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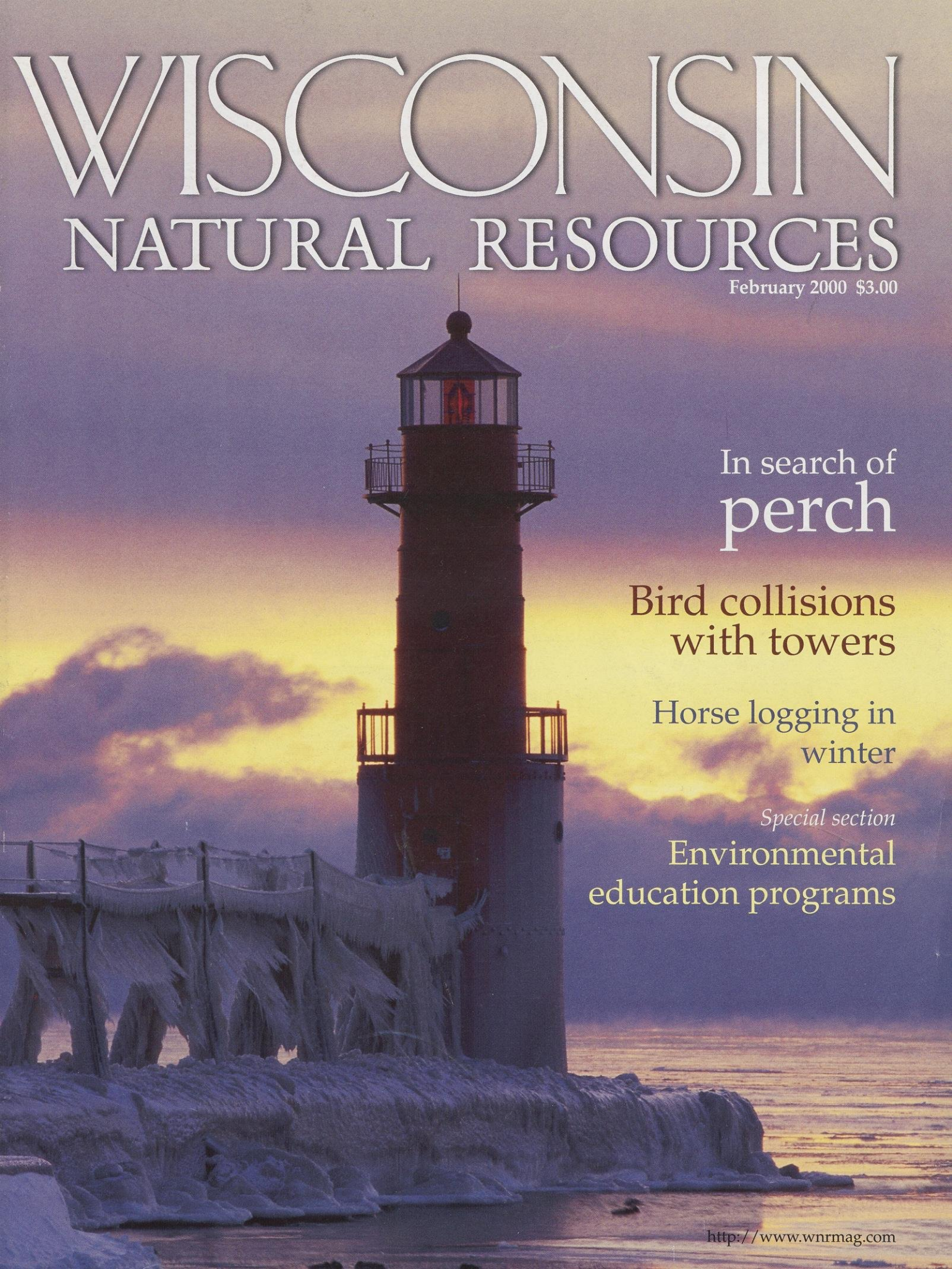

In search of perch

Bird collisions with towers

Horse logging in winter

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Get the drift?

Sculpted drifts are formed by wind, weather and whimsy.

Anita Carpenter

When blizzard winds howl and snow moves horizontally across the earth, I know a beautiful winter-white scene is being created. In the stillness following the storm, sculpted snowdrifts are everywhere: along fencerows, on rooftops, around boulders and across highways. Some drifts are gentle and graceful, shallow and wispy; others are stark and angular, deep and hardpacked. Now stationary in their elegant beauty, snowdrifts were active, moving entities as they formed under the influence of turbulent physical forces.

