Wisconsin natural resources. Vol. 31, No. 4 August 2007

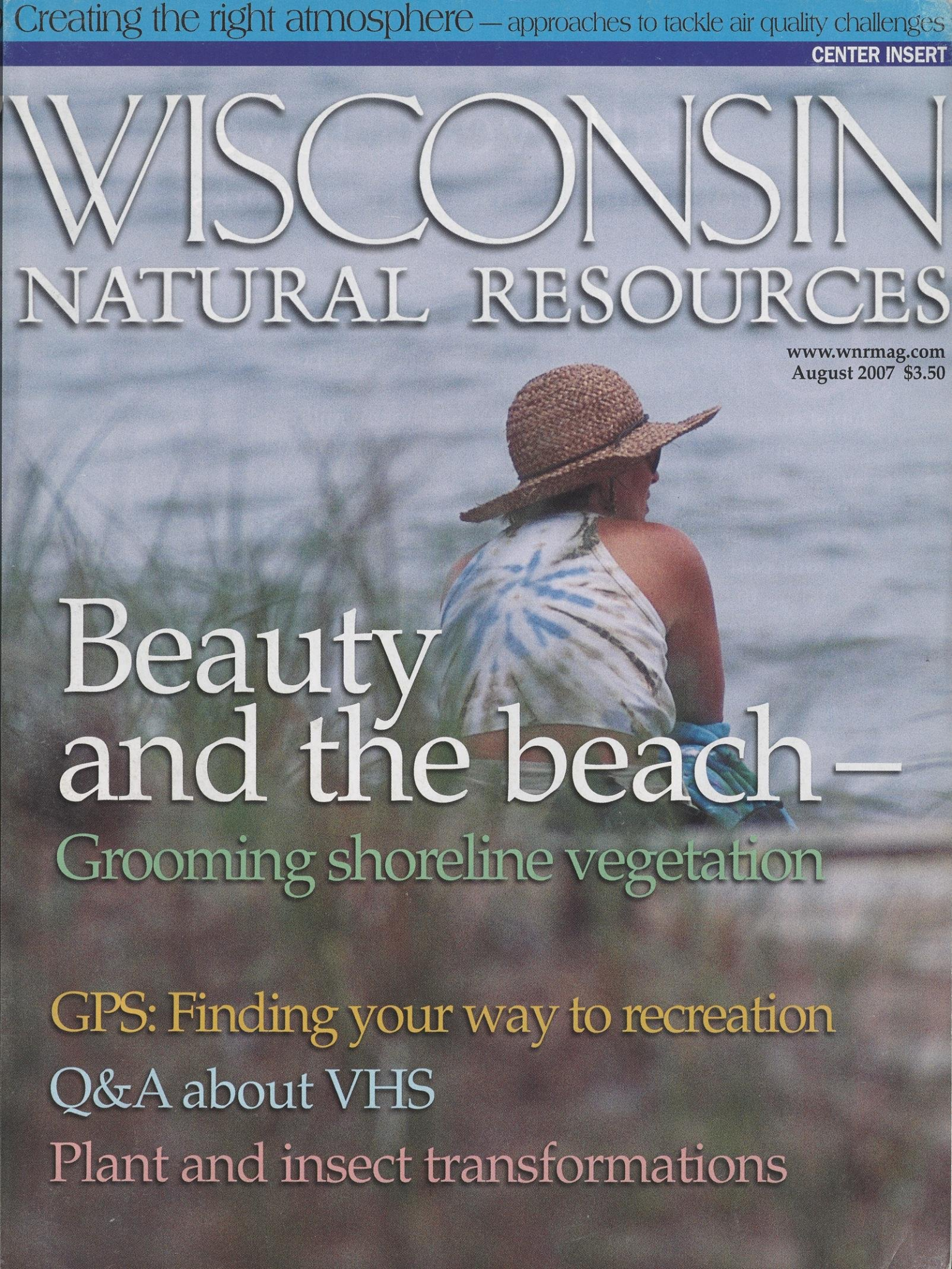
[Madison, Wisconsin]: Wisconsin Department of Natural Resources, August 2007

Creating the right atmosphere — approaches to tackle air quality challenges

CENTER INSERT

WISCONSIN NATURAL RESOURCES

www.wnrmag.com
August 2007 $3.50



Beauty and the beach —
Grooming shoreline vegetation

GPS: Finding your way to recreation

Q&A about VHS

Plant and insect transformations

Milkweed love

Pollination is tricky, but it works!

Anita Carpenter

On a humid, late summer day common milkweed's sweet, lilac fragrance hangs heavy in the still, moist air as insects of all kinds converge on its lavender blossoms. The hungry visitors crawl over the droopy blooms, pausing often to sip a high-energy nectar meal. The meal is not without cost. Unknowingly, while drinking, the insects pick up milkweed's precious pollen and deposit it on the next nectar-rich blossom.

Milkweed pollination seems simple: offer nectar and let insects do the work. Although milkweed is a very popular dining site for hungry insects, why are so few pods produced compared to the number of flowers? With milkweed nothing is simple. The pollination process is complex and so chancy that it's a wonder it occurs at all.

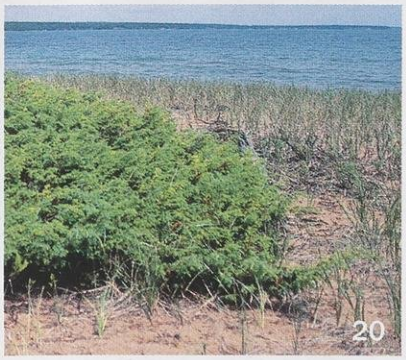
continued on page 28

A dun skipper (*Euphyes ruricola*) is one of several butterfly and moth species that can pollinate milkweed if its leg slips into a pollen sac while seeking a nectar meal.

WISCONSIN NATURAL RESOURCES

August 2007
Volume 31, Number 4

JAY SAMPSON



ROBERT QUEEN

DON BLEGEN

FRONT COVER: Natural vegetation protects the shoreline and can still provide an enticing, peaceful place for visitors to relax on coastal beaches.
ROBERT QUEEN, Madison

BACK COVER: Bluff Creek State Natural Area in Walworth County. For more information, or to order a guidebook to State Natural Areas, contact the State Natural Areas Program, Bureau of Endangered Resources, DNR, P.O. Box 7921, Madison, WI 53707 or visit dnr.wi.gov/org/land/er/sna.
© THOMAS A. MEYER, Wisconsin Department of Natural Resources

Editor David L. Sperling
Creative Products Manager Natasha Kassulke
Contributing Editor Maureen Mecozzi
Circulation Manager Kathryn A. Kahler
Art Direction Elisabeth Albert, Waldbillig & Besteman
Printing Schumann Printers

PUBL CE-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.**

GREGORY K. SCOTT

Pointing a new to

Robert J. Manwell

way recreation

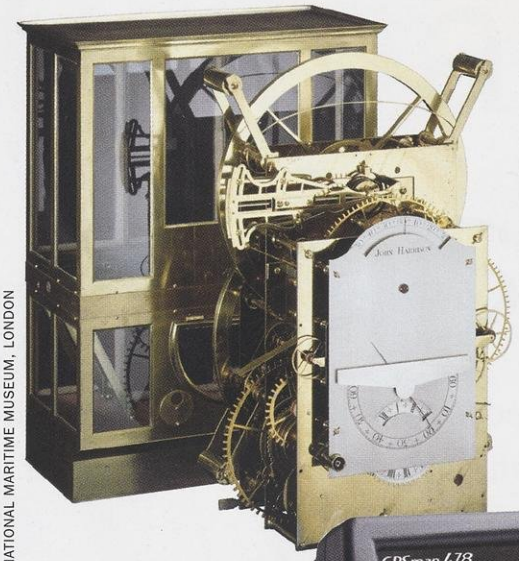
With a little map knowledge, GPS units can help you find a new hobby or make your way back to a favorite fishing hole, hiking trail, or wild asparagus patch.

It hasn't always been so easy, knowing exactly where you are on earth. Learning how to get there from here perplexed explorers, armadas and merchants for centuries.

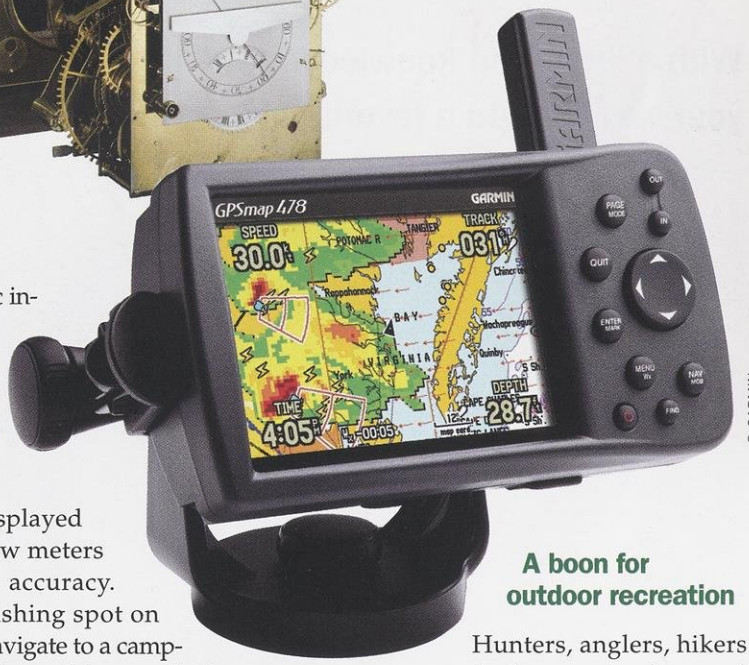
Caching in! Geocachers solve clues, follow GPS bearings and find their way to a hidden box in a high-tech treasure hunt.

RYAN SIMONSEN

© NATIONAL MARITIME MUSEUM, LONDON



© NATIONAL MARITIME MUSEUM, LONDON



© GARMIN

LEFT: John Harrison spent more than a decade developing and perfecting durable, accurate, spring-driven chronometers that could be used to calculate longitude at sea.

CENTER: Harrison's third timekeeper (H3) is still on display and still operating at The Royal Observatory in Greenwich.

BELOW: Compact marine GPS units today can accurately display location, boat speed, water depth, navigation routes and other information on digital onboard maps.

In October 1707, a returning British war fleet led by Admiral Cloudesley Shovell foundered in dense fog on the rocky Isles of Scilly off the coast of southwestern England. Four ships sank and nearly 2,000 sailors died. The calamity in home waters pushed Parliament to pass the Longitude Act of 1714, establishing a prize of £20,000 for a practical and reliable method of calculating longitude at sea.

Latitude — the distance of a position north or south of the Equator — was easy to determine by celestial navigation using the elevation of the northern pole star, Polaris, or of the sun at noon. But two lines of position are needed to determine location. To find longitude, or one's east-west position, ocean navigators needed to know two things: the exact time in their home port, and the exact local time on the ship. Pendulum clocks, then the most accurate clocks available, did not work properly on the rolling seas, leaving sailors to rely on dead reckoning, which was inaccurate out of sight of land or in bad weather.

In 1736, John Harrison, a largely self-taught clockmaker, finally succeeded in building the key to calculating longitude. His invention, the chronometer, was a spring-driven timepiece accurate enough and rugged enough to work reliably at sea.

Today, finding your place on the planet is as simple as turning on a hand-held electronic instrument known popularly as a GPS unit. In moments your position is displayed to within a few meters of absolute accuracy. Mark a hot fishing spot on open water, navigate to a camping spot deep in a wilderness, find a portage on an overgrown shoreline, note the location of a rare plant, or direct rescuers to your location? No problem with GPS, which correlates to a set of built-in maps programmed into the unit.

The Geographic Positioning System (GPS) links to a system of satellites orbiting at fixed locations around Earth. The satellites send signals down to the surface. The unit in your hand picks up and triangulates the signals from several of the satellites to compute your location. Some units are capable of measuring altitude as well.

Outdoor enthusiasts have been quick to pick up the new technology for recreational use. Law enforcement, search and rescue teams, foresters, biologists, surveyors, engineers, pilots, utility workers and many other professions use GPS daily. The relatively inexpensive technology also has spawned a popular new outdoor recreation called geocaching.

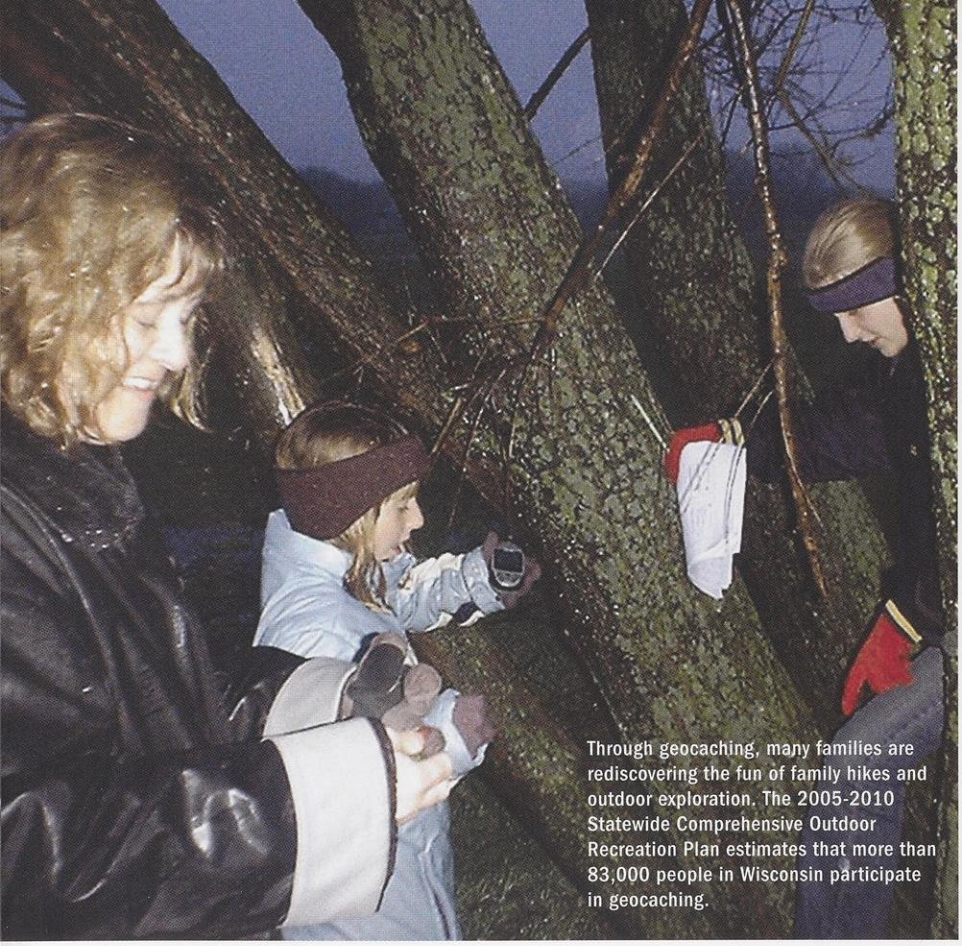
A boon for outdoor recreation

Hunters, anglers, hikers and other people who spend a lot of time enjoying the outdoors appreciate the additional measure of accuracy a GPS unit lends to their adventures.

"We sell to a variety of customers," says Rich VanDoorn, a manager at a local Gander Mountain store. "We see the hunters and anglers you'd expect, but we are also selling units to farmers who link GPS to computers in their tractors to measure the boundaries and sizes of their fields and accurately calculate pesticide and fertilizer application rates.

"Some GPS units can be programmed to read lake maps, including depth contours, stored in the unit's memory. These are popular with anglers. Other units can carry detailed topographic maps, sun and moon cycles, and a built-in barometer, which are popular features with both hunters and anglers."

Because they are used outdoors, most GPS units have some degree of weatherproofing. Some models float, a desirable feature if you are fishing,



Through geocaching, many families are rediscovering the fun of family hikes and outdoor exploration. The 2005-2010 Statewide Comprehensive Outdoor Recreation Plan estimates that more than 83,000 people in Wisconsin participate in geocaching.

JEFF MUCH

paddling, boating or sailing. VanDoorn says the most popular unit his business sells runs about $200 and is packaged with map software.

GPS is a great tool — but like any technology, may not operate properly due to environmental conditions and shouldn't be used exclusively, say experts.

"GPS doesn't replace traditional map and compass skills," Tom Ponik at REI [another outdoor equipment retailer] told me. "It's a great addition to backcountry navigation but it can fail or get dropped and broken, and if you can't find your way with a map and compass, your trip will be spoiled at the least or you may end up in a serious situation at the other end of the trouble scale."

Of the retailers I talked with, only REI offers classes on how to use GPS. The course is called, appropriately, GPS 101, and is offered periodically based on demand; advance registration is required. Students have a classroom session then get some hands-on experience in the store's parking lot.

Most of Ponik's early customers were backcountry travelers, and they are still important users, but geocachers are catching up. Lately he's been selling small wrist- and handlebar-mountable GPS units to runners and cyclists, who use the units to accurately record mileage and route information on their rides and runs.

New features you can find

Spawned by the military's need to accurately navigate across oceans and continents, the GPS satellite system originally had what's called "selective availability" (SA). Considered necessary for national security, SA intentionally produced an error of up to 150 meters in non-military GPS receiving units on earth. Military-issue units could work around the error.

Due to the growing civilian demand for the best accuracy possible, selective availability was turned off in May 2000, instantly upgrading the accuracy of GPS receivers available to civilians to within a few meters under good conditions. Newer units can also take advantage of WAAS, or Wide Area Augmentation System, that adds a bit more accuracy.

Older units had limited internal memories and offered only black and white screens. These units had sufficient memory to display crude maps but not much useful detail. Now it is possible to buy units featuring removable memory cards similar to the matchbook-sized removable memories used in digital cameras.

With the expanded memory capacity, units can hold a large number of highly-detailed maps. Most places selling GPS units also carry map databases on compact discs with the quality and detail of the 7.5 minute, 1:24,000 topographical maps published by the U.S. Geological Survey. Users can download data to a CD using a home computer, and then load the desired maps onto the GPS unit's removable memory.

Mapping software allows detailed route planning that displays elevation gains and losses, distances and waypoints. Waypoints, which are essentially dots on a map, can be recorded in the field; these points of interest can be transferred to a map when the user returns home. There are a number of software brands and features for GPS units with prices starting at around $100.

Units sold these days are capable of displaying your position and your destination in several ways. In addition to maps, numerical latitude and longitude readings are also displayed. Positions are pinpointed electronically using other numerical systems. Many users choose the UTM or Universal Transverse Mercator system that shows 1,000-meter-square grids, making it relatively easy to calculate distance from one waypoint to another, or to plot your position onto a paper map in the field using the information displayed on the unit.

Direction-of-travel may be shown graphically as in an electronic "road" on the screen, which the user follows. Or, users can choose a more traditional compass bearing. Backcountry users still need to interpret a map because the direction between two points is shown as the shortest possible distance — in other words, a straight line. Straight-line travel often is not possible due to rivers, lakes, canyons or steep terrain that require the hiker to assess the topography and plan a route.

"All GPS units can show the user where they are, what direction to head to get somewhere, and can record waypoints for future use," says Steve Collins, manager of Fontana Outdoor

LAWRENCE FRYE

As handheld GPS units become more popular, active people of all ages rekindle a spirit of outdoor exploration as they make their way across hills, streams, fields and forests. Users customize their own waypoints to mark their campsites, locations of wild food patches, or mark cache sites in the woods and in town.

Sports in Madison. "Additional features come at a cost."

Collins characterized GPS units as "navigational units" and "mapping units."

"Upgraded features like color screens make certain mapping details easier to read, which are great, but they usually come at the cost of faster battery drain," he says. For folks taking units into the backcountry for days at a time, a simple no-frills "navigational" unit will have a longer battery life. "Using the unit as a positioning tool along with a standard paper topo map makes the best use of both items, since it's difficult to get a real sense of what's around you from a small portion of a map on a 2x3-inch screen," Collins says. Topo maps provide the true lay of the land and point out rivers, roads, wetlands, cliffs and other landmarks that are a bit farther away.

Other features adventurers may want to consider are built-in altimeter and compass functions. Collins advises against relying solely on satellite signals to produce accurate altitude and compass readings.

"Altimeters that are barometer-based tend to be more accurate," says Collins. "Satellite-signal compasses only show direction when you are moving, unlike a magnetic compass that shows direction whether you are stationary or moving."

Geocaching: the search for hidden treasure

Geocaching, a new recreational sport, uses GPS technology in a kind of high-tech scavenger hunt. The 2005-2010 Statewide Comprehensive Outdoor Recreation Plan (SCORP) reports that 83,000 people participate in geocaching in Wisconsin.

Geocachers place small treasures in waterproof containers in a variety of locations — at a scenic vista, along a favorite hiking trail or picnic place, deep in a forest, on a rock cliff face, at the bottom of a shallow lake bed, or in urban settings such as parks, greenways and boulevards. Sometimes the "cache" is a larger landmark. The latitude and longitude of a cache is posted on the Internet so others can download the coordinates and set out to find the cache for themselves. It sounds simple, and some caches are relatively easy to find and reach, but others can involve strenuous cross-country hiking over a variety of terrain. Some cache directions combine latitude-longitude coordinates with compass bearings, distance clues and riddles.

