,” says the DNR’s Bob Wakeman. “You’ll need to install a rain garden or restore natural shoreline to minimize the impact of the increased runoff from impervious surfaces.”  A new breed of ecotourism is also taking root. Pete and Gail Moline’s Afterglow Lake Resort in Vilas County is dedicated to “silent sports” – snowshoeing and cross country skiing in winter and fishing, kayaking and paddleboating in summer on the resort’s 33-acre lake. Pete’s parents bought the 240-acre parcel near Phelps back in the late 1940s, but Pete and Gail adopted the gentler approach. Customers keep coming back – for 20 years on average. “When they arrive, it’s like a family reunion,” Pete says.  Scientists are also seeking more solutions. In the early 1900s, UW-Madison scientists Edward Birge and Chauncey Juday pioneered the study of inland lakes, making Wisconsin an international innovator in limnology. The state continues to be a leader: In April, the National Science Foundation selected a UW-Madison/Notre Dame partnership in Vilas County as part of the new National Ecological Observatory Network. The $100 million-plus project will monitor environmental changes over the next 30 years.  It is not an accident that state scientists, economists, lake associations and families are all searching for ways to preserve the lakes. “There’s more emotional attachment to a family cabin up north on a lake than almost anything else,” says Quarles & Brady estate planner John Lhost, who has worked with many families who own lake cottages.  The Watson family of Swan Lake, decedents of the Portage pioneer druggist, feels that emotional pull. Today, 76-year-old great-grandson James Watson Sr. lives year-round in the converted summer cottage his grandparents built in the 1920s from army barracks scrap. Three of his four children and their children live on the 1850 family plat, too.  Swan Lake seems to flow through the veins of the entire Watson clan. Family members who move away still return regularly. “Once you’ve lived on a lake, you always come back,” James says. His son, Jim Jr., has lived on the lake since age 1, half a century ago. His son and daughter learned to water ski almost as soon as they could walk.  Junior has charted the lake’s water quality for years. “In the 1930s and ’40s when my dad was a kid, it was crystal-clear,” he says. In the ’50s, there was a lot of land-clearing and agriculture, and by the 1960s, a toxic blue-green algae covered the lake. But in the early ’80s, the last sewage treatment plant upstream was removed, and the water clarity began to improve. By this spring, he noted, “it’s crystal-clear – 20 feet or more.”  But it may not last: Last summer’s 500-year flood temporarily grew the lake from 400 acres to 4,000, flooding it with nutrients and growing algae that could return this summer. Jim Jr. and other lake association members tried to convince neighboring farmers to install buffer strips of native plants between their tilled land and the lake, but “it’s hard convincing them,” Junior says, “when the DNR boat ramp has mowed lawn to the water’s edge.”  As the Watson clan has grown, each family’s parcel has gotten smaller. It hasn’t mattered, Junior says. “When I’m on the lake, I’ve got 400 acres and I can watch bald eagles soar. There’s nothing better.”  The magic of Wisconsin’s lakes can make even strangers family, and turn one-time Illinois residents, like Mary and John Knipper, into Wisconsinites. As they enjoy coffee on their deck overlooking the sparkling water of Delavan Lake, the Knippers often comment on how lucky they are. “There aren’t many people who get to begin their day as we do,” Mary says.  A lot of Wisconsinites complain about people from Illinois using their lakes, she says. “But they should take it as an incredible compliment, because those lakes make them dream about being in Wisconsin. And about being a Wisconsinite, too.”  *Mary Van de Kamp Nohl is a senior editor at* Milwaukee Magazine. *Write to her at* [mary.nohl@milwaukeemagazine.com](mailto:mary.nohl@milwaukeemagazine.com).  **Sidebar**  **Ranking the Lakes** What makes a lake pristine? Crystal-clear water? Most people think so, and our list of the clearest lakes (below) provides this ranking.  In Wisconsin’s northern glacial lakes, water clarity readings of 30 and 40 feet are common, says Laura Herman of the UW-Extension Lakes Program at UW-Stevens Point. “If we got a 5 foot reading up here, we’d think ‘Holy butt-kiss!' But in the southern part of the state, we’d think that’s OK.”  