Snow by itself does not produce drifts; it needs to be carried on the wind. The snow crystal type and wind speed determine when snow begins to move. Light snow crystals, like dendrites, require a lower wind speed; heavier crystals, such as graupel, need a stiffer wind to lift and carry them along. The minimum speed necessary to carry the lightest snow is about 11 mph.

Wind-carried snow will not form drifts unless an obstacle is encountered. Any bump in its path will do, big or little. The obstacle deflects the air flow increasing or decreasing its speed. The obstacle's shape, size and position relative to the prevailing wind determine the shape and location of a snowdrift.

When snow-carrying wind encounters a ridge, it rises and accelerates; the greater the slope, the higher the wind speed. Air currents reach their maximum velocity above the ridge crest, then slow down on the downwind side producing a swirling wind pattern or eddy at the ridge crest. Snow is deposited in a sharply-curved formation or cornice that grows out from the crest. Under the right conditions, these drifts continue to grow and can extend quite a distance from the crest, seeming to defy gravity. On a grand scale, these drifts can be potentially dangerous if they give way under their own weight (causing an avalanche) or under the weight of an unwary skier or hiker. Similar drifts form along road cuts and on flat roofs.

continued on page 30

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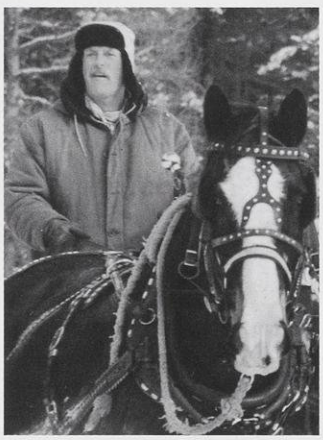
WISCONSIN NATURAL RESOURCES