"One of the great things about geocaching is that the whole family can partake in the activity," says Jeff Prey, recreational planner for the Wisconsin state parks system. "Many caches are easy enough for young children to find, while others can challenge even the most skilled outdoors person." The new trend is "virtual geocaches" that typically require finding certain information about the location's natural or cultural history, then checking your answer with the cache creator by e-mail or online at one of the many geocache websites.

The Department of Natural Resources recently developed guidelines for its property managers to use in overseeing geocaches placed on state lands. State parks and forests are popular sites for establishing geocaches and a visit to the DNR website provides links to maps

Where the caches are

For maps showing the locations of more than 1,000 documented geocaches in Wisconsin, visit: www.geocaching.com/map/wi.asp

CRYSTAL BODETTE

GPS is equally a research tool to revisit habitat and note changes over time. These researchers are members of a team investigating the few isolated American chestnuts remaining in Wisconsin.

ROBERT QUEEN

showing the locations of more than 1,000 documented geocaches in Wisconsin.

In general, most land managed by the Department of Natural Resources is open to placing geocaches with permission from the property manager. A site registration form can be downloaded from the website and a key tells you where to send the form based on the kind of property, such as a park, forest or wildlife area. Geocaches are not permitted at environmentally or culturally sensitive sites such as natural areas, archeological or historical sites.

Geocachers are asked to remember that many families participate in this new sport and certain items are not allowed to be placed in a cache such as food, pocket knives or weapons of any kind, illegal items such as drugs, or other materials normally restricted from minors.

Professional uses for conservation work

"We're all about where things are," says Bill Smith, a conservation biologist with a special interest in dragonflies. "We use waypoints to describe where we are and what's there at a specific point in time. By comparing repeat visits to the waypoint over time we can note any changes."

Before GPS technology was available, field biologists used aerial photos and quad maps to document the location of observations. It was and is difficult to precisely document in latitude and longitude where a sample point is from photos or maps. "An affordable handheld GPS unit does it within a few feet," says Smith. "In the case of field observation, GPS provides a degree of accuracy of observation unavailable to researchers only a few years ago."

Smith notes that "repeatability is a basic premise of good science." To that end, over the next four years the DNR's Division of Forestry will establish 4,000 permanent survey plots to measure changes in forest cover over time. Each plot will be visited once every four years by a forester who will meticulously record data on tree sizes and species, ground cover species and abundance, amount and type of woody debris, soil types, depth of coarse organic material such as leaves and needles, and a number of other environmental benchmarks.

"These recordings will give us a very accurate picture of what kinds of changes are taking place over time in

Geocaching lingo

You may see these terms in geocaching records:

FTF — First to find. A claim that geocachers like to make if they are the first to find a new cache. Some people even place a special FTF prize in the cache.

Muggle — A non-geocacher. Try not to let the muggles see you find a cache.

Multi-cache — When a first cache gives coordinates or partial coordinates to a next location or when multiple caches provide hints and clues to find a final cache.

TFTC — Thanks for the cache.

TNLN — Took nothing. Left nothing.

Virtual cache — When a "cache" is actually a landmark like a statue or tombstone. Geocachers are typically asked to answer a question from the landmark and contact the cache owner as proof they were there.

This listing courtesy of South Dakota Conservation Digest.

Aerial surveys use GPS readings and radio telemetry in combination to delineate animal territories as packs of wolves travel their range.

DNR PHOTO

SCOTT W. MULCAHY

The GPS coordinates provide the means to return to these locations on the ground to learn greater details about the packs and their habits.

our forests," said Teague Prichard, DNR public lands specialist. "The power of this project is in the ability to revisit the exact same place time after time to repeat and compare measurements. Each plot will have latitude and longitude coordinates and the foresters will use handheld GPS units to guide them to the survey plots. Before this technology was available, foresters would use survey stakes and flagging, all of which can disappear or be difficult or impossible to find four years later."

GPS is indispensable in aviation today. "Visual flight rules are still important for orientation and navigation in conservation aviation work, but GPS adds a degree of accuracy and repeatability we never had before," says John Jorgensen, chief pilot in the DNR aviation program.

"We use it every time we go up; not only as a navigational aid but as a precision tool that has many, many, specific applications for conservation programs," Jorgensen says. "It provides easy and accurate locations for everything from aerial population surveys for deer and wolves to nest counts for eagles, ospreys and trumpeter swans. It's also used to define areas that will be sprayed for gypsy moths and to determine the size of a forest fire."

GPS-equipped aircraft also have a public safety and law enforcement mission. Using GPS, pilots are able to pinpoint possible violations and pass information along to wardens on the ground for investigation. And GPS-generated latitude and longitude coordinates are used to direct initial attack ground crews to wildfires spotted from the air. Aerial photography benefits from GPS as new cameras are available that include GPS coordinates on the photo, similar to the familiar time and date stamps.

GPS adds an additional measure of safety in the cockpit, says Jorgensen. The location of towers and other structures that are a concern to low-flying survey aircraft can be programmed into an onboard GPS unit, alerting the pilot to the danger.

GPS coordinates are used to note environmental changes on the landscape, such as the locations of abandoned wells, new wells, spill sites, underground buried tanks and field inspections.

An economic engine

The GPS industry is growing. Estimated at roughly $12 billion in 2002 by *The Economist* magazine, it's difficult to walk into any outdoors shop, automobile showroom or electronics store and not run into a GPS display. The transportation industry has incorporated the technology into onboard navigation systems in trains, planes, trucks and automobiles.

The folded road map likely will never be replaced, but many paper-based mapping companies are expanding into digital mapping. A familiar purveyor of printed maps, the DeLorme Company of Yarmouth, Maine, is one of several businesses producing detailed digital mapping software for use with GPS units.

"Wisconsin is in the top five states for the number of DeLorme Gazetteers sold," said the company's Charlie Conley. "Similar to our home state of Maine, Wisconsin is a destination state for many

people and that is typically where we have our strongest sales, year after year."

The familiar red, white and green DeLorme Atlas and Gazetteers are found in all kinds of shops across the country and under the seat of most automobiles at trailheads, boat ramps, parks and forests.

"Gazetteers do a great job of getting you to easily identifiable places," says Conley. "They have a great deal of information and longitude and latitude tick marks in the margin of every page. At the scale of the maps we print to fit on the page of the Gazetteer, which is typically in the 1:150,000 or 1:250,000 range, they are only able to get the user into the ballpark in terms of pinpointing a location. [To get within] the few meters of accuracy handheld GPS units are capable of measuring, users need the digital version of our maps."

As an example, Conley notes that at large-map scales, a fine ink line on paper can represent several football fields on the ground. Conley recommends that people use the Internet to search out the features they would find most useful in a digital mapping application.

Another strategy? Ask as many GPS users as you know what they like or dislike about their mapping software, join a geocaching organization, or check out some online chat rooms. None of the retailers we visited loaned out software for field trials, and sales staff might be familiar only with product lines they sell. The software can cost hundreds of dollars, and in most cases, once you open and install it, you're stuck with it, so it's worthwhile to make the effort to learn as much as possible before you buy.

It was nearly 20 years after clockmaker John Harrison produced his durable timepieces that he finally received the prize for finding the solution to the longitude problem. It took much of that time for his system to prove itself simpler and more reliable than the complex astronomical observation systems his competitors advocated. Today, GPS technology is found in cell phones, portable computers, snowplows, delivery vehicles and even shoes. What would Harrison think now?

Robert J. Manwell is a DNR public affairs manager and an avid backcountry explorer.

GPS terms

Geographic Positioning System (GPS) — Refers to a handheld or mounted unit used to receive satellite signals and calculate position.

Latitude — A position's distance north or south of the equator, measured in degrees from zero to 90. One minute of latitude equals one nautical mile.

Longitude — The distance east or west of the Prime Meridian (measured in degrees). The Prime Meridian runs from the North to the South Pole through Greenwich, England.

Universal Transverse Mercator (UTM) — A nearly worldwide coordinate projection system using north and east distance measurements from reference point(s). UTM is the primary coordinate system used on U.S. Geological Survey topographic maps. The U.S. Geological Survey offers a webpage explaining UTM at http://erg.usgs.gov/isb/pubs/factsheets/fs07701.html.

Waypoints — Locations or landmarks worth recording and storing in your GPS. These are locations you may want to return to. They may be check points on a route or significant ground features like your campsite, where you parked your truck, a fork in a trail, or a favorite fishing spot. Waypoints may be defined and stored in the unit manually by taking coordinates from a map or other reference. This can be done before you leave home. More typically, waypoints are entered directly by taking a reading with the unit at the location itself, giving it a name, and then saving the point. Waypoints may also be put into the unit by referencing another waypoint already stored, giving the reference waypoint, and entering the distance and compass bearing to the new waypoint.

Wide Area Augmentation System (WAAS) — A second and more recent system of satellites and ground stations that provide GPS signal corrections to account for variations in atmospheric conditions, satellite orbits and timing. WAAS is currently available only in North America and most units sold today are WAAS capable. WAAS technology enables a typical GPS unit to remain within three meters of accuracy 95 percent of the time.

WAAS consists of approximately 25 ground reference stations positioned across the United States that monitor GPS satellite data. Two master stations, located on either coast, collect data from the reference stations and create a GPS correction message.

WAAS can correct for several environmental factors that influence GPS accuracy. For instance, GPS signals can be degraded by atmospheric conditions between space and the earth's surface.

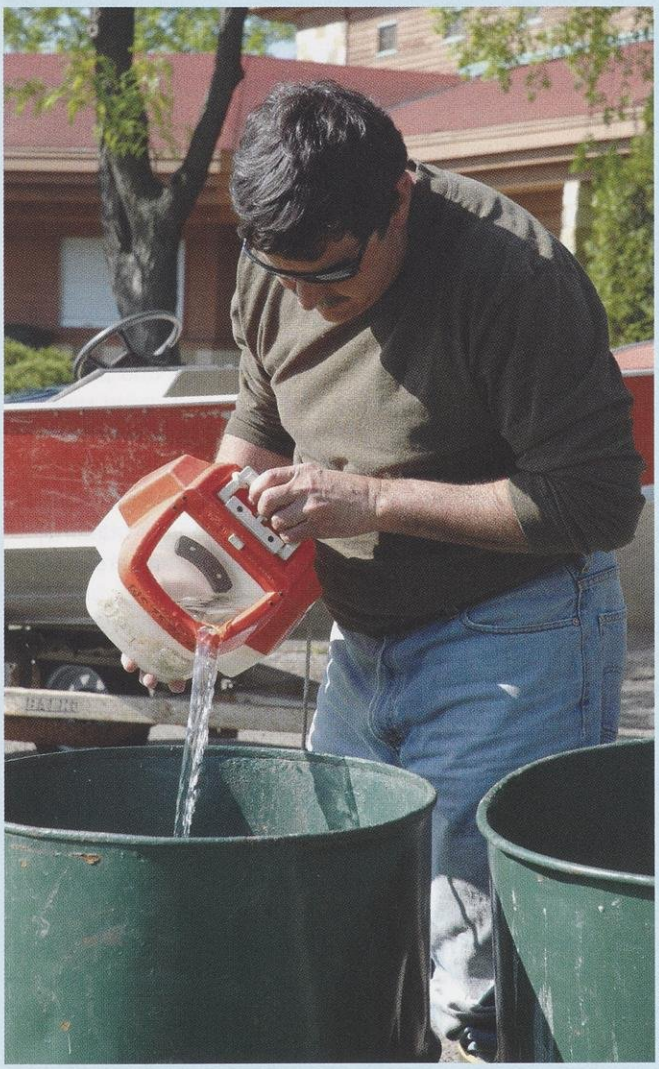
Scientists divide the atmosphere above Earth into layers. Two of these layers, the ionosphere and troposphere, both refract GPS signals, which affects the speed of the signals. Signal speed and time both are used to calculate position.

The size of this error depends somewhat on the position of the satellites your unit can "see" in the sky. Signals from a satellite low on the horizon must travel through a greater amount of atmosphere than a satellite directly overhead. Another source of error is blocked or reflected signals. Tall buildings, cliff faces and/or a heavy overstory can cause this problem. Sources of electromagnetic energy, such as electric transmission lines and sunspots, can introduce error. Avoiding tall structures and overhead obstructions will result in the best accuracy.

Q&A about VHS

Quick answers to common questions about an emerging fish disease.

Alisa Lopez



GREG MATTHEWS

To slow the spread of VHS, dispose of unused live bait before moving from one waterbody to another and drain water that could carry the virus from bilges, bait buckets and live wells.

What is VHS and where is it from?

Viral hemorrhagic septicemia, known as VHS, is an infectious disease of fish. The viral strain of concern was first diagnosed in Great Lakes fish in 2005, and was confirmed as the cause of fish kills in lakes Huron, St. Clair, Erie, and Ontario and the St. Lawrence River in 2005 and 2006. VHS was detected in Wisconsin waters for the first time this spring in fish from the Lake Winnebago System and Lake Michigan. Biologists have sampled fish for signs of the virus in Lake Superior, the Mississippi River and their tributaries.

VHS has been known as a disease of farm-raised rainbow trout in Europe for decades. The Great Lakes strain of VHS is genetically different from strains found in Europe and the Pacific Northwest, and seems to affect a wider range of freshwater species over a broader range of water temperatures.

Is VHS a health risk to people?

No. Anglers can continue to enjoy fishing and eating their catch. VHS has never been associated with human illness. Fish can be infected, carry and shed VHS without showing signs of disease. Such fish are safe to eat as long as the fish are fresh, properly handled and cooked. Never eat fish you find dead, decomposing, or that appear sick, regardless of cause. Decomposing fish host other bacteria harmful to people.

While it is generally safe to handle fish, always wash your hands after handling fish especially if they appear diseased or are dead. Dead fish and fish with visible sores may be contaminated with bacteria and it is a good idea to wear disposable, protective gloves when handling such fish.

Why do fish biologists consider VHS a serious threat to Wisconsin fish?

VHS can spread readily among fish of all ages. It infects a broad range of our native game fish, panfish and bait fish as well as "rough" fish, and it often kills fish. The strain identified in the Great Lakes is new and fish here have had no exposure to the virus, meaning their immune systems have no defense and are considered highly susceptible to disease. This is the first time a virus has affected so many different fish species from so many fish families in the Great Lakes.

How did VHS get into our lakes?

VHS is considered invasive and scientists are not sure how it arrived in Midwestern waters. The virus may have come in with migrating fish from the Atlantic Coast. It may have hitchhiked in ballast water from ships or it may have been brought in with frozen Pacific herring imported for use as bait. A likely way the disease spreads is through moving live fish or water from one body of water to another. The disease has been found in three inland lakes, one each in New York, Michigan and Wisconsin, and could have hitchhiked in a live well, bilge water, on a boat, or in minnows or other live fish.

How does VHS spread in a fish population and to new lakes?

Infected fish shed the virus into a lake or river through their urine and reproductive fluids. The VHS virus is absorbed into the gills of healthy fish and can remain infectious for up to 14 days in water. Healthy fish can also be infected when they eat diseased fish. Infected fish and water can easily spread the virus if they are released into a new lake or river. That's why emergency rules prohibit anglers, boaters and other water users from moving live fish and water from one body of water to another.

Can birds spread the virus?

We don't know yet whether the VHS strain found in the Great Lakes can be spread by birds, but the European strain cannot be transmitted through the feces of birds that eat infected fish — the virus is inactivated in the gastrointestinal tracts of birds. The European virus does appear to be transmitted on the feathers or feet of birds that are feeding on a pile of infected fish or sitting in water containing the virus.

What are the symptoms of a fish infected with VHS?

As with many fish diseases, symptoms vary with the severity of the infection. Fish may initially display few or no symptoms. As the infection worsens, signs may include bulging eyes, bloated abdomens, inactive or overactive behavior, or bleeding from the eyes, skin, gills and at the base of fins. Because many of these signs resemble those caused by other fish diseases, testing is necessary to determine whether a fish is infected with VHS.

What can provoke a VHS outbreak and will fishing restrictions be greater during these times?

Two important factors influence the severity of a VHS outbreak: water temperature and stress. The European strain of the virus grows best in fish when water temperatures range between 37-54°F and most infected fish die when water temperatures are between 37- 41°F. We do not yet know the critical temperature ranges for the Great Lakes strain of VHS. Freshwater drum and walleye have died when water temperature ranged from 66-70° F.

Any stressors, including poor water quality or lack of food, release the stress hormone, cortisol, which suppresses the fish's immune system. Additionally, other hormones related to spawning can also suppress the immune system. This may be why so many of the fish kills in the Great Lakes have occurred just before, during or right after the spawning period. If VHS is detected in a particular waterbody and a fish population appears to be in jeopardy, fisheries biologists will act to protect the fish populations.

Why do some VHS infected fish die and others don't?

The reasons are complex and unpredictable. In general, some species may be naturally more tolerant of VHS infection than others. If a population is already stressed from the factors listed above, more fish will die than if the population was not stressed. If fish are exposed to the virus when water temperatures are rising out of the range that allows the virus to reproduce, the number of virus particles in the fish will be lower. Therefore, the fish's immune system will produce antibodies that capture the virus and prevent it from damaging tissue.

Once a fish has produced VHS antibodies, it will be protected from future infection by the same virus strain for some time. This means that after the first disease outbreak occurs in a lake, the older, surviving fish will be protected. Younger fish will not have antibodies to the virus, so they will likely die at a higher rate when the next disease outbreak occurs.

What is the long-term outlook for VHS in the Great Lakes and state fish populations?

Fish that survive the infection will develop antibodies to the virus which will protect the fish against new VHS virus infections for some time. However, the concentration of antibodies in the fish will drop over time and the fish may start shedding the virus again, creating a cycle of fish kills that occurs on a regular basis. Nonetheless, experiences from other states indicate that fisheries can and have bounced back.

Can we vaccinate baitfish and stocked fish to protect them from this disease?

Although research is being done on vaccines to protect fish from VHS, there are no acceptable methods of vaccinations at this time.

Why are some of our local trout and catfish species considered vulnerable to VHS and others like brook trout and flathead cats are not?

Certain fish species are more vulnerable to VHS infection. The fact that some species are not on the list of susceptible fish species doesn't guarantee that they are not susceptible to the virus, only that VHS hasn't been detected in those fish.

ALISA LOPEZ

Fish are necropsied to look for hemorrhages and other signs of disease. The Great Lakes VHS strain infects fish of all ages, and many different species appear susceptible to this fatal ailment.

Does VHS threaten commercially caught fish like lake whitefish or chubs?

The Great Lakes strain of VHS was detected for the first time in lake whitefish from the Bay of Green Bay in May 2007. Currently, only a small percentage of fish are affected by the virus and it is too soon to tell what the effects will be on the lake whitefish population.

The Pacific Northwest strain of VHS is distinct from the one found in the Great Lakes. Pacific herring in Prince William Sound, Alaska first experienced disease outbreaks due to VHS in 1989. Since then, the population of Pacific herring has decreased in size and the commercial fishery for herring has closed in those areas.

Who bears the cost of testing for VHS?

Costs of VHS testing, fish collection, sample preparation, the purchase of radio and TV public service announcements, signs at boat landings, and brochures are paid by revenues from fishing license sales.

What are DNR researchers doing to locate infected waters and why can't all waters be checked immediately?

Based on what is known about disease distribution, the vast majority of waters are not considered to be infected. DNR biologists are testing suspicious fish from reported fish kills. Test results from a substantial number of inland lakes show the virus exists outside the Lake Winnebago system.

The testing period is confined to spring and fall because the virus typically does not replicate once water temperatures rise above 60°F. Testing conducted in the summer would therefore be inconclusive.

A long-term surveillance plan has been developed to provide information on the presence of VHS in Wisconsin waters. The Department of Natural Resources will test fish from what are classified as high risk waters. These waters are based on their proximity to the Winnebago system and whether they contain stocked fish originating from the Winnebago system. Since VHS is likely transported via boating activities, the high risk waters have a greater chance of being infected with VHS, based on the observed spread of zebra mussels which are transported by similar modes.

What is being done to prevent the spread of VHS through bait fish from dealers?

Wisconsin's Department of Agriculture, Trade and Consumer Protection regulates farm-raised bait fish more stringently than any other state. Any live fish on the APHIS (Animal and Plant Health Inspection Service) list of susceptible species moving out of Great Lakes states must test negative for VHS before they can be moved. All fish and eggs, wild harvested or farm-raised, and entering Wisconsin from states where VHS has been found, must test negative for VHS. If for any reason, inspectors suspect that farm-raised fish have been exposed to VHS, the farm will be quarantined and tested.

The Department of Natural Resources also now requires that anyone who harvests and sells minnows from the wild carry a free bait harvest permit and keep records of their bait collection and sale. This information will help fisheries officials trace new outbreaks of VHS.

How do I recognize that I am buying bait from a registered licensed bait dealer and why is that important?

Licensed bait dealers must keep their licenses available for inspectors at all times. Registered licensed bait dealers are required to keep records of all transactions in producing, buying and selling bait. This information can be an important tool for fisheries officials tracking down new cases of VHS.

GREG MATTHEWS

Buy bait fish from licensed dealers who track the sources of their stock. All fish and eggs sold as bait, whether harvested from the wild or farm-raised, must test negative for VHS before they can be sold.

Should I be as concerned about live bait like leeches, worms, grubs and hellgrammites as I am about bait fish?

No. Unlike bait fish, leeches, worms, grubs and hellgrammites cannot be infected with VHS. Therefore, there is less of a chance that VHS will be spread when using live bait other than bait fish. However, the bait listed above could carry and transmit the virus if it has been in contact with infected waters or fish. As a result, it is necessary to kill all bait fish, empty your live well or bucket, and dispose of other live baits on shore when you leave the water you're fishing.