Northern lakes have an edge because the glaciers dumped most of the topsoil down south. “So there’s less of it left to run into the lakes up north,” says Jeff Thornton, principal environmental planner for the Southeastern Wisconsin Regional Planning Commission.  Meanwhile, in the southern part of the state, runoff of nutrient-rich soil and agricultural fertilizers create algae blooms that diminish water clarity.  The Wisconsin Department of Natural Resources considers 32 feet excellent water clarity; 20 is very good; 10 feet, good; 7 feet, fair; 5 feet, poor; and 3 feet, very poor.  But the clearest lakes aren’t necessarily the healthiest, caution Wisconsin's DNR experts. An extremely clear lake may lack the plant life needed to support a robust fishery. Ecologically balanced lakes are more important: those with a healthy mix of native plants, forested shores, minimum runoff coming into them, a good fishery and diverse wildlife. That’s our healthiest lakes list.  At the other extreme are the murkiest lakes. Dodge County’s Fox Lake “is the most challenged lake in the state,” DNR Lakes and Wetlands Section Chief Jeff Bode says, noting its high phosphorus level and poor native plant community. Farms with 400 and 500 dairy cows dot its watershed and “industrial waste is being spread in its backyard,” he says. The lake underwent a restoration that held for a while, but it has relapsed. “The water is pea-soup-green again,” Bode notes.  **Wisconsin’s Clearest Lakes**  Black Oak Lake, Vilas County (30.8 feet of visibility)  Blue Lake, Oneida County (29 feet)  Bardon (Whitefish) Lake, Douglas County (26.3 feet)  Lee Lake, Oneida County (26.1 feet)  Upper Eau Claire Lake, Bayfield County (25.3 feet)  Fence Lake, Vilas County (25.1 feet)  Pine Lake, Waukesha County (24.3 feet)  Stone Lake, Washburn County (24.0 feet)  Bond Lake, Douglas County (22.8 feet)  Wind Pudding Lake, Oneida County (22.8 feet)  *Source: Based on July-August 2008 water clarity data provided by the UW-Extension Lakes Program.*  **Wisconsin’s Healthiest Lakes**  Owen Lake, Bayfield County.  Dorothy Lake, Chippewa County.  East Ellerson Lake, Vilas County  Burnt Wagon Lake, Chippewa County  Bond Lake, Douglas County.  Middle lake of Lauderdale Lakes, Walworth County.  Montgomery Lake, Kenosha County  Lulu Lake, Pleasant Lake and Wandawega Lake in Walworth County  Gilbert Lake and Lowe Lake in Washington County  Little Elkhart Lake in Sheboygan County  Pine Lake, Waukesha County  Max Lake, Stormy Lake, Smokey Lake, Black Oak Lake, North Twin Lake, Aurora Lake, Little John Lake and Vista Lake in Vilas County.  *Source: Selected by Wisconsin DNR lake experts.*  **Wisconsin’s Murkiest Lakes**  Tainter Lake, Dunn County (0.6 feet of visibility)  Fox Lake, Dodge County (0.83 feet)  Beaver Dam, Dodge County (1.08 feet)  Round Lake, Chippewa County (1.40 feet)  Mason Lake, Adams County (1.50 feet)  Petenwell Lake, Adams County (1.50 feet)  Park Lake, Columbia County (1.50 feet)  Ludden Lake, Iowa County (1.50 feet)  Lake Tomah, Monroe County (1.50 feet)  Dexter Lake, Wood County (1.50 feet)  *Source: Based on July-August 2008 water clarity data provided by the UW-Extension Lakes Program.*  **Wisconsin’s Biggest Lakes**  1. Lake Winnebago, Fond du Lac County, among others, 137,708 acres.  2. Petenwell Lake, Adams/Wood counties, 23,040 acres (The state’s largest man-made lake was created in 1948 by damming the Wisconsin River at Neceda.)  3. Chippewa Lake (part of the Chippewa Flowage), Sawyer County, 15,300 acres.  4. Poygan Lake, Winnebago County, 14,102 acres.  5. Castle Rock Flowage, Juneau County, 13,955 acres.  *Source: Wisconsin DNR, 2005 Wisconsin lakes inventory.*  **Wisconsin’s Deepest Lakes**  1.Lake Wazee, the former Jackson County iron mine quarry, 350 feet.  2.Green Lake, Green Lake County, 236 feet.  3.Redgranite Quarry, Waushara County, 163 feet.  4.Lake Geneva, Walworth County, 135 feet.  5. Lohrville Quarry, Waushara County,120 feet.  *Source: Wisconsin DNR, 2005 Wisconsin lakes inventory.*  **Most Popular Lake Names** Mud Lake, 116  Bass Lake, 82  Long Lake, 59  Spring Lake, 45  Lost Lake, 42  *Source: Wisconsin DNR*  **Top Ten Public Enemies** 1. Eurasian Water Milfoil, 479 lakes affected  2. Rusty Crawfish, 456 lakes  3. Curly Pondweed, 307 lakes  4. Chinese Mystery Snail, 217 lakes  5. Zebra Mussels, 121 lakes  6. Banded Mystery Snail, 105 lakes  7. Hybrid Milfoil, 28 lakes  8. Rainbow Smelt, 21 lakes  9. Spiny Water flea, 7 lakes  10. Japanese Mystery Snail, 3 lakes  *Source: Wisconsin DNR inventory, March 1, 2009.