February 2000 Volume 24, Number 1

DNR FISHERIES PHOTO

ROBERT QUEEN

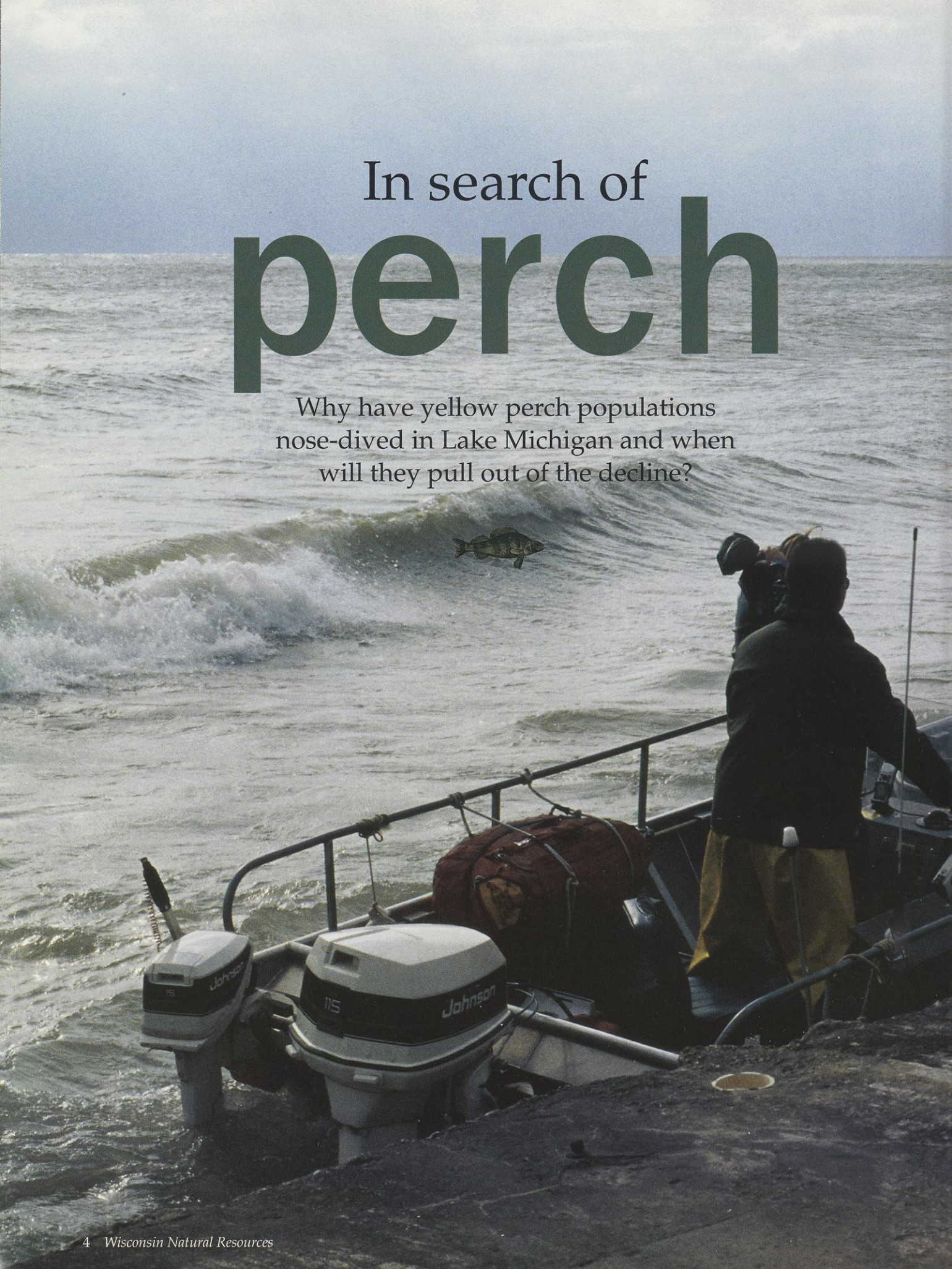


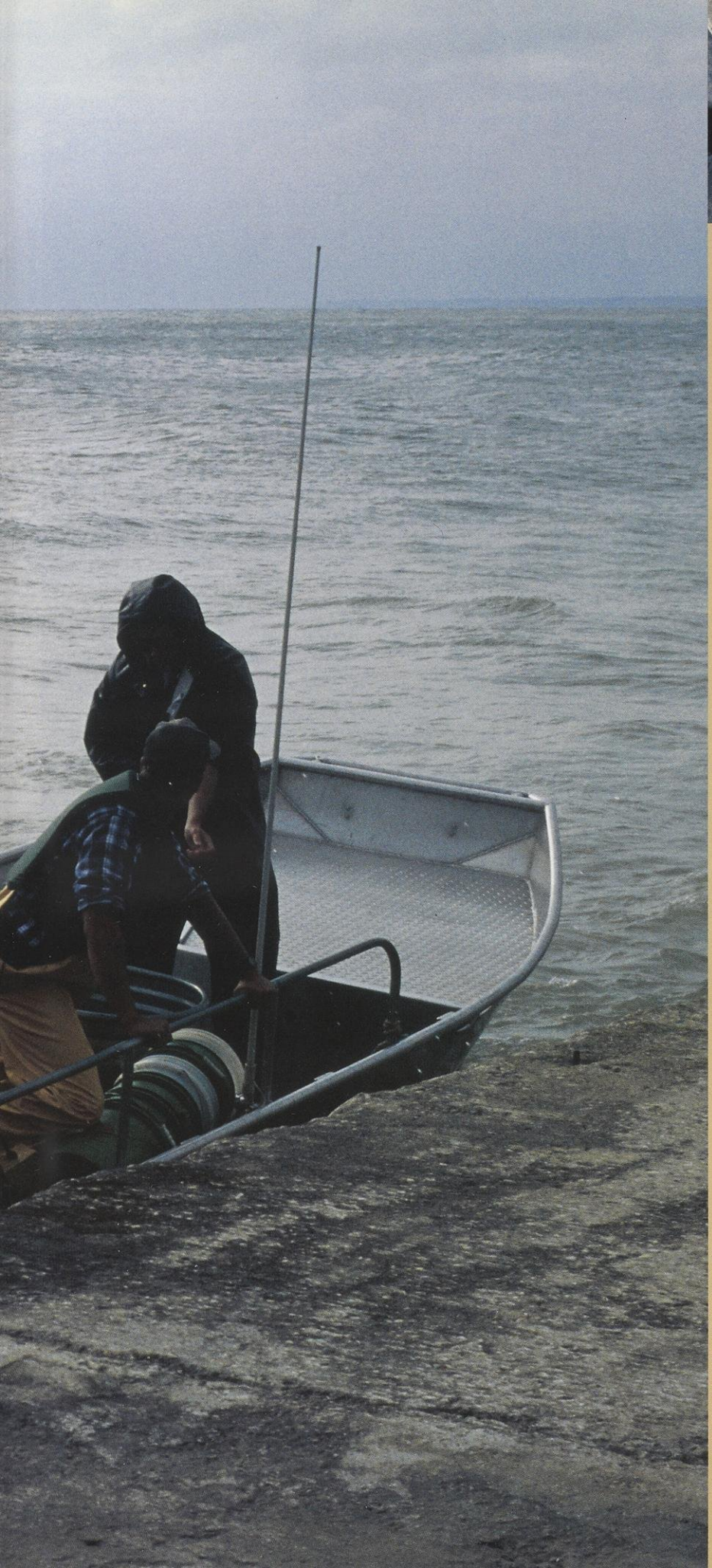
PAUL SCOTT

JIM NICEWANDER

In search of perch

Why have yellow perch populations nose-dived in Lake Michigan and when will they pull out of the decline?





(above) Each fish is measured and analyzed for clues to explain the population drop.
(left) Preparing for a cold September day of setting nets on Lake Michigan. Perch are regularly sampled from spring through late fall in all weather to gauge population changes and fish health.

CANDY SCHRANK *(ABOVE)* PRADEEP HIRETHOTA

John Karl and David L. Sperling

People all around Lake Michigan are asking questions about the sustained ten-year decline in yellow perch populations. What caused the decline? How long will it go on? What can be done, if anything, to reverse it? Unfortunately, the questions are much more abundant than the answers. Like all wild species, yellow perch are part of an intricate ecosystem that is difficult to understand in every detail.

"Lake Michigan is a huge system that constantly changes," notes Bill Horns, Great Lakes fisheries coordinator for the DNR. "There are so many factors to consider in unraveling why fish populations fluctuate," Horns says. "The size of the lake, nutrient loading, fish stocking programs, changing food sources, the influx of exotic organisms, changing land uses and fishing pressure all play a part. The changes are so dramatic that past history is not a good predictor of the future on Lake Michigan," he says. Moreover, the data on past perch populations in the Great Lakes is pretty spotty, Horns says.