Are there any rules related to VHS that I need to be aware of as an angler or boater?

Yes. The state Natural Resources Board has adopted emergency rules that prohibit anglers, boaters and other recreational users from moving water, live fish, including bait minnows, from the Lake Winnebago watershed, Great Lakes, Mississippi River, and those waters' tributaries up to the first dam impassable by fish. The rules also require that people fishing in those waters use minnows purchased only from Wisconsin licensed dealers, or, if harvesting their own minnows, that the bait is used only on the water in which it was caught. Dead fish, eggs, crayfish and frogs may only be used on the waters where they were captured.

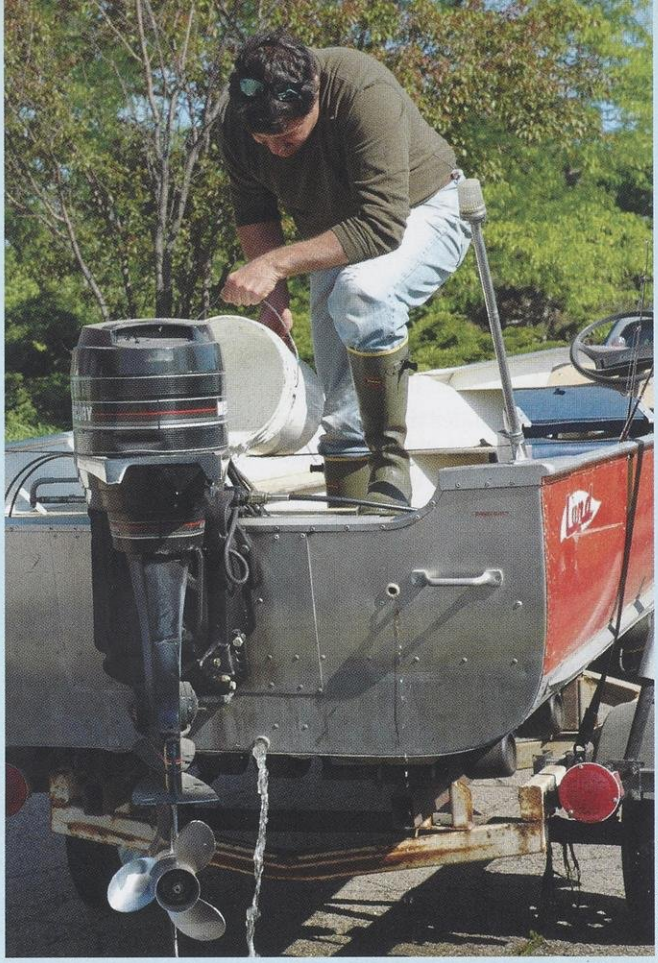
What can I do to help prevent the spread of VHS?

The DNR is asking the public to take precautions similar to those used in stopping the spread of invasive species:

- Put your catch on ice and do not move live fish (including unused bait minnows) away from the landing or shore.
- Drain all water from bilges, bait buckets, live wells and other containers when leaving the landing or shore.
- Use live minnows purchased only from registered bait dealers in Wisconsin or catch them yourself in the same water you fish.
- Before launching and reloading watercraft for the day, inspect and clean all watercraft for visible plants and animals. This advice applies equally to sailors, jet-skiers, rowers and anglers.

How do I disinfect my boat and equipment?

The Department of Natural Resources recommends that if you are spending time in VHS infected waters, disinfect personal protective gear, small equipment and the inside



GREG MATTHEWS

Boat trailers, sailboats, rowboats and fishing boats should be scrubbed clean, disinfected with bleach solution then rinsed with clean water before moving onto other lakes to stop disease spread. If VHS has been found in the water you are fishing, follow recommended cleanup steps and make that lake the last stop before disinfecting your gear and heading home.

and outside of larger equipment such as boats, trailers, live wells, bilges and pumps before entering another body of water. A solution of one-third cup chlorine bleach per five gallons of water can be used to properly disinfect these items. Follow these steps to help stop the spread of VHS:

- Remove all aquatic plants, animals and mud from your boat, trailer and equipment.
- Drain all water from your motor, live well, bilge, etc.
- Dispose of unwanted bait in the trash.
- Scrub or spray equipment with the disinfection solution and leave it wet for 10 minutes of contact time.
- Rinse all treated surfaces with clean water, or if you are going to a different lake on the same day, you can rinse the boat with water from the new lake before you launch. This is best done over gravel and away from the lake. Disinfection can also be done at home. It does not have to be done at the boat landing unless you plan to go to another lake immediately.

As a general practice, organize your schedule so that your time spent in infested waters is always your last stop before disinfecting your rig/gear and heading home.

What should I stock in my boat or vehicle to reduce the risk of VHS?

To properly disinfect your boat and equipment, it's recommended that you carry bleach, clean water if none is available on site, a sponge for scrubbing, bucket, gloves, eye protection and rain gear. DNR staff has also found it helpful to use a backpack sprayer filled with the prepared disinfection solution, which might be a safer and easier method than transporting and mixing disinfectants on site. Don't use sprayers formerly used to apply pesticides for this purpose. As a reminder, disinfection should be done away from the lake and is best done on gravel to prevent the solution from running into the lake, river or stream.

What should I do if I see a fish kill or diseased fish?

- Note the waterbody, date, fish species, and approximate number of dead/dying fish.
- If you caught a suspicious looking fish, place the fish in a plastic bag and then in a cooler on ice.
- Contact either your local fisheries biologist or call the DNR TIP line at 1-800-TIP-WDNR (1-800-847-9367).
- Please call first and please don't bring suspect fish into a DNR office or hatchery unless instructed to do so. DNR hatcheries operate under strict rules to prevent any disease from entering the hatchery.

How can I dispose of dead fish?

If you are a landowner with a few dead fish, the best action is to bury the fish under at least eight inches of dirt away from the water, or put the fish in a heavy duty plastic bag and dispose of it with trash that is headed to a landfill. Your municipality may have other requirements, so check with your waste hauler for specific instructions.

In the case of a lot of dead fish, locally available disposal options should be investigated and a plan developed. Dead infected fish may carry diseases that pose a risk to live fish, may host bacteria, attract vermin and promote other disease conditions. Land filling at a licensed municipal solid waste landfill may be the preferred option in many cases, in part because it is expeditious and sanitary. For further information, or to find a contact person to ask about solid waste disposal regulations in your county, call 1-608-266-2111 or visit: www.dnr.wi.gov/org/aw/wm/contacts/regions.htm.

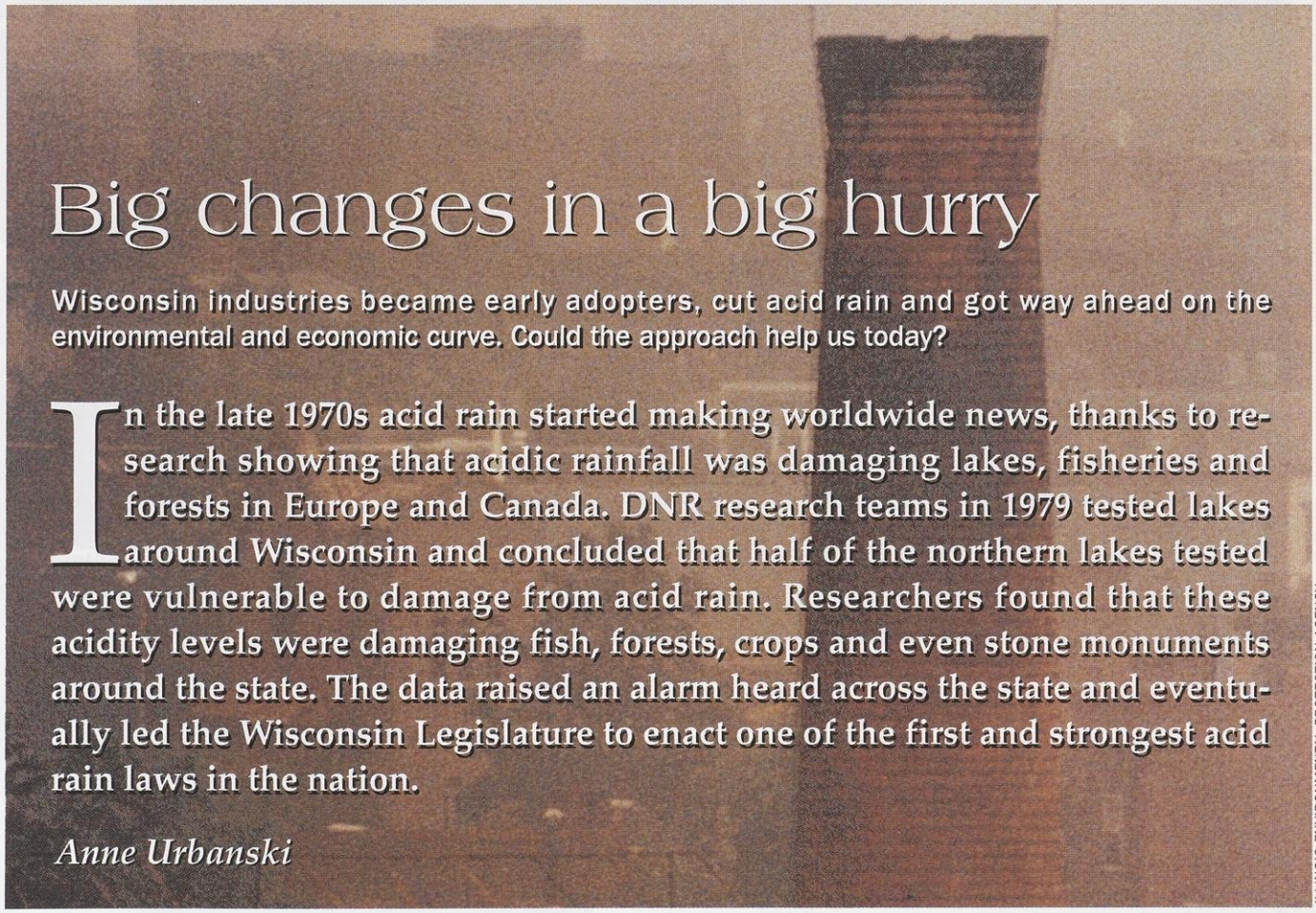
Where can I get updates on where VHS has been found?

You can visit the VHS website at www.dnr.wi.gov/fish/pages/vhs.html, contact DNR Service Centers or call the toll-free call center at 1-800-282-0367 or 1-608-266-2621 for information and updates.

Alisa Lopez is a communications specialist working with DNR's fisheries management program.

Creating the right atmosphere

APPROACHES THAT STAVED OFF ACID RAIN SET THE STAGE TO TACKLE TODAY'S AIR CHALLENGES.



Big changes in a big hurry

Wisconsin industries became early adopters, cut acid rain and got way ahead on the environmental and economic curve. Could the approach help us today?

In the late 1970s acid rain started making worldwide news, thanks to research showing that acidic rainfall was damaging lakes, fisheries and forests in Europe and Canada. DNR research teams in 1979 tested lakes around Wisconsin and concluded that half of the northern lakes tested were vulnerable to damage from acid rain. Researchers found that these acidity levels were damaging fish, forests, crops and even stone monuments around the state. The data raised an alarm heard across the state and eventually led the Wisconsin Legislature to enact one of the first and strongest acid rain laws in the nation.

Anne Urbanski

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Acid rain is caused primarily by emissions of sulfur dioxide and nitrogen oxides. Sulfur dioxide emissions come mostly from coal-fired power plants and pulp and paper mills. Nitrogen oxide emissions come mostly from coal-fired power plants, factories, motor vehicles and home furnaces. While in the air, sulfur dioxide and nitrogen oxides react with oxygen and moisture to form sulfuric acid, nitric acid and nitrous acid, which return to the land as precipitation through rain, snow or fog.

Wisconsin's acid rain law aimed to reverse the damage resulting from acid rain by aggressively limiting emissions of nitrogen oxides beginning in 1991 and sulfur dioxide beginning in 1993. The law passed in April 1986 and these goals were met:

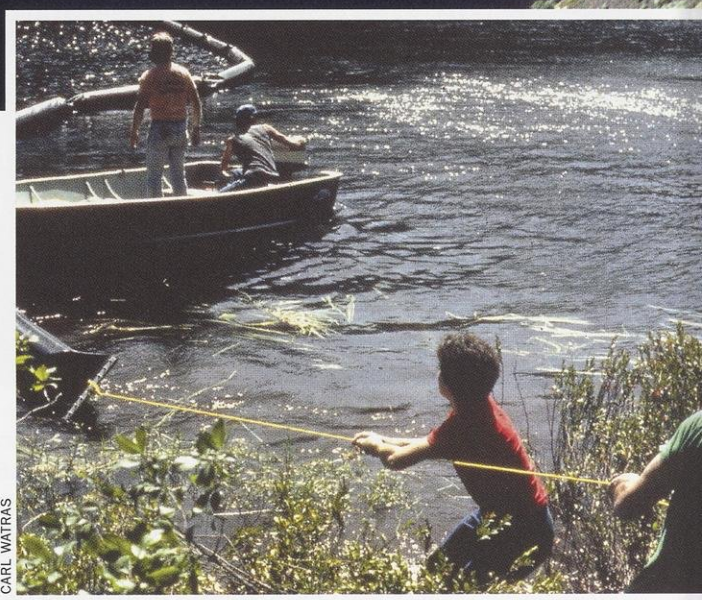
- Reduced acid rain and kept the pH of precipitation more neutral (at least 4.7) across Wisconsin.
- Created standards for nitrogen oxide and sulfur dioxide emissions from different sources.
- Required the state's five major electric utilities to reduce their sulfur dioxide emissions to 50 percent of 1980 levels by 1993.
- Capped annual emissions from the state's five major electric utilities at 250,000 tons of sulfur dioxide beginning in 1993, and 135,000 tons of nitrogen oxides beginning in 1991.
- Kept sulfur dioxide emissions from all large sources in Wisconsin below 75,000 tons per year.
- Reduced average sulfur dioxide emissions to 1.5 pounds per million BTUs of heat produced by plants owned by Wisconsin companies.

In just a few years, compliance with the state law brought noticeable improvements to Wisconsin's air and waters. By 1990 sulfur dioxide emissions from electric utilities had already fallen 46 percent. By 1992 these companies projected they would easily meet the law's mandates. During the subsequent 20 years, these changes at electric utilities helped reduce sulfur dioxide emissions by two-thirds compared to 1980 levels and improved the pH range to 4.78 in southeastern lakes and 5.29 in northwestern lakes.

Anne Urbanski communicates about emerging air issues, public health and policy for DNR's Air Management program.

Lessons from Little Rock Lake

COURTESY OF CARL WATRAS



CARL WATRAS

In a 1983 experiment, researchers divided Little Rock Lake in Vilas County with a plastic barrier (RIGHT) and acidified the bottom lobe of the lake to simulate how acid rain might change lake chemistry and biology. The research showed that small seepage lakes in northern Wisconsin are very susceptible to damage as acidic rainfall and snowmelt alter water clarity, algae growth, fish growth rates, and cause more subtle changes to aquatic food chains and water chemistry. When acidic conditions were neutralized six years later, the lake slowly returned to its natural state. Continuous research for more than 25 years has studied how acid rain changes lakes and how conditions abate when acid precipitation is reduced.

An acid rain experiment on a small Wisconsin lake almost 25 years ago continues to teach us about consequences of air pollution, energy use and growth.

Carl Watras and Ken Morrison

Northern Wisconsin's pristine waters are valued for providing recreational enjoyment for people and critical habitat for wild species. For example, the Northern Highland/American Legion State Forest (NHAL) in Vilas, Oneida and Iron counties has more than 900 lakes and 300 miles of streams within the 225,000-acre forest. Many of these lakes are protected from the pressures development can bring, but they are still subject to other environmental stresses. About 25 years ago consequences from the long-range drifting of atmospheric pollutants raised concerns about acid rain, soon followed by concerns about mercury deposition and climate change.

The Little Rock Lake experiment attracted international interest. Here Swedish scientists joined Wisconsin colleagues in examining how airborne mercury pollution settles in lakes and more readily moves into food chains as lakes acidify.

CARL WATRAS

Long-term research on one NHAL lake continues to provide insight into the consequences of atmospheric pollution. Research on Little Rock Lake began in 1983, three years before Wisconsin's landmark legislation on acid rain was signed into law by then-Governor Tony Earl. The research has continued for 24 years, providing the longest record of environmental responses to acid rain, mercury rain and climate change for any lake in the world. We'd like to share some of the lessons learned from this research that suggest ways to preserve the quality of our northern waters.

A simple yet revealing experiment

Little Rock Lake is a small, clear-water lake that sustains a warmwater fishery of yellow perch and largemouth bass. It is located in Vilas County about three miles southwest of the UW Trout Lake Research Station. Like most Vilas County lakes, Little Rock is a seepage lake, where no streams enter or drain the waterway. More than 98 percent of the lake's water comes from rainfall and snowmelt, so Little Rock is highly sensitive to atmospheric pollutants. Its shape also makes it an ideal water to study and simulate how such lakes respond to acid rain: The 45-acre lake naturally forms two lobes with a narrows between the two segments.

The original experimental design was simple but elegant. The two lobes were divided by stretching a flexible, impermeable barrier across the narrows. The plastic dividing curtain had floats on the top and was anchored on the bottom to form an effective barrier. Initially, the divided basins were monitored to ensure that the barrier itself had no effect on water quality or aquatic communities. Then one basin would be gradually acidified using small doses of sulfuric acid to simulate increasing acidic deposition. The other basin (the reference basin) remained untreated as a reference to measure the variable effects of weather.

Water quality, plankton, bottom-dwelling organisms, fish, and the natural biological, geological and chemical cycles would be monitored continuously in both basins as the treated basin was gradually acidified. The experimental effects were then compared to conditions in other lakes where acid rain impacts were suspected. The acidification phase of the experiment was planned to run for six years, after which acidification would stop. Then recovery of the treated basin would be monitored to determine whether lakes would return to their natural state if acid rain abated.

Scientists and students involved in the experiment had to make difficult career decisions. Final results would not be known for at least a decade, and the interim results were highly uncertain. But these concerns were quickly assuaged after the first two years of acid addition, because adding even very small amounts of acid brought about substantial changes to lake chemistry and biology. The lake was much more sensitive to acid rain than anyone had suspected.

Among the more obvious responses was increased water clarity, consistent with observations by scientists in the northeastern U.S., Canada and Sweden who had reported that where acid rain fell, lakes that had previously supported healthy fisheries became clear and fishless. The scientists suspected acid rain might be the culprit. In Little Rock Lake, clearer water allowed dense green algae growth on the lake bottom. Acidification also slowed fish growth rates. By the end of the acidification, largemouth bass were unable to reproduce successfully; eggs were laid, but they failed to hatch. The bass population got older and, on average, the fish got bigger because no young bass were being added to the population. This result was also consistent with observations in other regions where acid deposition was high. For a while, fishing was very good, and then the fish disappeared altogether.

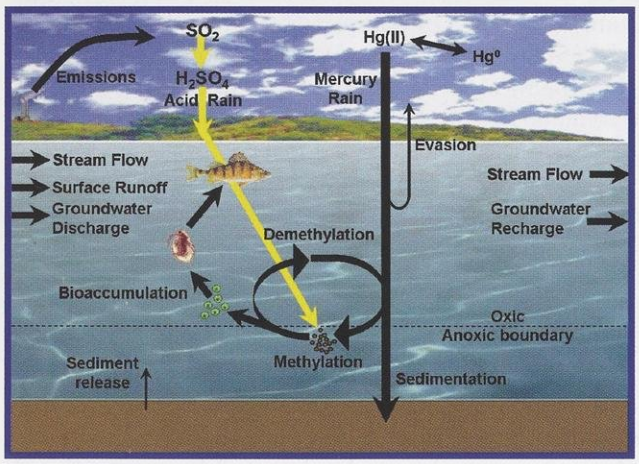
Another early response was increased mercury contamination in fish in the treated area. Mercury investigations were not included in the original design, but supplementary studies showed that mercury concentrations in perch from the treated basin were higher than in perch from the reference basin. This finding led to a comprehensive study of mercury cycling in Little Rock Lake and to potential links between acid rain and mercury contamination in Wisconsin lakes.

The mercury studies required new sampling and analytical methods. Concentrations of mercury and methylmercury (the chemical form that accumulates in aquatic food webs) were too low to be detected by conventional techniques. Sample contamination was a major problem. Scientists needed to wear special "clean" suits that were free of lint and dust in the field and lab. All containers and reagents needed to be scrupulously free of mercury. Highly sensitive analytical techniques needed to be developed as well. It took several years to make these advances, but by the late 1980s the fundamental aspects of the aquatic mercury cycle had been worked out — the first time for any pristine lake in North America.

We learned that rainfall is the principal source of mercury to northern Wisconsin lakes and their watersheds. After entering lake water, atmospheric mercury escapes back to the atmosphere as a gas, becomes buried in sediments, or is converted to methylmercury by certain bacteria. Methylmercury is passed up the food chain where it poses health risks to animals that eat fish, including humans. Along the chain from water to fish, the concentration of methylmercury can increase 10 million-fold. This phenomenon is called biomagnification, and

methylmercury is one of the few toxic substances known to biomagnify in nature.