*  **Wisconsin’s Top Ten Fishing Spots** *Wisconsin ranks No. 2 nationally in the number of days of fishing by nonresidents and the number of nonresident anglers – nearly 400,000. Only Florida ranks higher – and it has an ocean! Some 1.4 million licensed anglers fished Wisconsin waters in 2008, catching an estimated 88 million fish. The most frequently caught were: panfish, bass, walleye, northern pike, trout, catfish and muskie. In all, 165 species are found in the state.*  1. Chippewa Flowage, Hayward: One of the largest lakes in the state, known for its muskie fishing.  2. Lake Winnebago, Oshkosh: Wisconsin’s largest lake is known nationwide for its tremendous walleye fishery and winter sturgeon spearing season.  3. Lake Poygan, Winneconne Lake and Lake Butte des Morts, Oshkosh: Connected to Lake Winnebago, these lakes have quality walleye and bass.  4. Petenwell Flowage, Wisconsin Rapids: Part of the Wisconsin River system, the area is known for its muskie fishing.  5. Eagle River Chain, Eagle River: Part of the world’s largest chain of lakes (in number of lakes), this popular destination is known for its diverse fishery, which includes muskie and walleye.  6. Mississippi River (all of Wisconsin that borders it): A diverse and robust fishery holding hundreds of species of fish, most notably bass and walleye.  7. Green Bay (part of Lake Michigan), Green Bay: Known nationwide for its trophy-sized walleye and up-and-coming trophy muskie fishery.  8. Chequamegon Bay, Ashland: One of Lake Superior’s premier areas for smallmouth bass, the bay also holds salmon, trout and walleye.  9. Shawano Lake, Shawano: A great lake for bass, walleye and muskie.  10. Three Lakes Chain, Three Lakes: A very diverse fishery featuring walleye, bass and muskie, with numerous trophy fish of all species.  *Source: Information from the U.S. Fish and Wildlife Survey and the American Sportfishing Association. Top ten picks by Steve Swierczynski, research director for Rhinelander- based Fishing Hot Spots Inc.*  **Wisconsin’s Best Swimming Spots** What makes a great swimming hole? A sandy beach, a hard-bottom lake with clear water and public access. We asked local officials and DNR lakes experts to help us indentify the best in each county (listed geographically):  **Southeast** **Milwaukee County**: Upper Kelly Lake  **Waukesha County**: Pretty Lake, Silver Lake and Ottawa Lake  **Waukesha-Jefferson County**: Golden Lake  **Washington County**: Eastern bays of Big Cedar Lake, Erler Lake, Little Cedar Lake, Pike Lake and Silver Lake  **Racine County:** Browns Lake  **Kenosha County**: Lily Lake, Powers Lake and Silver Lake  **Walworth County**: Rock and Pleasant Lakes and Big Foot Beach on Lake Geneva  **North and Northeast**  **Vilas County:** Silver Lake Beach and Park, Little Star Lake Park and Beach, Crystal Lake Park and Beach, and Black Oak Lake Park and Beach  **Oneida County:** Two Sisters Lake, Clear Lake, Sugar Camp Lake, Lake Minocqua and Buck Lake  **Marinette County**: Lake Noquebay and Timms Lake  **Oconto County**: Boot Lake and Bass Lake  **Langlade County:**Jack Lake and Summit Lake  **Lincoln County**: Pesobic Lake, Tug Lake, Bass Lake and Seven Island Lake  **Door County:** ClarkLake  **North Central**  **Waushara County:** Little Silver Lake  **Waupaca County**: Shadow Lake  **Portage County:** Sunset Lake  **Jackson County:** Wazee Lake  **Wood County**: Lake Wazeecha  **Adams County**: Jordan Lake, Crooked Lake, Wolf Lake, Parker Lake and Deep Lake **Marquette County:** Pleasant Lake  **Columbia County:** Silver Lake in Portage  **East Central**  **Sheboygan County**: Crystal Lake and Elkhart Lake  **Fond du Lac County**: Mauthe Lake and Wolf Lake  **Winnebago County:** Lake Winneconne and Lake Winnebago  **Southwest**  **Bayfield County:** Twin Bear Lake and Lake Owen  **Douglas County**: Lake Nebagamon and Dowling Lake  **Burnett County:** Devils Lake  **Washburn County:** Shell Lake  **Sawyer County:** Round Lake  **Barron County:** Silver Lake  **Polk County**: Balsam Lake  **Chippewa County**: Round Lake in Samson  **Price County**: Elk Lake and Solberg Lake  **Taylor County:** 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