Fish population trends prior to 1970 were based on records from commercial fish harvests. Those catches varied as the demand for fish changed, fishing technology became more efficient, and harvest regulations were tailored in each state. Also each state collected harvest figures in different ways, Horns says. "This absence of consistent lakewide data over time makes it difficult to interpret the decline we are seeing now," Horns says. "We really don't know if this is a crisis or a part of the natural variation in Lake Michigan."

Perch decline or cyclic dip?

Whether or not the perch decline is cyclic, it is certainly dramatic. From 1989 until commercial netting was closed in 1995, typical

yellow perch catches in commercial nets dropped 90–95 percent per outing. And approximately 85 percent of the sport angler's catch from Lake Michigan had been yellow perch prior to the population crash.

An unpopular, but necessary step to give the Lake Michigan perch fishery a chance to recover was curtailing its harvest by people.

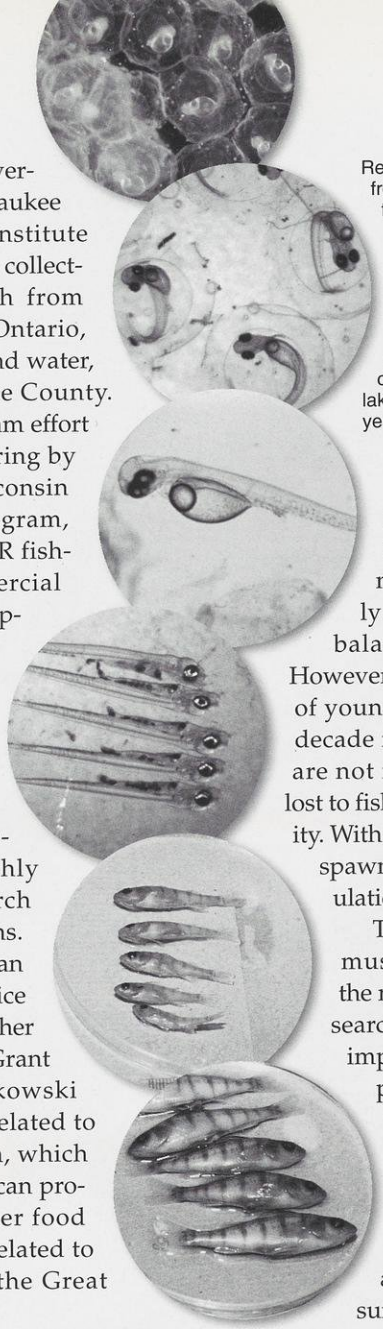
In 1995, commercial harvests were cut and sport harvests were reduced from 50 to 25 fish per day. In June 1996, sport harvests were reduced to five fish per day and commercial harvests of yellow perch in Lake Michigan were closed altogether. Limited commercial catches still continue in Green Bay, but many a Friday Night Fish Fry has switched from serving local perch to serving fish more readily available from other waters.