When sulfuric acid was added to the treated basin, it stimulated the growth of methylating bacteria that inhabit the bottom waters of the lake. These sulfate-reducing bacteria inadvertently produce methylmercury as a by-product of their growth. So during acidification, methylmercury production increased. As the lake de-acidified, these bacteria also declined and methylmercury production decreased again. The fish tipped back and forth between being more contaminated and less contaminated as conditions changed over the course of a few years.



COURTESY OF CARL WATRAS

Over years, the research sorted out and explained complicated interactions as bacteria reduced acids and converted mercury into a form that moved up food chains. Water chemistry, bacteria, insect life, plant life, fish and physical conditions continue to be monitored to look for long-term lessons from acid rain, other contaminants and, perhaps, climate change.

As the treated basin recovered, scientists unexpectedly observed that methylmercury levels declined in the reference basin too. Researchers discovered the reference basin was responding to the effects of cleaner air, as both mercury and acid rain levels have declined substantially over the past 10 to 25 years. The decline in mercury may be due to less commercial and industrial use of mercury in products such as paint, batteries and electrical switches.

Same lake, different dilemma

Regional reductions in acid rain and mercury rain lowered mercury levels in the water and fish of Little Rock Lake as well as across the board in other northern lakes. However, there is new evidence that the unexpected declines may have suddenly reversed in Little Rock Lake for another unanticipated reason. In the year 2000, scientists were surprised by data that hinted that the lake was becoming more acidic again. The concentration of sulfate in both basins was rising, pH was falling, and the concentration of methylmercury was rising too. Notably, the reversals were occurring despite continued declines in acid rain and mercury rain.

Further monitoring suggests that climate change may be driving the re-acidification of Little Rock Lake and, perhaps, other lakes in the region. Climate change is predicted to have several environmental consequences in northern Wisconsin. In addition to warmer average temperatures, seasonal precipitation patterns may shift, with more precipitation coming in the winter and less in the summer. Less rain in summer, paired with increased evaporation caused by warmer temperatures, could trigger more severe summer droughts and lower water levels in northern Wisconsin lakes.

The reversals observed in Little Rock Lake coincided with an extended period of low water in NHAL lakes. Water levels began to decline in 1998 and remain very low. Studies in Canada document what might be called an "acid drought effect" — a phenomenon whereby sulfate that had been reduced by bacteria is re-oxidized when shallow sediments are exposed to air during drought. Following heavy rain or spring melt, sulfuric acid is regenerated and washes back into the lake. In Little Rock Lake, re-acidification and an increase in methylmercury began about 1999 — one year after the onset of drought conditions.

Future effects of climate change and other human activity remain uncertain for the NHAL lakes. To document these changes, Little Rock Lake has been designated as one of three "sentinel lakes" in the region that will be monitored quarterly to compare their behavior to changes in weather and atmospheric deposition over five- to ten-year periods.

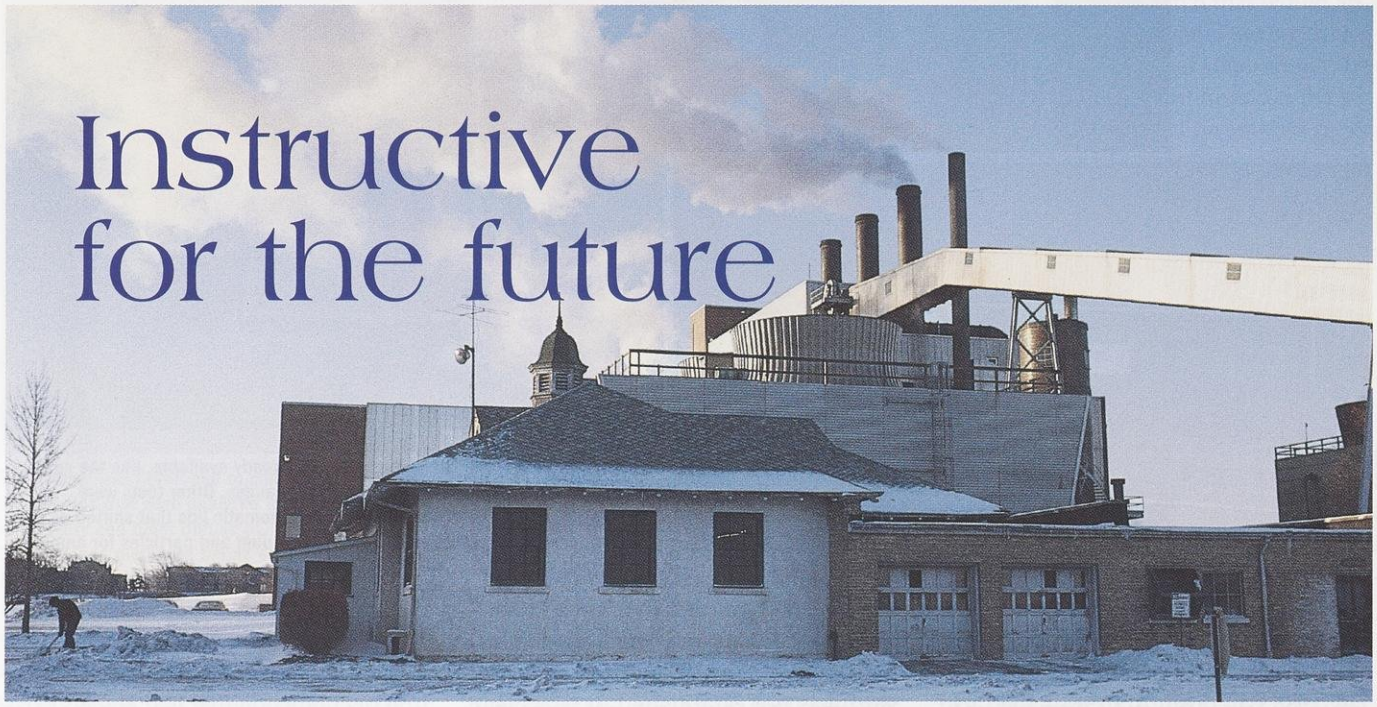
In addition to climatic change, there is growing concern that acid rain and mercury rain levels may increase relatively soon. To meet the anticipated demand for electric power, roughly 150 new coal-burning power plants may be constructed in the United States over the next decade. Several coal-burning facilities are either under construction or planned for Wisconsin and many more in neighboring states. Although new power plants generally employ cleaner technologies than older plants, a net increase in the emission of greenhouse gases, sulfur dioxide and mercury is likely unless older power plants are retired or upgraded.

Research results from Little Rock Lake illustrate that freshwater ecosystems can respond to environmental changes in unexpected but explainable ways. They show that one key to understanding environmental change is long-term monitoring. In the coming years, Wisconsin DNR scientists and their colleagues will continue following the status of Little Rock Lake and the other sentinel lakes of northern Wisconsin.

Carl Watras and Ken Morrison are lake researchers with DNR's Science Bureau and the UW-Madison Center for Limnology at the Trout Lake Research Station in Boulder Junction.

ACKNOWLEDGEMENTS: Research on Little Rock Lake has been supported by funds from the U.S. EPA, U.S. National Science Foundation, the Electric Power Research Institute, the Lake Superior Basin Trust, the Potawatomi Community of Forest County, and the Wisconsin Department of Natural Resources. These acid rain experiments were jointly conceived by DNR scientists and the UW-Madison Center for Limnology. They reached out to researchers from other UW campuses, the University of Minnesota and the U.S. Geological Survey to form the primary research team. Over the ensuing 24 years, hundreds of students and scientists from around the world have participated in studies on the lake.

Instructive for the future



DEAN TVEDT

Particle emissions from an industry in the 1970s. Historically, smokestack emissions, particularly from coal burning to generate electricity throughout northeastern states, contributed to acid precipitation across a wide region. Leadership from the utilities association, the Public Service Commission and the Department of Natural Resources directed research, studied the problem and developed an action plan to reduce acid rain in Wisconsin. The work was financed through small surcharges on utility customers. Could that model work now to address air contaminants like fine particles shown above or carbon dioxide emissions that contribute to changing climate?

Can Wisconsin's approach to tackling a borderless environmental problem in the '70s be applied to the needs of a new century?

Jon Heinrich

As the debate on climate change continues to rage, it's worthwhile to revisit a problem that was the global warming of its era. In the 1970s, the presence of "acid rain" and its effect on surface waters was a matter much disputed and even denied in some quarters, particularly in Washington, D.C.

Studies initiated by the Wisconsin DNR at the time indicated rainfall in the state was highly acidic, and that lakes in northern Wisconsin were changing in response to the increased acidity. Wisconsin began a program of requiring meaningful reductions in smokestack emissions from electric utilities and industries more than four years ahead of the federal 1990 Clean Air Act amendments to control acid deposition. Wisconsin's willingness to learn and to act made the state an acknowledged national leader in emerging air quality issues back in the '70s and '80s.

Wisconsin acts with Act 296

Lack of action at the federal level compelled the DNR air program to document the acid rain problem in the upper Great Lakes and take action to address it. While the Reagan administration stood firm against taking any initiative on acid rain, Wisconsin established the Acid Deposition Research Council to direct basic research. Findings showed lakes in northern Wisconsin had been adversely affected by acid rain. Despite this evidence, there was still resistance to adopting state requirements to reduce smokestack emissions.

The decision of a blue ribbon panel appointed by Governor Tony Earl broke the deadlock. The panel, whose members included DNR Secretary C.D. Besadny, William Keepers of the Wisconsin Utilities Association, and Mary Lou Munts, Chair of the Public Service Commission, concluded that Wisconsin electric utilities were contributing to the acid rain problem in Wisconsin and that state action was appropriate. The decision was a major victory in the national fight to get action started at a federal level because it showed that acid rain

ROBERT QUEEN

BRUCE RODGER

Some of the acid rain test equipment was already available, like the sulfur dioxide analyzer to the left and simple rain gauges. Other tools were invented to match the need. Buckets with automatic lids that shifted as the weather changed caught samples of rainfall, dust and particles for analysis.

was also a problem in areas beyond the northeast United States and Canada. On April 22, 1986 Governor Earl signed into law 1985 Wisconsin Act 296 — the "acid rain law."

Wisconsin's acid rain law set targets, goals and timetables for reductions in emissions of sulfur dioxide and nitrogen oxides. It provided funding for research and studies to identify economical means of achieving emission reductions. When the federal Clean Air Act was amended in 1990 it contained emission trading and capping provisions similar to those pioneered in Wisconsin Act 296.

As a result of the state law and the subsequent federal requirements, we've achieved the primary goal of reducing the acidity of rainfall in the state. Rain has a normal acidity of pH 5.0 to pH 6.0. In the early '80s, rainfall ranged from pH 4.4 in southeastern Wisconsin to pH 4.8 in northwestern Wisconsin. In 2005, rainfall ranged from pH 4.8 in the southeast to pH 5.3 in the northwest. The reduction in sulfur dioxide emissions by major electric utilities has certainly contributed to this improvement. Sulfur dioxide emissions from coal-fired power plants operated by the major utilities in Wisconsin have been reduced 67 percent below 1980 levels, from 506,954 tons to 168,633 tons in 2005.

We were successful thanks to public support, cooperation among key stakeholders, and the willingness of government to invest in the research necessary to determine the extent of an environmental problem and its likely causes. Although a definitive causal relationship was not established, it was clear that the coal burned by industry and the electric utilities was the principal contributor to acid deposition in the state. Armed with that knowledge, it made sense to take prompt action rather than wait for federal regulation to catch up with the facts. Wisconsin's proactive stance had economic as well as environmental benefits: Because our electric utilities had already begun to reduce their emissions, they were in a good position to take advantage of the national emission trading program established in the 1990 amendments to the Clean Air Act.

Acid or alkali?

Chemists use a pH test to determine a solution's relative acidity or alkalinity. This test measures the concentration of hydrogen ions in the solution, and ranks the solution's acidity/alkalinity on a scale from 0 to 14. A pH value of 1 is very acidic (like battery acid), while a pH value of 14 is very alkaline (like lye). A pH value of 7 is neutral, like distilled water. The pH scale is logarithmic, which means that pH 6 is 10 times more acid than pH 7, and pH 5 is 100 times more acid than pH 7.

National paralysis

There was little movement nationally on acid rain during the time Wisconsin was developing requirements to address acid deposition. Industry argued that natural factors rather than fossil fuel combustion caused acid rain, and insisted that natural sources of sulfur dioxide and nitrogen oxides were a significant part of the acid rain problem. Those opposed to reducing emissions from coal combustion portrayed acid rain as a natural phenomenon that had always existed. Industries argued that no action should be taken because no one could pinpoint the sources of acid rain or trace lake acidification back to emissions from specific stacks. The U.S. Environmental Protection Agency (EPA) supported this view by concluding that it was not possible to distinguish between the amount of acidification that was manmade and the amount that was caused naturally. Those opposed to action had a litany of arguments that were modified over time, passing from *"There may be a problem, but it has always been there"* to *"We don't know what causes the problem"* to *"We don't know how to act"* and finally *"Even if we acted, it would not help."*

The energy crisis of the '70s was still fresh in our minds in the early '80s and contributed to the national inertia on acid rain. With a nation dependent on foreign oil supplies, the Carter administration initiated actions such as converting power plants

ROBERT QUEEN

Technology was developed to collect water and air samples that were analyzed for tiny amounts of mercury and other diffuse pollutants that traveled long distances before settling out of the wind and clouds.

from cleaner burning fuel oil to coal. The memory of the "oil shocks" slowed down the speed at which the federal government required emission reductions from coal-fired power plants.

During the debate on acid rain, EPA damaged its credibility and politicized its role. The agency did not reflect the opinions of a majority of the scientific community, which had called for reducing sulfur dioxide and nitrogen oxide emissions from coal-fired power plants. A 1981 National Academy of Sciences report recommended a 50 percent reduction in the acidity of rainfall and snowmelt in the northeastern U.S. to protect lakes and forests. "Scientific uncertainty" was the official EPA explanation for the lack of federal response. Kathleen Bennett, EPA's air pollution control chief, stated that "scientific uncertainties in the causes and effects of acid rain demand that we proceed cautiously and avoid premature action."

In 1982, Bennett appeared at a Senate Energy Committee hearing and stated "There is no good measure of when acidity in rain should be considered detrimental...hence at this point; there is no clear reference for developing a remedial program." In 1984 the Reagan administration called for more research before regulation, even after the negative effects of acid rain were widely conceded and the National Academy of Sciences concluded that acid rain could be addressed effectively through sulfur dioxide emission reductions from coal-burning power plants in the eastern U.S.

Eventually EPA and the U.S. Congress did act, by including a comprehensive national program to reduce the emissions that cause acid rain in the 1990 amendments to the Clean Air Act. Adopting a nationwide approach to address acid rain was a watershed event for air quality management in the U.S. For the first time, those responsible for emissions in upwind states that caused problems in downwind states were required to clean up the air we all share.

What worked well

Wisconsin's actions to address acid rain were based on research supported and conducted in-state. The undoing of the scientific approach on a national level did not hinder Wisconsin from addressing a serious environmental issue, even though we understood that our action alone would not entirely eliminate acid rain from falling in our lakes.

The members of the blue ribbon panel representing industry, ratepayers and the environment accepted the responsibility to develop recommendations to resolve the issues. These leaders showed a commitment to solving the problem. The Department of Natural Resources agreed to do the research that would answer questions; the panel agreed to let the science dictate what steps should be taken; and government financed the research through small payments from every residential energy user.

It's a model we can use to confront the difficult air quality problems we face today. When the acid rain debate was undertaken in Wisconsin and the rest of the nation, the issue of the long-range transport of air pollutants across state and national borders was just emerging. Now other serious pollution transport issues like mercury contamination, ground-level ozone and fine particulates, and the very large elephant in the room — "climate change" — must be tackled.

The questions we faced then apply to the issues we face now: Who is responsible? Who should bear the costs? What role should Wisconsin play in addressing regional, national and global air quality issues? Reflecting on what worked with acid rain years ago will help Wisconsin deal with the air quality issues we face now and in the future.

Jon Heinrich recently retired after 33 years with DNR's Air Management program. Heinrich supervised the development of many air quality programs, including efforts to contain ozone, sulfur dioxide, hazardous substances and mercury emissions.

Lasting benefits from the way Wisconsin addressed acid rain

- ❍ Dramatically reduced sulfur dioxide and nitrogen oxide emissions while reducing rainfall acidity.
- ❍ Increased the credibility of using Wisconsin-specific research to drive regulations.
- ❍ Showed a willingness to invest in research to determine the extent of air pollution problems.
- ❍ Recognized that air pollution does not have borders and that local emissions contribute to regional air pollution.
- ❍ Increased support for regional solutions to air quality problems.
- ❍ Set cleanup targets, then provided flexibility to meet those goals.
- ❍ Spurred interest in voluntary programs and "green" solutions by business partners.
- ❍ Showed the benefits of convening a balanced panel of business, environmental and legislative leaders committed to resolving an environmental/health problem.
- ❍ Fostered a partnership with weather service professionals on air quality and health reporting.
- ❍ Brought together the Lake Michigan Air Directors Consortium (LADCO) — Illinois, Wisconsin, Indiana and Michigan — to work together for over 27 years; and added Ohio to regional air quality efforts starting in 2004.
- ❍ Proved the economic benefits of taking state action ahead of the federal government that allows us to tailor solutions to Wisconsin businesses and industries.

— *Anne Bogar, DNR Air Management*

Air apparent

DNR PHOTO

Images captured on an automated haze camera or "haze cam" in Milwaukee show that we are still challenged to reduce air pollution that can travel long distances over wide regions. The combination of pollution and weather conditions contribute to ozone, haze and fine particles that cause health concerns prompting air quality watches and warnings some days.

DNR PHOTO

Forecasting air issues

Natasha Kassulke

Recent scientific evidence suggests efforts 30 years ago are not enough to protect public health and the environment, and the acid rain story is far from over.

A report by the Intergovernmental Panel on Climate Change (IPCC), "Impacts, Adaptation and Vulnerability," emphasizes that global warming is already having worldwide effects and predicts regional impacts if temperatures continue to rise.

According to IPCC findings, for each degree of global warming, the earth will experience more wildfires, coral bleaching, flooding and storm damage. A rise of more than five degrees Fahrenheit in average temperatures would result in water shortages for up to 3.2 billion people, 20 percent of the global population would be directly affected by flooding, and three to eight times more heat waves would occur in some cities.

Key findings of a Wisconsin Public Interest Research Group Foundation report, "An Unfamiliar State, How Global Warming Could Change Natural Wisconsin," concluded:

- The Great Lakes would likely be smaller, shallower and less able to sustain healthy populations of aquatic life.
- Wisconsin habitats of several key tree species — balsam fir, paper birch, white spruce, jack pine and red pine — would likely be reduced.
- Popular winter pastimes such as ice fishing and snowmobiling would have much shorter seasons.
- Hunting and fishing opportunities might change as populations of several game birds shift northward and coldwater fish, such as brook and brown trout, lose habitat.
- Drought and heat stress would reduce cattle vigor and dairy herd milk production.

"Climate change impacts are already occurring in Wisconsin," says Dr. John Magnuson, UW Madison Emeritus Professor of Zoology and Limnology. Reduced ice cover on lakes is a visible signal of warming especially during the last 35 years. Increases in runoff and associated algal growth and shoreland flooding from extreme rain events over the last hundred years are expected to continue increasing through this century.

There is broad scientific consensus that carbon dioxide and greenhouse gas emissions in the United States must be reduced at least 15 to 20 percent by 2020 and 80 percent by 2050 to prevent the worst impacts of global warming. While Congress considers action, some states have already established emission reduction plans. California enacted the nation's first statewide cap on global warming pollution. Wisconsin has joined over 30 states to form a national registry to track greenhouse gas emissions. Some states are also turning to alternative biofuels produced from ethanol, switchgrass and woody biomass.

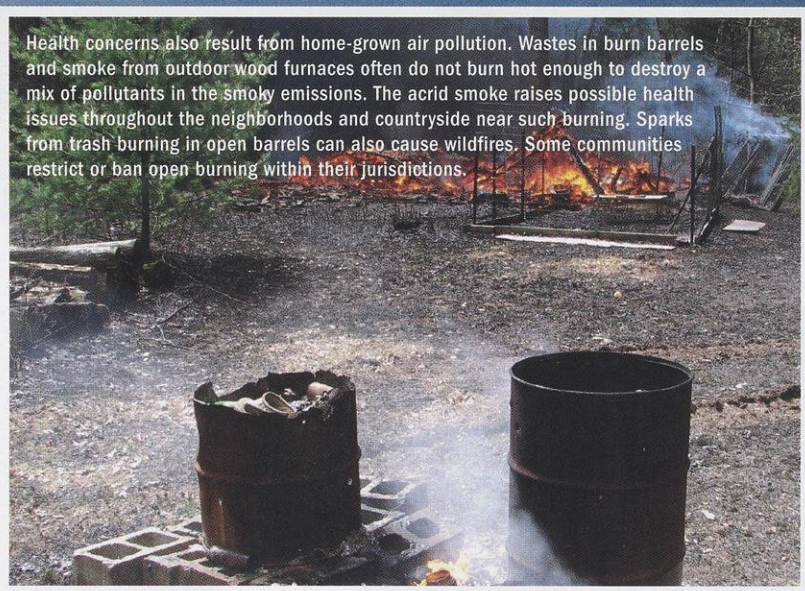
The state's "bioeconomy" includes a Declaration of Energy Independence that sets three broad goals:

- To generate 25 percent of our electricity and 25 percent of our transportation fuel from renewable fuels by 2025.
- To capture 10 percent of the market share to produce renewable energy sources.
- To become a national leader in research that makes alternative energies more available and affordable.