To better understand this precipitous population crash and better manage the fishery, agencies and universities from the four states bordering Lake Michigan are collaborating. In 1994, the Great Lakes Fisheries Commission's Lake Michigan Technical Committee formed the Yellow Perch Task Group to encourage and coordinate multistate research that is investigating the dynamics of the perch population. The Sea Grant programs of Wisconsin, Michigan, Illinois and Indiana are supporting a significant portion of this effort. Funds from the Great Lakes Fishery Trust, personnel from state management agencies, and support from commercial and sport fishing groups around the lake provide the remainder.

When are perch vulnerable?

In addition to documenting the population drop lakewide, the Yellow Perch Task Group researchers wanted to determine at what stages of their life cycle perch were most vulnerable. If fertilized eggs were not viable, then something was harming parent fish. If the eggs were fine, but the number of fish fry was low, then investigators would have to determine if fish eggs might be poisoned or preyed upon heavily after the eggs hatched. Or perhaps fry were not finding sufficient food or cover.

Scientists at the University of Wisconsin-Milwaukee Great Lakes WATER Institute compared eggs and fry collected from yellow perch from Lake Michigan, Lake Ontario, Green Bay and an inland water, Lake Mendota in Dane County. The work was a real team effort — day-to-day monitoring by the University of Wisconsin and the Sea Grant program, fish collections by DNR fisheries staff and commercial fishers, and financial support from sport anglers. This research found no problems with the earliest life stages of Lake Michigan perch. Their fertility, hatching, and survival rates were roughly comparable with perch from the other locations. However, Lake Michigan perch took roughly twice as long to develop as other perch. Wisconsin Sea Grant researcher Fred Binkowski said this is probably related to the gape of the mouth, which determines when fish can progress to the next larger food size. It could also be related to feeding behavior in the Great Lakes.



Research shows in their early life from fertilized eggs, to hatched fry, sac fry and young larvae, Lake Michigan perch develop normally. Sometime between early spring and fall, young-of-the-year perch are especially vulnerable to predators and environmental changes. Natural mortality is claiming 25 percent of the lake's perch population each year.

Binkowski's group has also preserved more than 10,000 perch specimens from this study. These will be examined for swim bladder inflation, fish size at first feeding, growth rates, abnormal development and other early life information. The research team is also maintaining live samples of the Lake Michigan perch in the laboratory to investigate their sex ratios, growth rates and survival rates.

Tests of 150 of the 3,000 larval perch raised in the lab show close to 50:50 sex ratio, so the perch decline appears to be linked to environmental causes rather than genetic problems. Tests next May or June on the brood stock raised in the lab will provide added information about perch larvae grown in the mid-1990s.

When young fish mature normally, the faster growth rate of females does not drastically upset the male/female balance of the population. However, the poor survival rates of young perch during the last decade mean that new females are not replacing the old ones lost to fishing and natural mortality. With few females available to spawn, the yellow perch population could collapse.

Though further analyses must be conducted before the results are conclusive, researchers now know several important things about the population crash: few young perch are surviving to adulthood. The causes of this "recruitment failure" are not known, but the effects are clear: with few perch surviving their early years, the average age of the population is increasing quickly. Natural mortality is now removing about 25 percent of the population each year.

The task group identified 16 factors in the early life of yellow perch that may be contributing to the population decline. These include predation by alewives, unusual weather, starvation, competition from other organisms that feed on plankton, and interference from exotic organisms like zebra mussels in the Great Lakes. Any or all of these factors may be responsible for the perch failure. Thoroughly investigating each one would require resources far beyond those currently available. Consequently, the task group is focusing on the most probable factors.

The group is also standardizing the

(OPPOSITE) PHOTOS 1–4 FRED BINKOWSKI PHOTOS 5–6 CANDY SCHRANK

PRADEEP HIRETHOTA

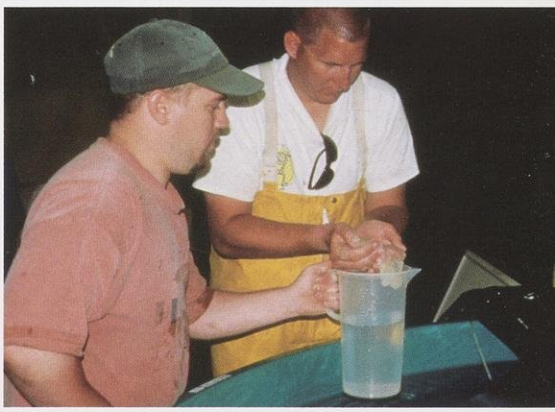
methods used to assess perch from state to state. Previously, states used different kinds of sampling gear and measured populations differently. Standardized methods will allow states to compare their year-to-year census figures in more meaningful ways.

Lake sampling gave varied results

During the summer of 1998, perch were extensively sampled around Lake Michigan. Each captured fish was measured, marked and released. Subsequent resampling and recounts of the numbers of marked fish give researchers a statistical means of estimating the population size. Yellow perch were found to be reproducing throughout the lake, but the numbers were highly variable. According to Bill Horns, perch reproduction in 1998 was good in Indiana waters and moderate in Green Bay, but it continued to be poor in other areas of the lake.

In another study from summer of 1998, Binkowski and Brian Belonger of Wisconsin DNR looked at the yellow perch of Green Bay, where more perch appear to survive to adulthood than in the rest of Lake Michigan, but that's not unusual. Historically, strong year classes in Green Bay have not coincided with strong classes in southern Lake Michigan. Yet, Binkowski and Belonger found reasons for cautious optimism: The sum-

Research teams from state DNRs, universities, Sea Grant Institutes with help from commercial fishers and sport anglers are assessing perch. *(top)* Sampling and tagging fish during the spring spawning season.
(left) DNR Fish Health Specialist Susan Marcquenski examines perch reproductive systems and tissues.
(below) Preparing ribbons of yellow perch eggs for rearing at the UW-Milwaukee WATER Institute.



CANDY SCHRANK *(RIGHT)* FRED BINKOWSKI

mer produced the sixth largest class of young perch in the last 20 years and the highest since 1991. This appears to be the result of an unusually warm spring, in which perch grew faster and were vulnerable to predators for a shorter period of time. Furthermore, two of their common predators, alewives and white perch, were less abundant in 1998 than in recent years.

The 1998 higher survival rate will probably result in greater numbers of spawning fish in the spring of 2000, but many unpredictable factors could affect the young perch between now and then. To fully restore the perch population of Green Bay, strong year classes would be needed for several years in a row.

Narrowing reasons for the population dip

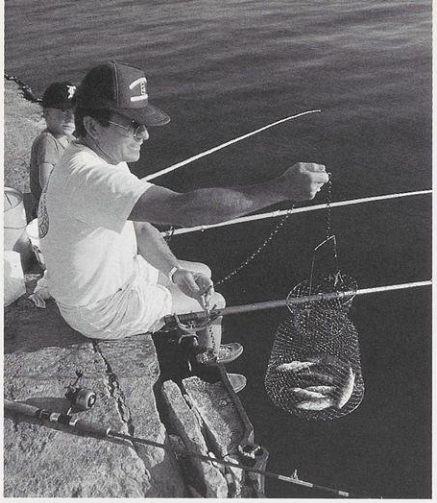
Scientists from several institutions continue to piece together other aspects of perch research. The field teams include specialists from Ball State University in Indiana; Central Michigan University; Michigan State University; Purdue University; Loyola University; natural resource agencies from Wisconsin, Michigan, Indiana, and Illinois; and the Illinois Natural History Survey.

Their efforts are helping the Yellow Perch Task Group better understand the population dynamics of this favorite fish. Sea Grant's Binkowski likens the work to solving a murder mystery.

"Researchers can't really explain why perch populations are declining, but they keep crossing more and more suspects off the list. This 'crime' was committed in 1990 and the trail is pretty cold," Binkowski told anglers at a summer update on perch research in Racine.

DNR fisheries biologists had documented and predicted the perch decline in presentations to the Natural Resources Board as early as 1994. Though the decline was predicted at a time anglers were still enjoying excellent fishing, surveys of young fish showed the populations of catchable-sized fish would drop dramatically.