Mercury reductions

"Controlling mercury emissions is vital in protecting Wisconsin's environment and public health," says Al Shea, DNR Air and Waste Division administrator.

Citizen interest in controlling mercury remains high. The federal government adopted mercury rules for electric utilities that warrant changes to Wisconsin's existing rules. The nature of those changes remains controversial. The federal rules would reduce mercury about 70 percent by 2018 — not really more stringent than Wisconsin's existing mer-



Health concerns also result from home-grown air pollution. Wastes in burn barrels and smoke from outdoor wood furnaces often do not burn hot enough to destroy a mix of pollutants in the smoky emissions. The acrid smoke raises possible health issues throughout the neighborhoods and countryside near such burning. Sparks from trash burning in open barrels can also cause wildfires. Some communities restrict or ban open burning within their jurisdictions.

JONATHAN STONE

cury rule. Industrial and electric utility groups strongly favor adopting federal rules without change. "I believe that they have a legal and political commitment for that," says Kevin Kessler, DNR air management bureau director.

Environmental groups, on the other hand, petitioned the Department of Natural Resources earlier this year to reduce mercury emissions by 90 percent by 2012 and to reject the federal "cap and trade" program that would allow electric utilities to buy credits from other utilities instead of making the reductions at their own plants.

Stay tuned. The economic, political, environmental and public health stakes regarding Wisconsin's mercury rules are high. Mercury emissions remain an issue needing the same type of scientific and political consensus that was reached on acid rain in the 1980s.

Other contaminants

Unfortunately, mercury is just one air contaminant challenge facing the state. The EPA adopted a new health-based standard last year for fine particulate matter, which several of our most populous counties don't currently meet. Official designations of these non-attainment areas and new regulations to address particulate matter are forthcoming.

Wisconsin and our neighboring states have made great strides on ozone during the past two decades. In fact, in June 2007, Wisconsin asked the EPA to designate eight counties as having reached attainment status for ozone. At the same time, new studies have found that ozone presents a greater health hazard than was previously recognized. Under court order, the EPA will issue more stringent ozone standards that will likely put some of our counties back in non-attainment and require more emissions controls.

The federal Clean Air Act also requires states to reduce haze and improve visibility. Reasonable progress toward that goal will be submitted to the EPA in late 2007.

Educating about options

Education continues to be an important goal to instill air pollution awareness, Kessler says. Communication strategies include school programs like "Easy Breathers" and "Air Defenders" as well as messages for adults that encourage using mass transit when commuting. Environmentally responsible driving also can cut exhaust emissions, reduce fuel use and save money.

Open burning of home garbage remains a concern and this low-temperature burning at ground level remains the number one dioxin threat to aquatic organisms. Burning solid waste materials such as treated wood, plastic, household garbage and most other trash is prohibited statewide; local ordinances may be more stringent.

Outdoor wood-fired boilers and furnaces are also becoming more popular and causing local air concerns. Wood smoke causes particle pollution and emits toxics at the low burning temperatures in these boilers. DNR has neither the authority nor funding to address the problem. As a result, this air pollution issue is largely handled by local governments. Some communities have enacted ordinances that prohibit or control burning and wood boilers within their jurisdictions.

Future resources

The air pollution challenges are greater than ever, but will the funding that is needed to continue and build on these efforts keep pace? The picture is not bright according to Kessler.

"Reductions in state and federal funding for our state air pollution program are compounded by the constraints in how we use our funding," Kessler says. "We don't have the discretion to address DNR's highest priorities and it's critical to work with our stakeholders to resolve funding issues."

Monitoring equipment that is aging is used to continue baseline sampling and identify problems early on. The Department of Natural Resources has had to reduce the number of air quality monitors and hasn't been able to replace obsolete equipment. People demand information online and in real-time. Operating within funding constraints, the state's air program continues to consolidate sites, increase automation, eliminate redundancies, upgrade to higher sensitivity monitors for reactive nitrogen and carbon monoxide, and enhance the air toxics monitoring network. But it's not cheap.

"Ironically, budgetary problems have arisen as a result of Wisconsin's air quality monitoring success," Kessler says. "Emissions are dropping yet our fees are tied to emission amounts, so success means we have less and less money to do regular local inspections and to monitor air quality. It's the price of success."

The last 30 years saw significant progress in air quality improvement, but the next 30 years will be equally important. The DNR's air management program will build on the acid rain partnership model and lessons that were learned.

"There are a lot of challenges, but also a lot of potential to make important and necessary changes in Wisconsin's air quality," Kessler says.

Natasha Kassulke is creative products manager for Wisconsin Natural Resources.

Looking for clear

A HOST OF APPROACHES OFFER PRACTICAL WAYS TO CLEAN UP THE AIR.

KRISTINA TEETER, AMERICAN LUNG ASSOCIATION OF THE UPPER MIDWEST

Medical clinics, local health advocates and family doctors are important partners in helping people understand the direct links between air pollutants and community health. Young and elderly patients whose lung tissue is more fragile, are especially susceptible to smaller amounts of air pollution.

Reach people close to home

Outreach through businesses, neighborhoods, health clinics and the airwaves keep people informed.

Anne Bogar

TV meteorologists, insurance company managers, allergists, computer programmers and social workers are just a few of an expanded network of partners conveying air quality information so the public can make informed choices to protect their health. While more than 3,000 substances have been measured in the air, we regulate about 500, and there are outdoor air quality standards for only six. We need the expertise and the contacts through all of our partners to share what we know and what we need to know about the health effects of air pollution. Today, our partners help clean the air in ways we could only imagine when we first started talking about acid rain a few decades ago.

Allergists, pulmunologists, family practice doctors, school-based clinics and school nurses are now all explaining the links between pollution and respiratory health. DNR educators work with the American Lung Association, Fight Asthma Milwaukee and the Partners for Clean Air Health Committee to develop and distribute information to over 275 clinics and doctors in southeast Wisconsin where pollution concerns are concentrated. We try to keep the message simple. Tear-off sheets similar to prescription pads share the gist of health information at medical office displays. Each clinic also gets cover letters, posters and pamphlets to share with patients in their native languages. Evaluation forms provide feedback aiming to refine the message for each community.

Working closely with the National Weather Service and broadcast meteorologists, the DNR issues air quality watches and advisories when air pollutant concentrations rise. "Watches" are issued when unhealthy levels of pollution that can affect those most sensitive (older adults, children and those with heart or lung disease) are predicted for the next day. During watches, individuals are encouraged to take actions to reduce emissions by limiting car trips, delaying grass cutting and docking their watercraft. "Advisories" are issued when air pollution concentrations reach or exceed unhealthy levels for sensitive groups. The Weather Service and forecasters increase public awareness and explain the link between weather and air quality. They show people how air pollution can move in large masses like storms and how air pollution has no borders, crossing community boundaries, city limits and vast expanses hundreds or thousands of miles away.

Businesses, government offices, schools, medical facilities and health organizations spread the word by sponsoring programs to discuss air quality health effects. Large employers in southeast Wisconsin were original members of the Wisconsin Partners for Clean Air and Ozone Action Days. Since 1995, the group has grown to more than 250 Wisconsin Partners who take voluntary actions to improve air quality. Many partners notify employees on air quality watch days and provide incentives to carpool, bus, walk or bike to work while reducing emissions at the worksite. In recent years, partners programs have expanded to Dane, Jefferson, Fond du Lac and Winnebago counties.

In one of the longer running programs, DNR staff cooperate with the Sixteenth Street Health Clinic in Milwaukee to help people make the connection between respiratory illness and poor air quality. It's part of a larger environmental health project focusing on adults and children in the culturally diverse community on Milwaukee's south side, targeting Hispanics, Southeast Asians and African Americans.

KRISTINA TEETER, AMERICAN LUNG ASSOCIATION OF THE UPPER MIDWEST

Physicians now test children starting at an early age to gauge lung capacity and susceptibility to air pollution. Simple tests like blowing a pinwheel can give early signals of a child's stamina for outdoor play.

To get the big picture of regional pollution, hazecams show current video of air visibility taken from rooftops and overviews at various panoramic locations. Hazy days are often caused by a mix of pollutants we can and cannot see. The hazecams update camera images every 15 minutes around the clock and are displayed with current air quality and meteorological data. The Midwest Hazecam network (www.mwhazecam.net) includes sites in Chicago, Ill.; Cincinnati, Ohio; Grand Portage and St. Paul, Minn.; Sault Ste. Marie and Seney Wildlife Refuge, Mich. and St. Louis, Mo. Funding for additional sites, including one in Milwaukee, was lost in the past year.

The acid rain control program developed more than 20 years ago helped forge the way to look for innovative solutions to air pollution problems. It emphasized relying on research and looking beyond our borders. The partners we work with today continue to pursue innovative ways to regulate air pollution and educate the public about air quality and their health. Our best solutions come from working together.

— *Anne Bogar coordinates community outreach programs for DNR's air management program.*

Give companies breathing room

Agree on goals and trust firms to innovate to reach them.

Mark McDermid

Companies are finding that a little bit of flexibility, better understanding of their business needs, some community involvement and a little public recognition provide a potent combination that can profitably reduce environmental risks. They understand that managing costs while meeting environmental standards is just one more challenge in remaining competitive and profitable while protecting both corporate and community interests.

In a more typical approach, it can take years to set the standards that businesses and communities must meet to comply with environmental laws. It would be preferable to tap the business potential to respond quickly and develop innovative solutions. The Environmental Cooperation Pilot Program and Green Tier provide a legal framework to challenge businesses to look at a full range of environmental opportunities and take steps that all pioneers take by working on problems together in uncharted territory.

Packaging Corporation of America (PCA) provides a concrete example of environmental and business gains made possible by addressing environmental risks through flexible and creative approaches.

Back in 1998, PCA was required to collect and incinerate gaseous emissions from its pulp mill in Tomahawk. PCA research identified a different kind of pollution control system, an anaerobic digester that could economically reduce six times more pollution than was required by existing environmental regulations. Using flexibility provided under the law, PCA installed the new system at half the cost of the more conventional technology. It captured and treated 1.6 million pounds of pollution, more than five times the 300,000 pounds that would have been captured using traditional methods.

RICHARD EBERT, PCA

RICHARD EBERT, PCA

An environmental partnership gave Packaging Corporation of America incentive to reclaim resources from pulp waste. The firm now collects methane produced in an anaerobic digester and uses the gas to produce steam and heat. George Kleist, PCA wastewater system manager, holds digester residues used as a high quality soil amendment for vegetable gardens, lawns, embankments and gravel pit reclamation. PCA has a three-year waiting list of customers who want to use the residues.

Further, PCA found that byproducts from their digester could be used for fuel and could replace virgin, purchased fuels. Consequently, PCA launched a $2.4 million project to collect biogas from the digester and use it to fire its on-site boiler to produce steam. The recovered biofuel produces the amount of energy equivalent to heating and cooling 2,250 homes. The program has reduced annual greenhouse gas emissions by 70,000 tons.

To put this into perspective, a $10 million biomass gasification plant currently planned for a pulp mill in British Columbia is forecast to reduce greenhouse gas emissions by 25,000 metric tons per year. So PCA is eliminating nearly three times more emissions for about a quarter of the cost of the Canadian project. PCA's closed loop system demonstrates that a flexible approach and technological innovation can enhance both environmental performance and company profitability.

Like Packaging Corporation of America, five other pioneers participating in Wisconsin's Environmental Cooperation Pilot Program have been outperforming the rest of the state in controlling greenhouse gases while addressing other significant environmental issues. Green Tier now provides a way for others to participate and offers even more tools to deliver environmental results with greater flexibility. Trade associations, organizations and companies alike have boldly stepped out of the comfortable confines of traditional regulatory approaches to explore their environmental and economic potential. Their strategies have saved thousands of hours of staff time, enabled bids to beat out national and international competitors, drawn work into the state and attracted new talent, all while addressing environmental issues in a comprehensive fashion.

— *Mark McDermid directs DNR's Cooperative Environmental Assistance Bureau.*

Consider international approaches to meet air quality challenges

Other countries show other ways to environmental innovations.

Lloyd and Patrick Eagan

We can learn from other countries' experiences even if they do not represent exact models for us to replicate. Leadership in environmental protection has been teeter-tottering among the U.S., Europe and Japan. In air quality protection for example, the United States led the world with the original Clean Air Act in the 1970s, but by 2000 Europe surpassed that lead, particularly in the areas of energy efficiency and climate change. Here are some observations from our opportunities to examine approaches to environmental protection in European countries and Japan.

In Germany, Wisconsin delegations toured power plants and learned about burgeoning growth of both air pollution control and renewable energy technology. During the late '90s, Germans passed a law requiring their utilities to slash nitrogen oxides emissions. The country reduced NOx emissions in four years, on time and under budget. How did this happen so fast? It appears that when the German public learned their forests were dying from nitrogen oxide emissions, the Green Party grew strong enough to win support for this key law. Also, the growth in windmills and renewable technology was seen as strategic, spurred in large part by regulation. German utilities were required to buy power from renewable energy producers even if it cost more than the current electrical rates. Establishing a guaranteed market for renewable energy created incentives for German entrepreneurs to develop new technologies to produce renewable energy.

Providing relevant and effective incentive systems to protect the environment will provide greater overall environmental benefits than regulations in the long run. Industries that discover how to sustain growth and decrease their environmental consequences are developing new sustainable economic models. The growth of the Danish wind industry provides a good example. Denmark, like Wisconsin, has none of its own fossil fuels. Danes took the oil crisis of the '70s very seriously and the country currently gets 20 percent of its energy from renewable resources, such as wind. Their experts on energy policy believe a goal of 100 percent renewable energy will be achievable. Danish energy cooperatives explored wind turbines to save money on energy production and spawned a profitable industry. Denmark has become the largest producer of wind turbines in the world and wind energy has become a key component of a sustainable Danish economy.

WOLFGANG HOFFMANN

PATRICK EAGAN

ABOVE: Wisconsin delegations saw how wind power was developed, regulated and placed in Germany.

RIGHT: A new way to get around? A prototype of a new kind of people mover on display at an eco fair in Japan.

In the Netherlands, we learned a National Environmental Policy Plan (NEPP) now includes aggressive targets to control greenhouse gas emissions. The government proposed an industrial tax on carbon emissions. The paper industry responded that such a tax would put them at a competitive disadvantage, but agreed to support the government greenhouse gas targets by pledging to become the most energy-efficient paper industry in the world. The Dutch government entered into a covenant with the industry to seal the deal. By using contract law as an alternative approach to regulation, the Dutch met both environmental and economic targets.

Finally, using "eco-designed" products is another approach to environmental improvement. Examples include green buildings, more fuel efficient vehicles, and more energy-efficient light bulbs and appliances. In Japan, "eco fairs" draw thousands of visitors each year and display a large variety of ecologically designed products. So, in addition to traditional regulations, economic incentives, alternative legal tools and environmentally sensitive product design can contribute to a greener and cleaner future that is economically viable.

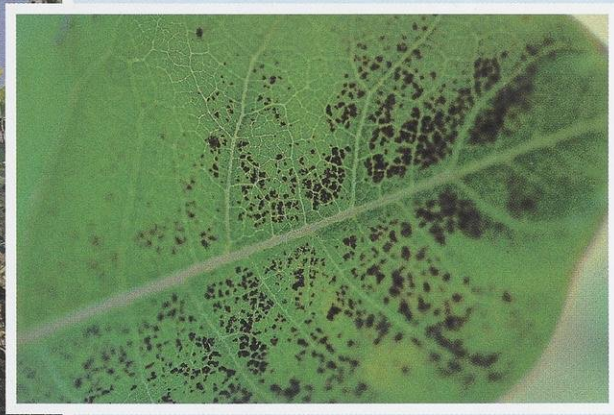
— *Lloyd Eagan directs DNR's South Central Region and Professor Patrick Eagan directs the Department of Engineering Professional Development program at the University of Wisconsin-Madison.*

Like people, some plants are more sensitive to air pollution than others. Biomonitoring can make use of these unique features to supplement test results from air monitoring equipment.

RIGHT: Lichens absorb minute amounts of air pollutants over long periods of time.

ROBERT QUEEN

ROBERT QUEEN



ROBERT QUEEN

LEFT: Plants placed near air monitoring sites also react to air pollution.

ABOVE: Milkweed leaves develop this characteristic brown stippling when exposed to airborne ozone.

What can you learn from a plant?

Quite a lot if you ask the right questions.

Ed Jepsen

Change is a fact of life and we typically want to know if it will provide more benefits than stumbling blocks. Studying plants and animals in their native habitats provides one reliable measure of how mixtures of complex changes affect nature. And teasing out whether ecosystem change is related to acid rain, ozone, climate change or combinations of manmade and natural factors takes time.

For instance, acid rain was predicted to naturally fertilize some agricultural crops, but the adverse effects on lakes and forests in Europe, North America and Asia far outweighed those minor benefits. Fortunately, we in Wisconsin were spared the worst of these consequences by reducing emissions quickly, and the nation soon followed suit.

Long-term studies of organisms, called "biomonitoring," and examining complex processes such as energy and nutrient flow can help us estimate natural background conditions. These studies provide a meaningful baseline for assessing future changes. While certain effects may be obvious within months or a year, others may take many years or decades to unfold.

Biomonitoring is just one of the valuable tools used to assess long-term trends. Combined with laboratory studies to determine explicit cause-effect relationships, and computer modeling to project changes over time and space, scientists can test the direction and magnitude of ecosystem changes.

Some of the natural changes are more dramatic and some are more subtle. Drought, flooding, intense storms, and insect and disease outbreaks have more immediate consequences, but the way people change the landscape, the slow introduction of exotic organisms, and the gradual changes to air, land and water are harder to see. Our sustained investment in long-term biomonitoring and other environmental monitoring builds a database we need to sense changes that can develop over decades or longer.

Biomonitoring studies to track the effects of air pollution have been conducted in Wisconsin since the early 1980s. The federal North American Sugar Maple Project and the state-sponsored Forest Monitoring Network tracked the health of the forest tree (aspen) canopy. These studies indicated tree canopies were generally healthy and air pollution impacts, if any, were too subtle to be detected by the study methods used.

State-sponsored biomonitoring of milkweed and lichen to track air pollutants has been discontinued, but regional forest health assessments still occur annually on Forest Service Forest Inventory and Analysis (FIA) plots in Wisconsin.

How valuable is this data? Ozone biomonitoring data collected on the FIA plots since the early 1990s guided EPA scientists in reassessing ozone standards. Based on this field data and other evidence, the EPA recommended lower seasonal ozone exposures to protect our plant communities.

— *Ed Jepsen is a plant pest and disease specialist with DNR's Bureau of Air Management in Madison.*

Individual actions, community benefits

Cleaner air begins at home.

Elisabeth Olson

The next time you go on a rant about today's environmental challenges — climate change, acid rain, mercury, energy demand, regional air and water pollution — stop and take a look in a mirror. Examining and revising your individual behavior is equally as important as scrutinizing corporate, government and community uses of resources. Your behavior can significantly reduce pollution and environmental damage while conserving energy. Together, our collective behavior can encourage policy change within government at the local, regional and national levels and promote better environmental practices within corporations.

Below is a short list of actions you can take to reduce your contribution to poor air quality. Choose the ones that work for you and everyone will benefit! Saving energy conserves natural resources and reduces air pollution caused by producing and delivering that energy. What you do does make a difference. So do it — and we'll all breathe easier.

In the basement:

- Set the temperature of your water heater to no more than 120 degrees to save energy.
- Put an insulating blanket on your water heater to reduce heat loss if insulation is not built into the tank.
- Insulate hot water pipes to reduce heat loss, particularly those closest to the water heater and those passing through unheated areas.
- Take good care of your home heating/cooling plant: Replace furnace filters. Replace filters in air conditioners and heat pumps and clean the evaporators and coils. To ensure maximum operating efficiency, many people hire professional services to clean these parts, check insulation on the coils and lubricate pumps on a regular maintenance schedule.

Upstairs:

- Inspect your home's insulation. Add more if needed, first in the attic, then in the walls.
- Caulk and weather-strip doors and windows.
- Install a programmable thermostat to set back your temperature automatically at night and when you are not home.
- Turn your heat down by three degrees at a time in winter to find a temperature that is comfortable for you. Similarly, set air conditioning higher in summer to discover how little air conditioning you need to stay comfortable.
- Purchase clean energy where available. Many utilities now provide alternatives for their customers to buy units of energy from renewable sources.
- Purchase Energy Star rated appliances. See www.energystar.gov or call the ENERGY STAR Hotline at 1-888-STAR-YES (1-888-782-7937).
- Turn off lights, computers and appliances when not in use.
- Replace as many incandescent bulbs with compact florescent bulbs or even LED bulbs as possible. They save energy and last ten times longer!

Laundry:

- Do laundry during off-peak hours.
- Wait until you have enough dirty clothes to wash a full load.
- Discover when cold water washes work as well as warmer settings.
- Clean the dryer lint trap after each load so that the dryer runs as efficiently as possible.
- Dry laundry on a clothesline, if practical.
- Avoid wearing clothes that need dry cleaning, or use a wet cleaning service as an alternative.