DNR netting crews in southern Lake Michigan in summer 1998 found the most young perch and three-year-old



ROBERT QUEEN

Perch populations would have to rebound substantially for three successive years before commercial catches might be reinstated and sport harvests relaxed.

perch in the last seven years of sampling. And the sex ratio was 58 percent male to 42 percent female — much nearer the 50:50 split that can help populations rebound. Jim Francis, who led the southern Lake Michigan Work Unit for DNR cautioned that we'd need at least three solid years of similarly good year classes to form a trend and consider the population as recovering or rebounding.

As Binkowski told a *Wisconsin Outdoor News* correspondent, it doesn't appear that perch populations dropped from fertility or genetic weaknesses, so researchers are now examining how weather, food shortage, predation and competition from exotic organisms could be harming perch.

It's possible that the invasive zebra mussels are part of the problem. The mussels are exceptionally efficient at filtering fine algae from water. Phytoplankton and small zooplankton are important food sources for larval perch once their yolk sacs are depleted after their first week of life. Removing the mass of fine plants and animals also clears the water and may make larval perch more vulnerable to predators who are sight feeders.

Most of the larval perch caught are sac fry — just a few days hatched. "We don't catch them when they get larger than 8mm until they reappear in our shoreline seines later in August." Binkowski said. "We still don't know where the perch are going as young larvae or what happens to them until we capture them again in August."

Larval perch have been found in the stomachs of 7 of 16 species studied by Belonger in Green Bay. Two Great Lakes invaders, white perch and alewives, consume higher percentage of larval perch in their diet as well.

"I wouldn't say predation is the whole reason for poor recruitment," Belonger said, "but it's significant in some years here in Green Bay."

Spring weather may also be an important factor in Green Bay. Belonger theorizes that pulling off a strong year class in the Bay requires steady warming trends in spring for eggs to hatch and reach the larval stage. Whether storms, steady warm-up or other factors prove more important isn't known.

In southern Lake Michigan, abundant alewives remain a strong suspect. They feed voraciously on larval perch between one-third to one-half inch in size.

A long, slow recovery

Even if scientists and managers do come to understand the causes of the decline, they may not be able to reverse it. For example, little could be done to rid Lake Michigan of zebra mussels, even if they are a significant factor in yellow perch decline.

It also could be that the yellow perch population has been fluctuating for many years. Although the current crash is the most severe, it may be part of normal ups and downs of the population: the nature of perch nature.

Binkowski sensed how difficult it is for perch anglers, commercial fishers, restaurateurs and Friday Night Fish Fry hounds to stay at bay as the research slowly unravels the combination of factors that may explain why perch declined and how they might recover.

"I sense the frustration," Binkowski said. "We're making strides, but Lake Michigan is a complicated ecosystem, and it's not likely there will be one definitive cause or answer that can explain why the population dropped or how soon it may recover." □

John Karl is a science writer with the University of Wisconsin-Madison Sea Grant Program. David L. Sperling edits this publication.

STEVE UGORETZ

Battered by the airwaves?

The push to digital and cellular broadcasting puts migratory birds on a collision course with technology.

By Wendy K. Weisensel

Thousands of colorful songbirds create magic in the air as they wing their way back and forth each spring and autumn on their annual migration. That such tiny fluffs of feathers can traverse such great distances against many odds is among the reasons humans are so entranced by wild birds.

But there's another kind of airborne magic — the invisible kind thousands of broadcast and telecommunications towers send and receive – that is competing with birds for airspace. It's not the signals, but the towers themselves that have added to the growing risks migrating birds face both on their perilous seasonal journeys and in the places they live each summer and winter.

"Migratory songbirds entering the 21st century face a lot of threats," says Bill Evans, an ornithological consultant affiliated with Cornell University in New York, who specializes in the nocturnal acoustical monitoring of migrating birds. "Collisions with telecommunication and broadcast towers are one cause of songbird death we can do something about."

Birds have died by the thousands in collisions with lighted television and radio towers around the country since the 1940s. While incidents involving massive bird kills occur infrequently, there's concern among ornithologists that bird deaths will greatly increase because of the explosive growth in the number of towers being sited in the U.S., Canada and Latin America to provide wireless services such as mobile telephones.

There's also a U.S. government mandate requiring television stations to convert to digital television by the middle of the next decade, which is already leading to the construction of more towers around the country, especially the taller ones that are thought to cause more of a collision risk for birds.

The growth in tower numbers comes when evidence shows the numbers of songbirds migrating to and from the tropics — "neotropical migrants" — have significantly declined, mostly due to habitat loss and related problems. According to the Ornithological Council, of the 124 species on the 1995 List of Migratory Nongame Birds of Management Concern in the U.S., 60 are neotropical migrants.