On the go

- Take mass transit, share a ride, walk or carpool.
- Plan ahead! Combining errands into one trip reduces mileage and saves gas.
- Avoid rush hours and listen to the traffic report before you go. Congested conditions increase air pollution and expose drivers to unhealthy conditions.
- Tighten your gas cap until it seals tightly or clicks. You can lose up to 30 gallons of gas vapors a year by not tightening your gas cap.
- Avoid topping off the tank. Pumping in more gas after the pump shuts off releases gas fumes into the air and reduces the benefits of vapor recovery gas pumps.
- Refuel when it's cool. Refueling during cooler periods of the day or in the evening generates less air pollution.
- Drive the speed limit. Gas mileage decreases rapidly at speeds above 60 mph.
- Avoid jackrabbit driving! Unnecessary braking and acceleration decreases gas mileage.
- Use cruise control on the highway to save fuel by maintaining a steady speed.
- Use overdrive gears on the highway to decrease engine speed and improve fuel economy.
- Don't let your vehicle idle. Idling even for short periods wastes more fuel than restarting the engine.
- Dejunk the trunk! Extra cargo is extra weight. Your engine burns more gas and releases more emissions.
- Care for your car. Taking good care of your car can help reduce emissions. Regular oil changes and tune-ups improve your vehicle's performance, extend its life and save gas. Properly inflated tires improve gas mileage, reduce emissions, and help your tires last longer.
- Use those handy inside-the-windshield blockers when parked outside on a sunny day. It takes more energy to cool a hotter car.

Your ecological footprint

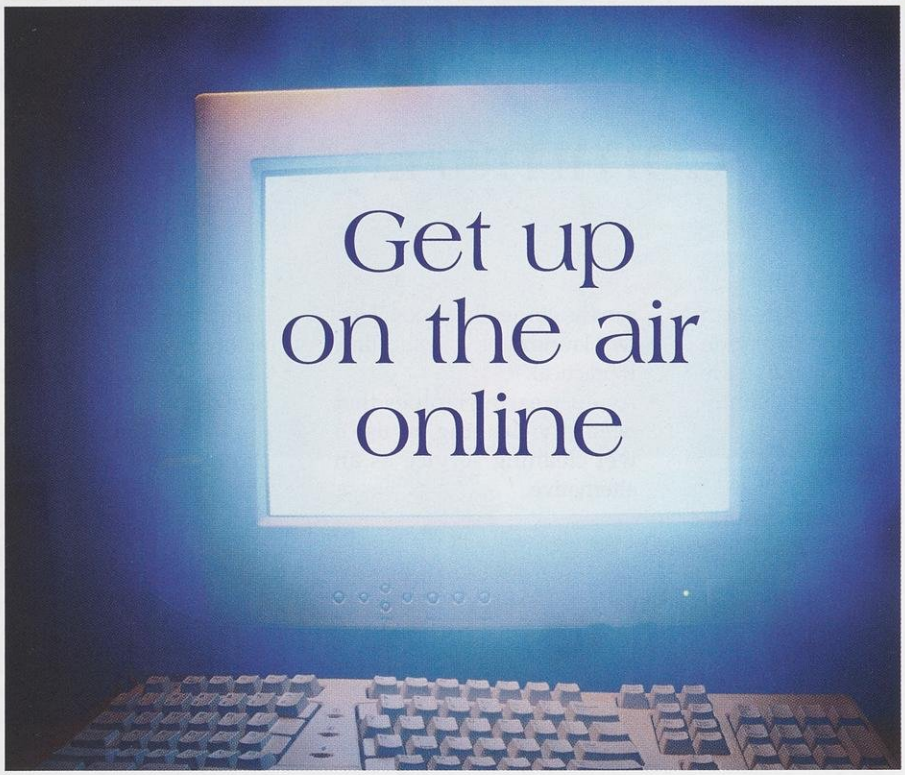
An ecological footprint is a tool to measure how much land and water area a human population requires to produce the resources it consumes and absorb its wastes under prevailing technology.

A 15-question quiz can help you gauge your consumption to national and international averages. The quiz will give you an idea of your ecological footprint relative to other people in the country. The quiz is not highly detailed, but will help you better understand yourself as a consumer, given your current environmental behaviors.

By measuring the ecological footprint of a population (an individual, a city, a nation, or all of humanity) we can assess and manage our ecological assets more carefully. Ecological footprints enable people to take personal and collective action to live within the means of one planet.

What's your "shoe size?" Visit www.myfootprint.org to find out.

Elisabeth Olson develops educational outreach programs on air quality for DNR's Bureau of Education and Information.



For more ideas of things to do to reduce climate change, educate yourself about the issue by visiting web resources listed below. Many good books and articles on climate change have been published over the past few years.

U.S. Environmental Protection Agency — EPA maintains an excellent website on climate change. It contains lots of information on climate change science, greenhouse gas emissions, state and federal policies, mitigation methods and lots more, including links to many other excellent climate change websites: www.epa.gov/climatechange/

United Nations Framework Convention on Climate Change — This website provides information related to the UN Framework Convention on Climate Change and the Kyoto Protocol: www.unfccc.int/2860.php

Intergovernmental Panel on Climate Change (IPCC) — This worldwide group of over 2,000 scientists is responsible for assessing the status of global climate change. They publish assessment reports every five years for the United Nations and the world community. The reports tend to be very technical, but they also publish summaries for policy makers and the general public: www.ipcc.ch/

National Oceanic and Atmospheric Administration — The NOAA website has a thorough discussion of weather and climate change for all audiences: www.education.noaa.gov/cclimate.html

British Broadcasting Corporation (BBC) — Information about science, impacts, adaptation, policies and more: www.bbc.co.uk/climate/

Union of Concerned Scientists — The Union of Concerned Scientists provides excellent information on climate change and on how it will likely affect the Great Lakes region and Wisconsin. To access the information on impacts on the Great Lakes and Wisconsin, go to: www.ucsusa.org/greatlakes/glchallengereport.html

Green power alternatives — To find out whether your electric utility offers customers the opportunity to purchase wind power, solar power or other green power, visit the U.S. Department of Energy's Energy Efficiency and Renewable Office, the Green Power Network: www.eere.energy.gov/greenpower/buying/index.shtml. Look for "Can I buy green power in my state?"

To learn about buying or leasing more energy efficient vehicles, visit www.epa.gov/greenvehicles. The site rates cars and trucks by air pollution scores, greenhouse gas emissions and fuel economy. The highest scoring vehicles earn a Smartway seal of approval as a good environmental performer.

To stay in touch with what's going on in the DNR Air Management program, subscribe to one or more of these e-mail lists at dnr.wi.gov/org/aw/air/newsletters

- **Air Health Advisory —** notifies you whenever DNR issues an Air Quality Watch or Air Quality Advisory anywhere in Wisconsin.
- **Air Matters —** notifies you when a new issue of our Air Matters newsletter is available online or the What's New section on the Air Management home page is updated.
- **Clean Air Act Task Force (CAATF) —** sends links to DNR web pages where you can find the latest information on CAATF activities.

DNR's air quality and health site — dnr.wi.gov/org/aw/air/health. Related links provide information about mercury in the air, acid rain in Wisconsin, nitrates and sulfur, health studies and open burning.

Technical papers about acid rain research at Little Rock Lake:

- Frost, T.M., J.M. Fischer, et al. (2006) "The experimental acidification of Little Rock Lake," Magnuson, J. J., T. K. Kratz, and B.J. Benson., Eds. Long-term Dynamics of Lakes in the Landscape, Oxford University Press.
- Watras, C. J., K. A. Morrison, et al. (2006). "The methylmercury cycle in Little Rock Lake during experimental acidification and recovery." Limnology and Oceanography 51(1): 257-270.

Resources for younger readers:

- **DNR's EEK! site:** dnr.wi.gov/eek/earth/air/index.htm
- **EEK's "You can make a difference" page:** dnr.wi.gov/eek/earth/makeadifference.htm
- **Exploratorium Museum in San Francisco has a neat site to view climate research data:** www.exploratorium.edu/climate/index.html
- **EPA Climate Change "Kids Site:"** www.epa.gov/climatechange/kids/index.html

---

Listing compiled by Eric Mosher, DNR Bureau of Air Management

Produced by DNR Bureau of Air Management and DNR Bureau of Education and Information.

Project Coordinator: Elisabeth Olson

Graphic Design: Waldbillig & Besteman

PUBL-CE 7047

Behind The Pattison

By Roger Drayna

Illustrations by Elizabeth Cavanaugh

In late June, my brother Chuck from Oshkosh and I drove up to Superior. Our first priority, as always, was to drive past the well-kept Dutch colonial home our parents built on Lamborn Avenue in 1930. Chuck was four when our family moved in. I was born a few months later. The Martin Pattison Elementary School was just half a block away.

I already knew the school had been razed, but coming up against that reality in the form of an expanse of sky and a new housing development triggered a torrent of nostalgia — memories of the mythical world we called "Behind the Pattison." This was the whole geographical province stretching southward from the backdoor of that imposing landmark. By the time we had hiked to its farthest reaches, which took a lot of years, it must have encompassed 20 square miles.

COURTESY OF SUPERIOR SCHOOL DISTRICT

COURTESY OF CHARLES HERUBIN

COURTESY OF ROBERT GEIMER

COURTESY OF ROGER DRAYNA

ABOVE: The former Martin Pattison School at 1016 N 21st Street in Superior.

LEFT: Jack Wallenstein (12) and Bob Geimer (14) (L to R) at the Geimer home in the late '40s.

RIGHT: Charles (Skip) Herubin and his dog, Rover, in front of the Herubin home on Baxter Avenue.

BELOW: Author Roger Drayna fishing the Brule at Rainbow Bend at about age ten when his "Behind the Pattison" adventures with the guys were still fresh.

BEHIND THE

I was pretty young, perhaps eight, when I started exploring "Behind the Pattison." My companions were neighborhood pals: Charles (Skip) Herubin, Bob Geimer and Jack Wallenstein. Our jaunts were within easy sight of the school, just beyond the baseball diamond, actually.

It wasn't long before we were building campfires out of willow sticks and roasting potatoes in the coals. With our cheap jackknives — every kid had to have a jackknife — we'd peel away the charred exterior and salt the dickens out of the white, steaming meat.

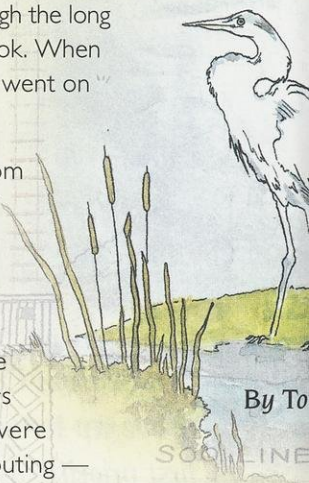
As the years passed, and we grew stronger — and bolder — the hikes got longer.

First came the abandoned South Shore railroad trestle just beyond 28th Street. There was a grove of poplar trees, a creek and a hill. Now, sprawled beside our campfires, we could enjoy a degree of independence although our security was assured by that sturdy structure clearly visible across the brushy fields no more than a half mile away.

Next came Bums' Jungle where 28th Street intersected with the Soo Line tracks. This was a full mile from our part of town and separated from it by an extensive patch of scrubby tag alder and poplar woods. In those days, at the end of the Great Depression, it was a sinister place, more so in the lengthening shadows of late afternoon. Once as we hastened homeward, we came into a grassy opening and found a hobo with his bedroll, cooking supper in a Karo syrup pail. We walked faster then and looked over our shoulders a lot.

Tower Pond was just beyond; it got its name from the railroad watchman's tower located there and a marshy water hole hardly more than a widening of another creek.

It was at Tower Pond that Skip and I saw our first great blue heron. When we spied this gawky creature, it looked to us like it had stepped straight out of the comic strip "Alley Oop." Without a word, we dropped onto our bellies and wormed our way through the long grass until we got a really good look. When we tried to get even closer, off it went on great sweeping wing beats.



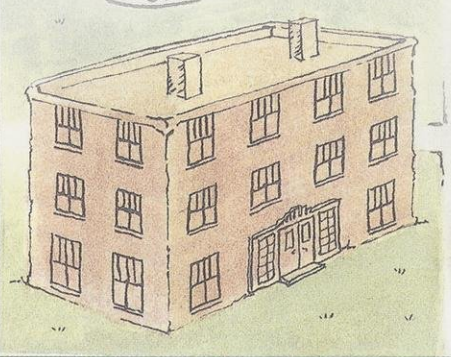
Dick Flaherty, another kid from Sacred Heart Grade School, of fond memory, was into bird identification and confidently put a name to our ungainly monster.

A couple more years and we were into Scouting — our hikes got longer and more purposeful. They included such things as building fires with one match and cooking somewhat more elaborately. More elaborately meant canned baked beans and bacon fried to the point of disintegration.

Going past Bums' Jungle

As our explorations became more extensive, we sometimes came straggling home late for supper. This was not met with much approval by mothers who believed "Behind the Pattison" meant exactly that — just beyond the baseball diamond. How could they know that we had been all the way to an overpass that carried the Soo tracks over Stinson Avenue? Our sole purpose was the joy of an unobstructed view as the sun set gloriously behind the Duluth Hills.

At last, we would strike out cross-country all the way to the Nemadji River.



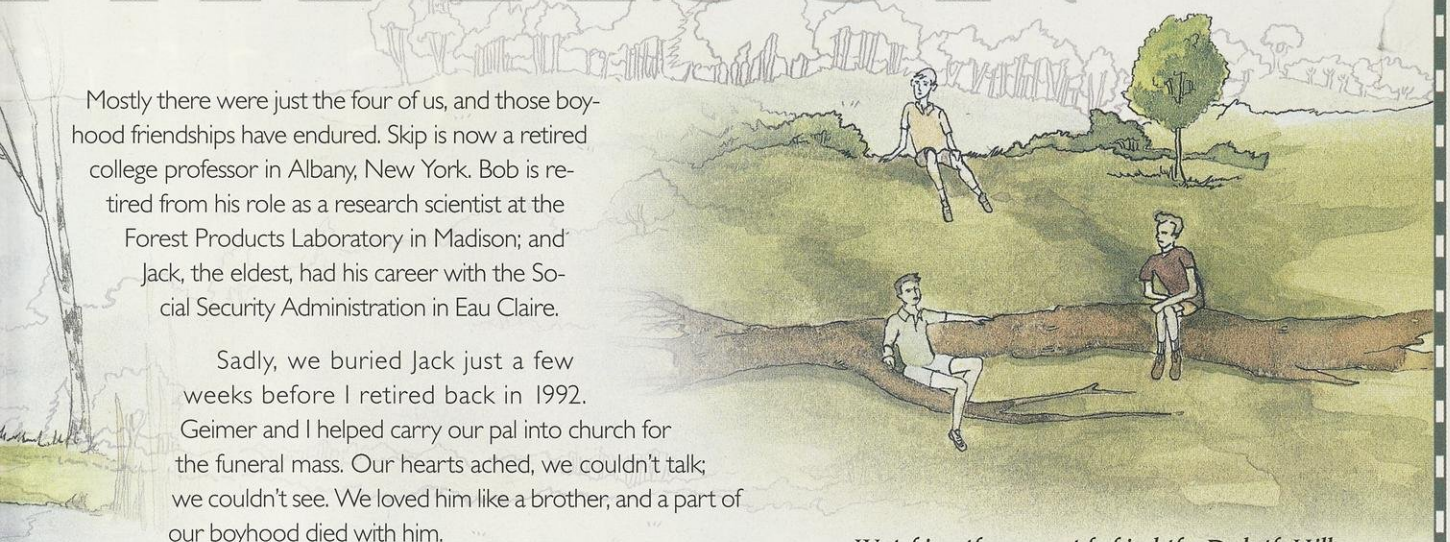
Roasting potatoes behind the diamond

By the railroad trestle

PATTISON

Mostly there were just the four of us, and those boyhood friendships have endured. Skip is now a retired college professor in Albany, New York. Bob is retired from his role as a research scientist at the Forest Products Laboratory in Madison; and Jack, the eldest, had his career with the Social Security Administration in Eau Claire.

Sadly, we buried Jack just a few weeks before I retired back in 1992. Geimer and I helped carry our pal into church for the funeral mass. Our hearts ached, we couldn't talk; we couldn't see. We loved him like a brother, and a part of our boyhood died with him.



Watching the sun set behind the Duluth Hills

To my own great good fortune, these friends were also very smart kids. mportant parts of my education came from conversations that went on for miles and miles. We shared books ranging from Jack London, the adventures of Richard Haliburton, and Sir Walter Scott's "Lady of the Lake" to the wonders found in the World Book Encyclopedia.

For us, "Behind the Pattison" was truly a magical place. There were sunsets and ski trails and cackling pheasants startled into flight where they fed on spilled Dakota grain along the railroad tracks. Every few years, snowy owls would suddenly appear from up around Hudson Bay. We ran traplines for weasels and muskrats and skunks. We got to know trees and animal tracks, and how to deal with some of the godawfullest weather on the continent.

"Behind the Pattison," to the uneducated eye, was just an undistinguished open space destined some day to become house lots and the campus of Superior Senior High School. It was immeasurably more, of course. It was a place for kids to stretch their legs, their minds and their spirits.

Over the years, I have come to understand that our "Behind the Pattison" was not unique. Most of us, in some way, have such touchstones and refuges. They are the places we hiked, built shacks, cooked bacon to disintegration, burned off excess energy, talked earnestly about life, and, at last, went off to become men and women.

Our explorations were part of a more innocent time. Even with that school building only a memory, I imagine there are kids in Superior still hiking to some of the places where we roamed over half a century ago. Of course, it is no longer "Behind the Pattison."

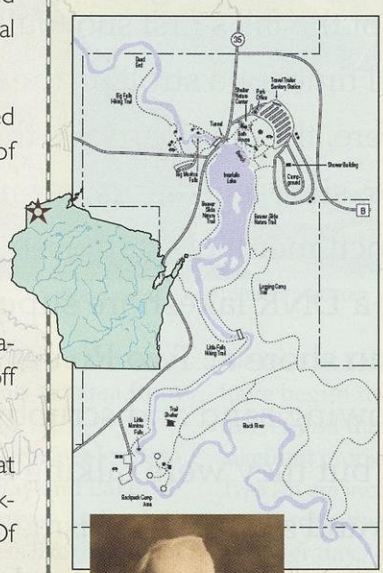
In some form and with many names, I think places like this still exist wherever there are open spaces to be explored when kids have time, even in this highly scheduled world, to hike and dream and to innocently be kids. I sure hope so; I don't like to think of a world without "Behind the Pattisons."

Roger Drayna is a retired public relations director for Wausau Insurance and has been a freelance writer since 1951.

PATTISON STATE PARK

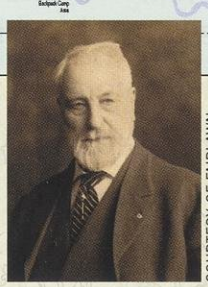
Pattison School is gone, but that spirit of outdoor exploration lives on at Pattison State Park 12 miles south of Superior on Highway 35.

The park features Big Manitou Falls, the highest waterfall in Wisconsin at 165 feet and the fourth highest falls east of the Rockies.



The 1,436-acre park offers breathtaking vistas of the Black River gorge and a splendid view of the deep valley that rises toward the steep bluffs of Duluth, Minn. A fine beach, nine miles of hiking trails and camping are available.

Martin Pattison, lumber baron, miner, banker and three time mayor of Superior, secretly bought 660 acres along the Black River in 1917 to save the impressive waterfall and surrounding area from development as a power dam. The property was dedicated as a state park in 1920.



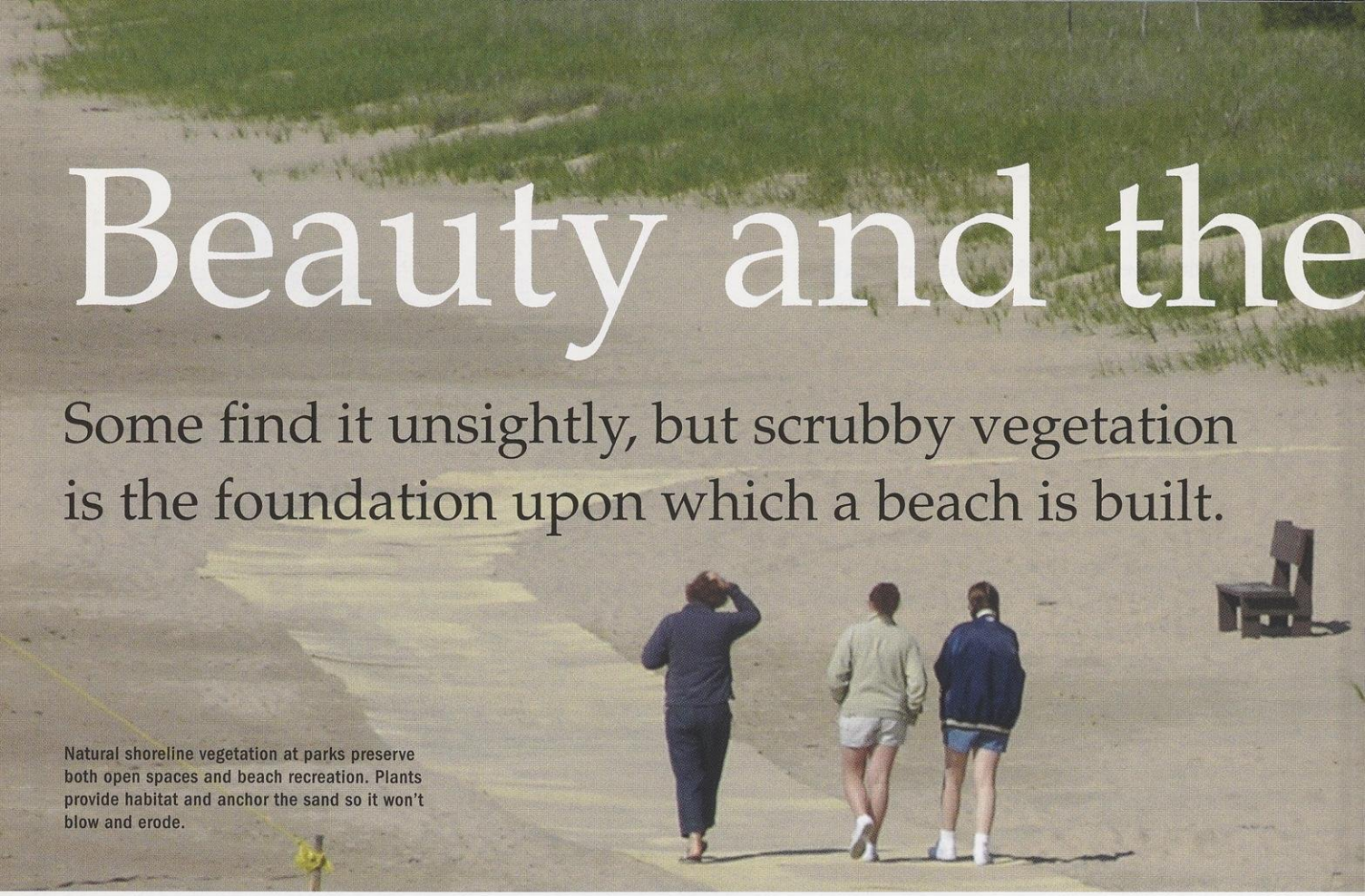
COURTESY OF FAIRLAWN COLLECTION

Martin Pattison

Pattison also bought an entire city block near the Superior Harbor and built the 42-room Fairlawn Mansion that is now preserved as a museum and is open for public visits.

Beauty and the

Some find it unsightly, but scrubby vegetation is the foundation upon which a beach is built.



Natural shoreline vegetation at parks preserve both open spaces and beach recreation. Plants provide habitat and anchor the sand so it won't blow and erode.

DNR PHOTO

Kristy J. Rogers

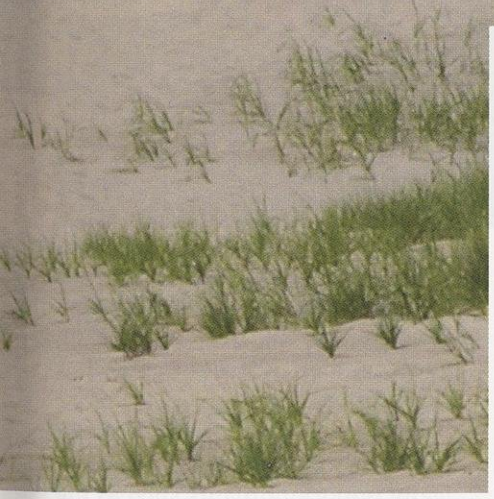
The eve of the fall's first snowfall hardly seemed an ideal time for a stroll on the beach, but there they were, the city manager, the city recreation director, state legislators, prominent business owners, city council members, representatives from the parks board and a DNR lakeshore supervisor walking the Lake Michigan shore at Two Rivers. The cold wind whipped past blowing sand and scrubby vegetation on Neshotah Beach, but they were talking about sunshine, lakefront festivals and summer tourism.

Lake Michigan levels have remained low for several years, and a permit first issued four years ago allowed the city to groom 1,156 feet of the public beach running along State Highway 42. Due to low water, more than 2,000 feet of beachfront was exposed at least 300 feet wide. In these low water conditions, the city saw opportunity.

People come to the coast in summer to feel the breeze, fly kites, and see the sand, contended Two Rivers City Manager Greg Buckley. The city wanted its permit extended to groom the entire length and full width of the exposed lakefront to remove "unsightly" weeds. This is hardly pristine beachfront, Buckley said. If we don't groom the entire beach and remove the vegetation, it gives the impression that we don't have enough community pride to care for our beach. If people want to see "natural" beach, they can drive up the coast a few miles and go to one of the state properties like Point Beach.

Kelley O'Connor, the DNR Lakeshore Basin Supervisor who oversees several hundred miles of Lake Michigan and Green Bay shoreline, explained how the beachfront serves an important purpose: Plants like rush and bulrush anchor the sand, stave off shoreland erosion and buffer the nearshore area from the erosive forces of wind and water, she said. Moreover, the huge expanses of lakebed exposed as the water recedes is public property, held under the Public

beach



JEREMY HODGES, HERALD TIMES REPORTER, MANITOWOC. USED WITH PERMISSION.

Kelley O'Connor (*left*), DNR lakeshore team supervisor in Green Bay, discusses lakeshore grooming with Two Rivers City Manager Greg Buckley, legislators and members of the city council at Neshotah Beach. The city wanted to remove more grasses and small shrubs that started growing following a few years of low water on Lake Michigan. Permits enacted in 2003 restrict grooming here to about 1,100 feet of public beach, leaving 10 acres of groomed sand.

This isn't just dune grass and low-growing plants we're used to seeing in natural lakefronts, Buckley said. The plants provide a natural buffer against runoff pollution and dunes absorb energy when wind and waves batter the coast, O'Connor explained. It's a trade-off.

Trust Doctrine for public benefit. The whippy clumps of beach grasses (called "marram") stabilize the shore, protect against floods and reduce the amount of sand blowing into nearby parking lots, concession stands and roads.

The local state senator and representative weighed in, backing up their constituents' desire for a tidy, well groomed beach.

Noted wetland ecologist Don Reed, who was in the Two Rivers area at a Nature Conservancy meeting, read about the beach grooming debate in the newspaper. On a walk down the same beachfront the next day, he identified several threatened and endangered species of beach vegetation that he noted in a letter of support for protecting the area from more intensive grooming.

For several years lower water levels in Lake Michigan, Green Bay and Lake Superior have left both private and public lakefront property owners like the City of Two Rivers with additional beachfront. Piers, moorings, docks, boat launches, public swimming and play areas extend farther from the shoreline to the water when levels drop, but low water levels also present an opportunity to do shoreline repairs.

Nature has wasted no time in claiming many of these newly exposed areas. Vegetation has quickly taken hold and, in the case of Lake Michigan, sand dunes have begun to form. As the vegetation thrives and the dunes rise, the calls from lakefront property owners like the City of Two Rivers increase.

"During the summer, I received 10-15 calls per day," said Mike Hanaway, former DNR water management specialist. "All the questions centered on a common theme — What can I do with the beach?"

In terms of what is best for the natural ecosystem, the answer is: "Do nothing." Unfortunately the question isn't that easy or simple. Well-meaning people want different things from the shoreline. Some want a clear, smooth path where they can walk barefoot along the water; others

Grooming a narrow area can provide the pristine, sandy surface prized by barefoot beach fans. Grooming equipment loosens the soil but can also seal in bacteria in moist, warm growing conditions. Maintaining more of the natural vegetation will provide a shoreland buffer to slow erosion when water levels eventually rise.

seek an unobstructed view of the lake. The City of Two Rivers desires a beach that will draw people to community events. Still others want a beachfront free of exotic invasive grasses like Phragmites and loosestrife.

No matter the reason, the decision to mow, grade, groom or otherwise manipulate the beach should not be taken lightly. Recent studies by coastal ecologists at Michigan State University in East Lansing and Grand Valley State University in Allendale, Mich. explain some of the consequences of changing the natural processes by which plants colonize a beachfront:

- Clearing a swath of vegetation through a coastal marsh produces a fundamental change in the chemical and physical conditions in near-shore waters. These changes negatively affect the larval forms of important game fish, reducing or eliminating habitat for species including yellow perch, smallmouth bass and largemouth bass.
- Adult fish netted adjacent to undisturbed areas were present in greater numbers and greater varieties than adjacent to "groomed" areas.
- Invertebrate communities upon which fish depend for food and nutrient cycling were reduced by vegetation removal and grooming. The number of individual organisms collected adjacent to undisturbed beaches was 29 times greater, on average, than adjacent to raked or cleared areas.
- Beach grooming and repeated mowing rapidly destroy stands of ecologically important plants such as the naturally deep-rooted and long-lived rush and bulrush, which serve to anchor underlying sand and soil.
- The removal of vegetation increases the movement of sand and erosion of shoreline areas.

DOUG STAMM

Plants in more natural shorelines provide a place where aquatic insects can grow and young fish can find food and shelter.

One of the most pronounced changes in the past five years can be seen on the western shore of Green Bay. Low water levels have promoted the growth of submergent plants (species that grow completely underwater) and emergent plants (species that grow underwater and extend above the surface). Both types of plants provide critical nursery habitat for fish that need to find shelter in extremely shallow waters, such as yellow perch and minnows.

Mike Hawley, DNR fisheries technician, has been conducting surveys using seine nets in the shallow waters along the western shore of Green Bay for the past 20 years. "The past few years we have seen a huge increase in the number of young-of-the-year yellow perch and minnow species found in our seine surveys and that is really encouraging," he said. "There are many factors that can influence fish populations, however I feel

very strongly that this recent population boom is a direct result of the increased vegetated habitat."

Fish are not the only critters that benefit from the new habitat provided by lower water levels. Frogs and turtles, aquatic insects, muskrats and shorebirds all rely on these areas. When the water levels rise on the new vegetation, aquatic invertebrates thrive, providing a wonderful lunch for fish, frogs and shorebirds.

"Shorebirds feast on the aquatic invertebrates that become exposed when the water recedes," says Jeff Pritzl, the regional wildlife biologist in DNR's Northeast Region. "The real benefits for the shorebirds will come down the road, when the water levels increase and flood the new vegetation." When the water rises, more food grows amid the shallow plant life, and shallow protective cover forms. The sand dunes along Lake Michigan also provide unique habitat for several rare plant species.

"When Lake Michigan was high in the 1990s much of the beachfront dune habitat was destroyed," explains Carolyn Rock, naturalist at Whitefish Dunes State Park near Sturgeon Bay. "The lower water levels have allowed the frontal dunes to re-form and the vegetation to again flourish, but there are still plenty of places for swimmers and sunbathers to play near the water and relax on the sand."

Protecting rare species and habitat unique to our inland coasts has become a primary goal at Whitefish Dunes. Beach grooming has been reduced to help achieve this goal. Point Beach State Forest near Two Rivers has taken a similar approach to preserving shoreline habitat by completely eliminating beach grooming activities and promoting educational programs on natural dune creation processes.

If you have ever had sand blown into your eyes during a walk on the beach, or had to shovel sand off of your patio, then you can appreciate the benefits natural beaches provide for people. Beach vegetation is the most critical defense against sand erosion. It works in two ways. First, the roots hold the sand, anchoring it from underneath to stop it from blowing or eroding away. Second, the blades or leaves block and catch blowing sand. The accumulating sands create sand dunes. When the water level rises again, the dunes and vegetation protect the shoreline from erosion and flooding. Without dunes and dune vegetation, the soils that support buildings and roads near the shore would be washed away at a faster rate.

Beach vegetation also filters out and absorbs stormwater nutrients flowing toward the lakefront. By soaking up nutrients in runoff, beach plants and grasses help eliminate the food source for Cladophora — a truly stinky algae that grows in large mats and washes up on the shoreline. Once you've caught a whiff of decomposing Cladophora during a stroll on the beach, you won't forget it.

Phragmites, an exotic, reedy grass that grows in dense stands more than six feet high, crowds out other plants and colonizes disturbed areas, especially beachfronts that have been groomed. It grows thick and tall, eliminating the ability of natural vegetation to grow and thrive. It is also an eyesore, blocking lakefront views and inhibiting access to the water. "Once Phragmites has invaded it is very difficult to remove or control," says Bob Bultman, Door County invasives species coordinator. "Healthy natural vegetation is your best weapon against Phragmites."

Whenever the prospect of beach grooming is raised, it's worthwhile to remember that plant-free, groomed beaches come at a price — a price even the wealthiest communities cannot afford to pay. Look instead at the benefits the newly vegetated areas bring to fish, birds and humans living along the shore.

Kristy J. Rogers is the aquatic habitat coordinator for DNR's Northeast Region in Green Bay.

Beach behavior

What can you do to help protect natural beachfronts? Here are a few ideas:

- Reduce your footprint when visiting beach areas: Do not trample fragile beach grasses. Stay on marked paths. Do not feed the wildlife. Don't litter. Do not drive on the beach. Besides being illegal, it's terribly destructive.
- Learn more about the value of natural shoreline vegetation, and discuss with your neighbors the benefits natural shorelands can bring to your community. Beach vegetation stabilizes the shore, slows flooding, filters runoff, provides nurseries for fish, birds and aquatic invertebrates, and stems shoreline erosion.
- If you are a shoreline property owner, set a goal of restoring or protecting your shoreline so that at least 70 percent remains in a natural state. Keep piers, boats and the removal of vegetation to one area that is 30 percent or less of your total shoreline frontage. Please be aware that there are specific standards for vegetation removal, pier placement, etc. For more information, contact your local lakeshore association, find out about local ordinances and get involved in lakeshore restoration projects.
- Work with local conservation groups, state park friends groups, nature preserves and neighbors to fight the spread of invasive species. Many groups hold work days to remove invasives and educate people about the disruptive presence of these plants in the environment.
- Before altering shorelines or grooming beachfronts, contact your local DNR water management specialist to determine which activities require permits. You should also contact local zoning offices or town officials to find out if permits are required or if local expertise is available to guide your proposed renovations.

Under emergency rules adopted by the Natural Resources Board in June 2007, people who own beachfront property on the Great Lakes can get general permits to remove nuisance level deposits of algae, mussels and dead fish during the summer of 2007. The board reacted to complaints of increased populations of invasive species like zebra mussels and quagga mussels as well as blooms of the algae Cladophora. The general permit has a $50 application fee and is processed in less than 30 days.

Under the emergency rules, removals are limited to plant and animal nuisance deposits in the "swash zone" where wave action cycles on the beach. Total amount of material removed is limited to 3,000 cubic yards and equipment used to skim the deposits off the top of the lakebed must minimize impacts to the lakebed and surrounding vegetation. Contact Martin Griffin, DNR water regulation and zoning specialist, (608) 266-2996, for more information.

Transfor

Plants and animals change form, shape and appearance as they mature through the seasons. See for yourself.

Story and photos by Don Blegen

Wisconsin's outdoors is filled with fascinating plants and animals. Quite often, these species are well-known and familiar to us in one stage of their life cycle but relatively unknown in another. Here's a shortcut to recognizing some of these relationships. Even after years of observing nature, it's enjoyable to see more of these connections.

RIGHT: Hackberry butterfly caterpillars feed exclusively and greedily on hackberry leaves.

LEFT: After pupating in chrysalises, they emerge as the splendid hackberry emperor butterflies.

mations

A group home on hackberry

If you live near a hardwood forest, the chances are good that scattered among the maples, oaks and hickories are a few hackberry trees. Hackberries (*Celtis occidentalis*) are easily recognized by their warty, furrowed bark.

This tree is the host plant to the hackberry butterfly, sometimes called the hackberry emperor (*Asterocampa celtis*). Its caterpillar feeds only on hackberry leaves. The hatched caterpillars can be so abundant and feed so voraciously that they can strip whole areas of hackberry trees free of leaves. Usually this does not do any long-term damage. After the caterpillar goes into a chrysalis for about a week, the caterpillar emerges as a beautiful butterfly with unusual feeding habits. Unlike most butterflies, the emperor does not seek a sip of flower nectar. It has a more robust appetite for stronger flavors and feeds on rotten fruit, carrion, dung and tree sap. Hackberry butterflies drink readily out of puddles of standing water. They seem absolutely unafraid of people. In fact, they can get real familiar landing on your arm and sucking up a bead of perspiration with their uncoiled proboscis.

The female butterfly lays her eggs in a clump on a hackberry leaf. Dozens of tiny caterpillars with their big appetites devour leaves right next to their nursery sites. The butterflies often raise two generations a year that hatch out in midsummer and later in the summer. If the second generation hatches too late in the season, the caterpillars can hibernate on the trees and will undergo metamorphosis the following spring.

ABOVE: Yellow goat's-beard has a beautiful, symmetrical flower with darker flecks near the center.

RIGHT: Its seed head is a geometrical patterned sphere that is a fragile marvel to behold before the seeds set sail on a mild wind.

A fragile, geometric marvel

Yellow goat's-beard (*Tragopogon pratensis*) is an exotic species from the Old Country, an introduced weed from Eurasia that grows in ditches and waste places. Its blossom is nothing to get excited about, just a yellow dandelion look-alike, but what the flower becomes is something special.

Like the dandelion, the yellow goat's-beard blossom is a composite. That means the blossom is not one flower, but a compilation of many, in this case, as many as a couple hundred individual blossoms. When these flowers mature and develop into a seed head, they form a model of geometry. Each flower forms into an aggregate cluster of seeds so intricate that many people call it a "puffball," not to be confused with the fungi of the same name. The goat's-beard puffball is similar in form to a mature dandelion seed head. If picked very carefully so as not to dislodge any of the parachute seeds, goat's-beard puffballs can be used in floral arrangements.

On close examination, the seed head has developed into an example of geometric perfection unfolding in an intricate pattern that rivals the most complex origami designs. Take a close look to appreciate it; a description in words can't do it justice.

LEFT: The white-lined sphinx moth caterpillar is a green, striped hornworm.

MIDDLE: Its chrysalis has a long "handle" that houses the developing proboscis.

RIGHT: The adult hovers and dips up, down, forward and back to reach flower nectar.

The mystery of the hovering sphinx

The adult white-lined sphinx moth (*Hyles lineata*) is often mistaken for a hummingbird. It feeds on flower nectar and its darting, rapid flight looks very much like that of a summer hummer. The moth is about the same size as a hummingbird as well. Sphinx moths can hover motionless in midair, move left, then right, up, down, even backwards like a hummingbird. Its wings beat so rapidly that they blur and hum. No wonder people confuse them!

If you get close enough, you will see that the moth sucks nectar with a long tube or proboscis that coils up like a watch spring when not in use. Also look at its legs. The moth has three pair and its back is covered in tiny scales, rather than feathers.

The white-lined sphinx moth belongs to a large group of moths collectively called sphinx or hawk moths. They are all excellent fliers that have sucking tubes as long or longer than their bodies to reach deep into flowers. Most of the family grows from caterpillars that have sharp spikes or horns on their rear ends. Such caterpillars are often called "hornworms."

Many of the hawk moth caterpillars feed only on specific plant species. The white-lined sphinx moth is not so choosy. It will feed on grape, Virginia creeper, purslane, apple blossoms and other plants. It pupates on the ground forming a chrysalis with a long "handle" that contains the developing proboscis. After undergoing a complete metamorphosis inside the chrysalis, the moth changes from a wormlike caterpillar into a remarkably nimble master of flight that hovers near flowers, extends its proboscis into the center of flowers to suck up nectar, then rolls its proboscis back into a tight coil before darting on to the next blossom. Watching it perform intricate aerial acrobatics, it's hard to believe this same creature spent most of its life crawling around as an ugly green caterpillar with a spine sticking out of its south end! Truth really is sometimes stranger than fiction!

When plants take winged flight

In late March or early April, box elder trees (*Acer negundo*), and all other members of the maples, produce blossoms that pop out even before the leaves emerge. The tiny blossoms lack the showy petals and sweet smells we usually associate with flowers. Nevertheless, these are true flowers and have all the necessary reproductive equipment to produce fruits and seeds.

The main difference is that these are wind-pollinated flowers and do not need to expend the effort to make bright colors and sweet odors that fruit trees use to attract insects to carry the pollen from one blossom to another. Wind-pollinated flowers specialize in producing huge quantities of pollen to increase the odds that a few grains will land by chance on another receptive flower. In box elders, the flowers are single-sexed coming in either the male (staminate) or female (pistillate) forms. Male flowers produce the pollen that contains the sperm and female flowers contain an egg inside an ovary. Once fertilized, the pistil undergoes a dramatic change and develops into a dry type of fruit containing a seed.

In the case of box elders and other maples, that fruit takes the form of a samara. To kids of all ages, they are the "helicopter seeds." Actually, they develop into a double samara over the summer and greatly increase their size. Come October, the tree's leaves all fall, but the samaras hang tough. It often takes a stiff wind in November or later to split the twin samaras at their joining point and dislodge them into whirling flight.

If a seed falls directly beneath the parent tree, its chances of maturing into a new tree are close to zero because it can't get the light and nutrients it needs to grow. Seeds need to be carried outside the shadow and root-reach of their parent. The parent tree is immobile and can't distribute its progeny by moving from place to place as animals do. A winged samara is one clever way to catch the wind, whirl horizontally great

LEFT: Dragonflies start life as armored gladiators – tough aquatic nymphs – for up to three years.

RIGHT: They emerge as the most agile, sleek fliers of the insect world. This one is a green darner dragonfly (*Anax junius*).

Master of two worlds

Just about everyone knows that butterflies and moths transform from caterpillars. But another kind of flying insect, the dragonfly, makes a life change every bit as dramatic.

The dragonfly begins its life as a wingless, gill-breathing aquatic insect that can move by crawling or by jet propulsion. It finishes its life as an air-breathing aerialist, arguably the most acrobatic of all insects.

A dragonfly nymph is a fierce predator, capable of devouring other aquatic insects and even small vertebrates like tadpoles and minnows. It ambushes prey by blending in with bottom twigs and weeds or by shooting water out of its abdomen, darting at prey with amazing speed. In either case, the *coup de grace* is administered by a unique jaw assembly that is as deadly as that of any monster in an *Alien* movie. Its jaw is hinged, extensible and tipped with two forceps-like jaws that pierce and hold the victims in a viselike grip so they can be eaten.

The nymph spends up to three years living in a pond, lake or slow-moving stream. Then, on some kind of an inborn signal, it crawls out of the water into the air and climbs up a reed, a boat dock or any other vertical object near the shoreline. The nymph's back splits open and the creature within crawls out, leaving the empty case behind. This new creature crawls upward an inch or two, and the hump on its back slowly unfolds into silvery, shimmering wings. The wings are wet at first, filled with a fluid forced into them by some internal pump. Gradually, they dry as four transparent wings that are delicate-looking but possess remarkable structural strength.

In an hour or two the process is complete and the creature launches into flight. For the next several weeks or months, the adult dragonfly will rule the air until old age or frost cut it down. Capable of speeds exceeding 40 mph, able to hover in midair, to turn so abruptly that the eye can hardly follow the movement, able even to fly backwards — the crawling nymph has been transformed into an aerobatic marvel that can pick flying insects out of the air with casual grace. It is a true mosquito hawk, devouring mosquitoes, gnats, midges, mayflies and other protein-rich flyers. Shifting, wheeling, darting, hovering, the dragonfly slices the air in sweeping arcs as its huge eyes pick up the tiniest movement in any direction, its spiked legs forming a kind of caching basket to scoop prey from the air. Its jaws crunch up one mosquito in mid-flight as the 25,000 lens facets of its two huge eyes search for and locate the next, and its powerful wings maneuver into position for the next interception.

Sometime during the summer, the female will lay her eggs. Some do so on the water's surface and the eggs sink like little stones. Others make slits in emergent vegetation and lay their eggs in the cavities. Either way, after a short time, the eggs hatch into small nymphs with big appetites. Few survive, but the lucky ones feed fiercely and grow steadily shedding their old skins as many as 10 times before the last molt. One day, the nymph that has lurked in the dark depths for so long walks out of the only world it has known into another completely different realm to be transformed into a lithe creature of air and light, its tiny brain holding an instinctive memory of the intricacies of flight and the tactics of aerial attack.

Photographer, author and retired biology teacher Don Blegen writes from Spring Valley.

LEFT: A profusion of box elder flowers prepare for pollination.

MIDDLE: The seeds develop as helicopter seeds, or samaras.

RIGHT: The samaras often hang tough until late fall or winter when a stiff wind may carry them away from the shade of the parent tree to increase their chance of finding open ground where they can sprout and grow in spring.

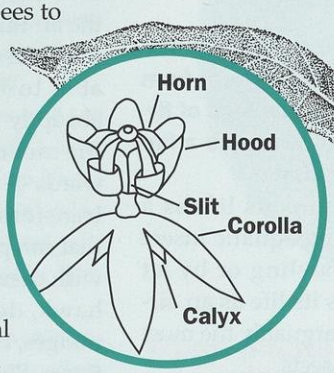
distances and at times even gain altitude. On a windy day in winter, the snow may be covered with samaras that have finally spun their way free at great distances from their parent trees, guaranteeing success of another generation of box elders — pollinated by the gentle breezes of April and spread far and wide by the harsh winds of early winter.

Milkweed love

continued from page 2

For a better understanding, let's first examine milkweed's unique flower. As each of the approximately 50 individual blossoms in a flower cluster opens, the five floral leaves of the corolla split and fold back revealing a five-part waxy cup. Each tiny nectar-holding receptacle is called a hood and within each hood, a pointed horn curves toward the flower's center. The horn's function is unknown but if you observe nectaring bumblebees, the horns seem to physically direct the bees to the nectar.

Hidden deep within the flower are two ovaries, each with its own style but sharing one stigma. Ten pollen-laden sacs lie outside and around the ovaries but are also hidden within the flower. Access to the pollen sacs is through a minute vertical slit located between each hood.



COURTESY OF ANITA CARPENTER

JIM McEVOY

Common milkweed's clusters of lilac flowerheads are as fun to explore as the pods filled with silky parachute-like seeds that develop in fall.

Each waxy-yellow pollen sac, called a pollinium, is flat and less than 2 mm long. Two pollen sacs or pollinia are joined at one end by two tiny filaments centered with a black speck called the translator. The complete structure resembles two tiny saddle bags.

When an insect crawls around and over a flower, its leg may slip into one of the slits. The leg hooks onto the translator. As the insect flies off, the leg pulls free from the slit extracting the sticky pollinia which wrap around the insect's leg. (You can duplicate this behavior by carefully inserting a needle into the slit. Hook the visible black speck, and gently lift up and pull. Out slides the sticky pollinia which adhere to the needle.) The insect flies to another milkweed flower and as it crawls around and hangs onto the bloom, its leg may slide into another slit. The opening closes around the leg and as the insect extricates itself, the pollinia may be scraped off and left behind. The intact pollen sacs must pass through the stigma, into the style and fertilize the ovary. Often only one ovary per flower matures into a follicle we commonly call a pod.

Milkweed pollination depends on several chance happenings. Will an insect's leg slide into a slit? Will the leg hook the translator? Is the insect strong enough to pull out the pollinia? Will the insect visit another milkweed? Will the pollen-carrying leg slip into the right slit? Is the insect able to shove the pollen in deep enough to be beneficial? Will the pollinia be scraped off?

Although many insects visit milkweed, increasing the chances of pollination, are all these insects effective pollen carriers? Are the feathery-light butterflies and moths, whose legs may not slip into the slits, as efficient pollinators as the heavier, bulkier bumblebees? Probably not.

Other insects succumb to the hazards of visiting milkweed, further reducing the probability of successful pollination. Besides the hidden dangers of lurking ambush bugs and flower spiders waiting to pounce upon unsuspecting diners, some insects become entangled in the sticky blossoms. An insect frantically beating its wings usually has one leg stuck in a slit. Death is sure to follow.

This complex pollination might lead one to believe that milkweed would not reproduce very successfully. Yet common milkweed, *Asclepias syriaca*, is a familiar sight along roadsides and in meadows with its delicate flowers giving way to bursting seed pods later in the fall. The reproductive strategy may be chancy, but it seems to work.

Anita Carpenter enjoys the fragrance and anatomizes flowers on walks near her Oshkosh home.

Readers Write

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@wisconsin.gov

WHITE TURKEY LEGALLY BAGGED

I was entertained by Lonnie Bernarde's turkey story "Spooked by a feathered specter" (April 2007). Though the story was interesting and well written, I was upset when I got to the end of the story to find out Lonnie had illegally transported his turkey one-half mile back to his truck before putting his tag on it. As you know, the hunting regulations clearly state that "You may not carry by hand, possess or transport a turkey unless you have lawfully killed and tagged the turkey." I would hope in the future such articles would be screened for hunting violations before being printed.

David J. Sachse
Horicon

We checked with Mr. Bernarde who offered this explanation: "I understand the concern about violating game laws. Perhaps a better word than 'tagged' would have been 'bagged' since I tagged him shortly after I took my foot off his neck. Also, I slit the tag while waiting for him to expire the first time!"

As a photographer, I was looking forward to reading this article because I also enjoy the search for a male turkey. As a naturalist, I understand hunting and its purpose to control animal populations. When I search for an animal or bird to photograph, I try very hard not to disturb nesting individuals. Most naturalists would certainly claim the same philosophy. In this article, the writer outlines the story very well

until the end. How can an experienced hunter not make sure his target is dead once shot. Allowing the turkey to "have his last moments in peace" is not normal. The remainder of the article was very hard to read and certainly not funny. Later in the article he says, "I sprinted to my gun, slammed some shells into the chamber and took off hunting for my runaway prize." This person should have broken the neck of the bird and not allowed it to suffer a slow death. Slamming shells into a shotgun and running throughout the marsh is not the way my youngest son was taught when I took him to hunter safety class. There certainly must be many stories with proper hunting events that you could tell.

Phil Billings
Oregon, Wis.

We printed the story for several reasons. The author clearly showed that he had done some things right and made some mistakes that in hindsight should have been handled differently. He had an unusual quarry. He explained both his hunting techniques and the strategy he intended to follow. He hunted his plan and still would have considered it a successful opportunity regardless of the outcome. He was willing to share the fact that he had made an error in judgment in assuming the turkey had died. He took steps to try and rectify that error as he had reverence for both the bird and the opportunity. We considered all those attributes worthy of sharing with our readers and thought the story provided lessons for others in an interesting narrative.

LAPHAM LEGACY EXAMPLE FOR ALL

The article in your February 2007 issue about Increase A. Lapham ("Citizen scientist") by Erika Janik was greatly appreciated. I had never before heard of Mr. Lapham. After reading the article three times, I realized how much we all have been benefiting from this man's works and accomplishments. To appreciate our natural resources is truly a virtue. It is good to be reminded.

Julie Rinholen
Mondovi

WHY NO PREFERENCE FOR SENIORS?

The article about bear hunting ("Learn to bear hunt," June 2007) for young people was well done and it is encouraging to see efforts to involve young people in hunting. However, I would like to know why some consideration is not given to seniors who have numerous preference points but have yet to draw a bear tag. Wouldn't it be fair to give hunters over the age of 70 (or 65) a "free" preference point in order to increase their chances of drawing a tag? A great percentage of senior citizen hunters have contributed many years of license fees for hunting and fishing so why not give them a small break? After all, seniors also have a terminal illness (not to make light of youngsters who do) called life span.

Earl Stahl
Neenah

Jon King, from DNR's Learn to Hunt Program, says the program was established to give novice hunters a chance to get out into the woods and attempt hunting without obstacles or hurdles. With so many activities competing for the time of young hunters, we needed to do what was necessary to prevent the decline of hunters in Wisconsin. "But remember, this program is for novice hunters," King says. "A novice hunter is anyone who has less than two years of hunting experience. That means anyone from 10 years to 100 can give the sport a try."

BALANCING GREAT LAKES WATER DEMANDS

I was quite disturbed by your article in the June issue ("A firm hand on the spigot") advocating the banning of any water being exported from the Great Lakes. This attitude is selfish and myopic. Wisconsin has no coal, no oil and no natural gas. Nearly all of the state's energy must be imported. I challenge you to explain how Wisconsin would cope if West Virginia, Montana, Alaska, Texas, Kuwait and others took a similar stance and banned the export of their energy supplies.

Ron Winter
Boulder Junction

We actually don't see this issue very differently. The crux here isn't about banning water diversions or exports. All the states and provinces want to manage commerce to protect regional resources and regional assets. Improving lake water quality and setting up a system for states and provinces to consider diversions in a consistent fashion is an important step.

You are absolutely right that collective decisions on communal resources have serious consequences. They can change the discussion from shared resources to economic power, just as oil producing and exporting countries have created a system that controls how we value, use, allocate and charge for limited reserves of fossil fuels.

There are similar economic and ecological costs in managing water supply even though it is a renewable resource. We need to moderate wasteful habits in how water is used, and we need to look at ourselves first. There is a difference between "hoarding" water and being prudent in balancing the needs of communities, businesses, future generations and wildlife for access to clean water supplies. The Great Lakes agreement is as much about holding up a mirror to our own activities in Wisconsin as it is about building a wall around the Great Lakes. The aim is to hold everybody accountable to the same standards, and you are right that we can't expect others to change their habits and conserve water or energy supplies if we are not willing to take those steps ourselves.

PRAISE FOR OUTDOOR EXPO

After I read about the Outdoor Expo ("Keeping connected," April 2007), our family made the drive up to Beaver Dam from Pleasant Prairie for the family portion of the Expo. It was everything promised in the article. My girls got first-hand experience in handling firearms, bows and fishing poles. They climbed into kayaks and tents (telling me how we REALLY needed to upgrade our camping gear). They touched pelts, called turkeys and climbed in blinds. The refrain of the day was, "Mom, this is so much fun!" My eldest watched in fascination while a girl not much older than her skinned an otter. Sadly, the event was sparsely attended. I can only assume that better advertising would help this really unique experience. As a result of attending the Expo, we have purchased a bow for target shooting: the mission succeeded for one family!

Linda Lynch
Pleasant Prairie

DAVE HARRIS

Creature Comforts

Shaping up for hunting season

MARK S. WERNER

It's not enough to work out yourself. Your canine companion needs pre-season hunting conditioning, too. Retrieving, pointing, flushing and tracking game can poop out your pooch if he has been taking full advantage of those lazy "dog days" of summer instead of feeling the burn of exercise.

As with any athlete, some of the most important training is that which is done during the off season. Now is the time to be working your dog. Let those retrievers roam with you as you stake out prime hunting territory. Consider working your dog with a "dummy" bird.

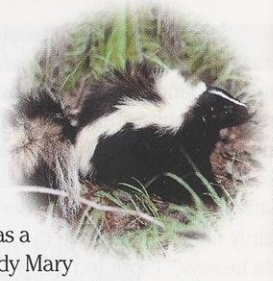
The Kettle Moraine State Forest-Northern Unit offers dry and wet training grounds for people who want to train their hunting dogs. The wet dog training area, located on Division Road just south of Highway F, is recommended for retriever and waterfowl skills training, while the dry dog training area, located on Highway U just east of Highway A, should be used for developing upland bird skills. Call (262) 626-2116 for more information.

The **Richard Bong State Recreation Area** also has space to train both hunting and sled dogs. All such activities take place in the special use zone or managed hunt areas. The Richard Bong State Recreation Area is eight miles southeast of Burlington on State Highway 142. For more information, call (262) 878-5600.

Consult the Wisconsin Dog Training and Trialing Regulations to determine if a permit is required for the type of training you plan to do. This publication (WM-444 04/2004) summarizes Wisconsin's laws, which pertain to individuals who possess a bird dog or hound dog training license. Visit dnr.wi.gov/org/land/wildlife/captive/dog_train_trial.pdf for more information.

And don't forget to provide lots of water and some "atta-boys and girls" for a job well done!

No room for Pepe Le Pew



HERBERT LANGE

Twenty years later, and I still remember the smell. It was a sort of stinky Bloody Mary cocktail — a combination of tomato juice, skunk scent and wet dog. Our collie, Midnight, had encountered a skunk and my mom got busy bathing him in the age-old remedy for deskunking — tomato juice.

From experience, I can tell you, tomato juice — and vinegar, which also is often recommended — don't work well for countering the foul smelling musk. They barely mask the odor and do not remove the smell. If your pet encounters a skunk, here is some better advice:

First, make sure your pet has not been bitten by the skunk. Skunks can carry rabies. A trip to the vet also is warranted if your pet's eyes are red or inflamed. Then, bathe the animal. Treatment is more effective if done immediately — before the dog's coat dries. Wear rubber gloves and old clothes. One bathing technique widely touted for eliminating skunk odor calls for mixing the following:

- One quart of three percent hydrogen peroxide
- One-quarter cup baking soda
- One teaspoon strong liquid soap

The ingredients will fizz when mixed and use it while it is still foaming. Keep the mixture away from the pet's eyes, nose and mouth. Leave the lather on for up to 10 minutes and then rinse thoroughly with tap water.

A bird has got to eat

It's the season for bird seed sales. In fact, many nature centers and environmental groups host fund-raising seed sales in September and October while birdwatchers beef up their supplies for winter feeding.

Watch for notices of bird seed sales in your area. The Audubon Society, local birding clubs, nature centers and even farmer's market vendors offer some sweetheart deals on their own or partner with businesses such as pet supply stores and garden centers to sell high-quality mixes on a pre-order basis.

FAVORITE BIRD SEEDS

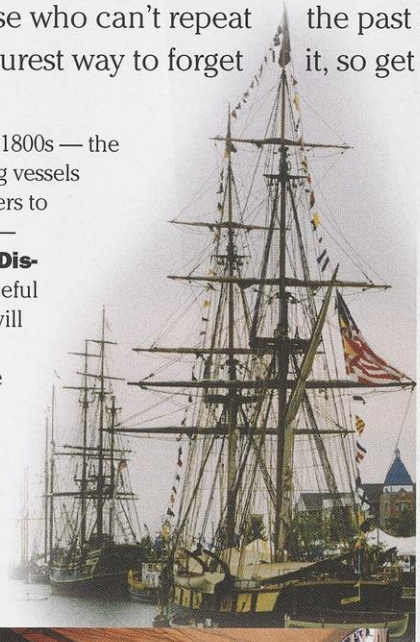
- **Black oil sunflower** – thin-shelled, high in fat: favored by grosbeaks, cardinals, finches and chickadees
- **Striped sunflower** – for larger birds that open shells like jays and woodpeckers
- **Hulled sunflower** – all meat and no mess for finches and siskens
- **Safflower seed** – songbirds like 'em, squirrels and blackbirds don't
- **Niger (thistle seed)** – finches and chickadees
- **Cracked corn** – doves, jays, and ducks

STEPHEN J. LANG

A good old time

Sure, Santayana told us those who cannot remember the past are condemned to repeat it, but TRAVELER says those who can't repeat the past are missing out on a good party. Neglecting to celebrate history is the surest way to forget it, so get out there, observe and enjoy the passage of time.

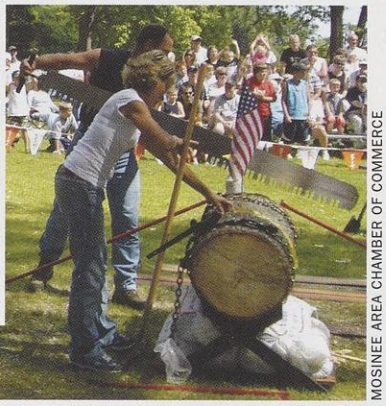
Kenosha looks back to the 1800s — the era when tall-masted sailing vessels carried cargo and passengers to and from the city's harbor — during **Kenosha Days of Discovery**, August 10-12. Graceful replicas of the "tall ships" will once again ply the waterfront at 54th Street and take visitors back in time. This maritime festival features ship tours, exhibits, sailing excursions, and enough food and entertainment to keep a swabbo grinning for the entire weekend. See www.kenosha daysofdiscovery.com or call (262) 653-4444.



KENOSHA DAYS OF DISCOVERY

Little mateys can shiver their timbers, talk pirate and tell tall tales of tall ships at the Kenosha Days of Discovery. Arrgh!

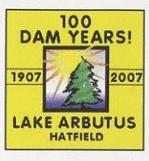
They'll be choppin', racin' and whoopin' it up when the LogJam Festival celebrates Mosinee's 150th birthday.



MOSINEE AREA CHAMBER OF COMMERCE

Logging reshaped the landscape and economy of central and northern Wisconsin in the late 19th century. At Mosinee's **LogJam Festival**, August 18-19 in the city's River Park, visitors can explore exciting, interactive and educational exhibits highlighting the experiences of early settlers in Wisconsin River country. Watch loggers demonstrate sawing, splitting, and rolling techniques, see log raft races, and enjoy a lively gathering of street merchants, a flea market, an antique/art fair, and much more. Need another reason to celebrate? It's also Mosinee's sesquicentennial. See www.logjamfestival.org or call (715) 693-4336.

Don't let the title fool you: It may be just **Another Dam Holiday**, but residents of Hatfield (pop. 5,000 summer; 50 winter) intend to make a big splash on August 11 to mark the 100th anniversary of the creation of Lake Arbutus. Join in canoe and kayak races on the century-old waterbody; on shore, visit DNR displays and see the latest boat models. Have fond memories of the lake? Go to www.lakearbutus.com and post your reminiscences to share with others.



In our December 2006 story "Across the trestles of time" we featured Badger #2, the famous "fish car" built in 1912 to carry fish fry to stock Wisconsin lakes. The railcar will be restored by the Mid-Continent Railway Museum in North Freedom when enough funds are raised to match a grant from the Jeffris Family Foundation. Help Badger #2 get back on track at the **Gandy Dancer Festival — Bluegrass for Badger #2** fund-raiser, August 12 from 11 a.m. to 8 p.m. in Madison's Central Park, 1100 East Wilson Street. The Wisconsin & Southern Railroad offers free train rides while fiddlers and pickers the Alan Munde Gazette, Nob Hill Boys, Round the Bend, Larry Penn, Jefferson County Water Street Hotshots, and Filisko & Noden provide the tunes. Enjoy food, beverages and crafts, and take in the displays on Wisconsin's fisheries history and the future of passenger rail in Madison. See www.midcontinent.org for further details.

MID-CONTINENT RAILWAY MUSEUM

Wisconsin, naturally

BLUFF CREEK STATE NATURAL AREA

Notable: Bluff Creek, and its small, clear, spring-fed tributaries, anchor this diverse natural area situated along the western flank of the Kettle Moraine. Seepage slopes, bubbling springs, calcareous mound fens, wet-mesic prairie, sedge meadow and oak woodland provide exceptional habitat for a wide variety of terrestrial and aquatic species.

STATE NATURAL AREAS

How to get there: From the junction of U.S. Highway 12 and County Highway P just a half mile east of Whitewater, go south on P 2.1 miles to the Bluff Creek bridge crossing and find the parking area west of the road. Walk east or west into the natural area. See *dnr.wi.gov/org/land/er/sna/sna271.htm* for a detailed map and more information.