COURTESY OF BILL EVANS FROM FAA REGISTRATION RECORDS

Wisconsin has between 900–1,000 communication towers higher than 200 feet but only 30 higher than 800 feet (shown in red) believed to pose a higher risk to migrating birds.

Unfortunately, the types of dead birds most frequently found at tower sites are neotropical species such as warblers, thrushes, vireos and flycatchers. Ironically, scientists are pretty certain about this because, armed with collector's permits, the scientists themselves and amateur bird enthusiasts have been visiting tower sites for years as favored places to gather dead birds for study purposes.

So how big an impact do towers have on bird deaths? Evans and other scientists put the estimate at a conservative two to four million songbirds a year in the eastern United States, but the overall impact of tower collisions on bird populations on a national, regional or species scale is unknown. Research projects on the subject have dwindled just when more information is needed to start forming solutions.

Many forces claim songbirds

Despite their concern, avian researchers say tower collisions are not the major cause of songbird declines. Natural causes, such as disease or exhaustion from the rigors of migration, take a toll. Thousands of birds also can be killed in storms that occur at peak migration periods, but historically bird populations have been large enough to withstand the infrequent impact of storm deaths.

Birds also die from crashing into other manmade structures, including utility wires, buildings — especially tall, lighted buildings with reflective glass — lighthouses, fences and vehicles.

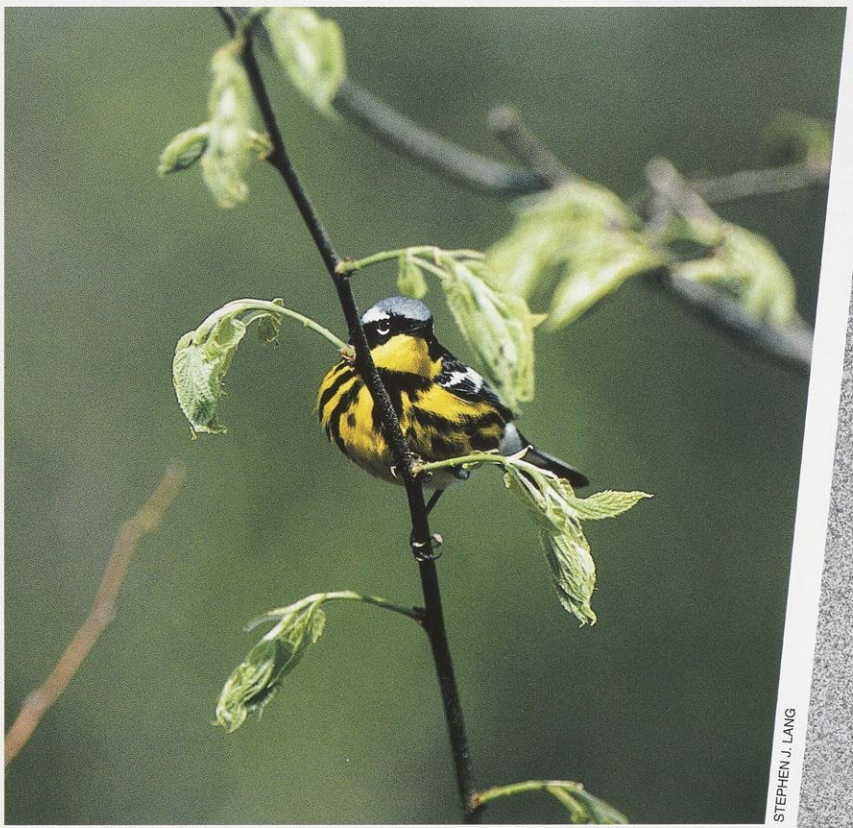
The biggest culprits thought to be causing songbird declines are changing land uses in both North and South America that fragment the forests and grasslands various migratory species depend upon for survival. "Changing farming practices and development also contribute," says bird expert and Madison resident Sam Robbins, author of *Wisconsin Birdlife.*

Fragmented habitat leads to secondary causes of bird mortality that over time can make a significant dent in bird populations. For example, predators that thrive in fragmented landscapes, such as raccoons, skunks and cowbirds can cause a large increase in nest egg destruction. Also predation by household and feral cats claims far more songbirds — an estimated 8 to 220 million birds annually in Wisconsin alone. Unless more information is gathered soon and appropriate actions taken, scientists believe migratory songbirds will increasingly suffer from a combination of causes driving down their abundance, including tower collisions.

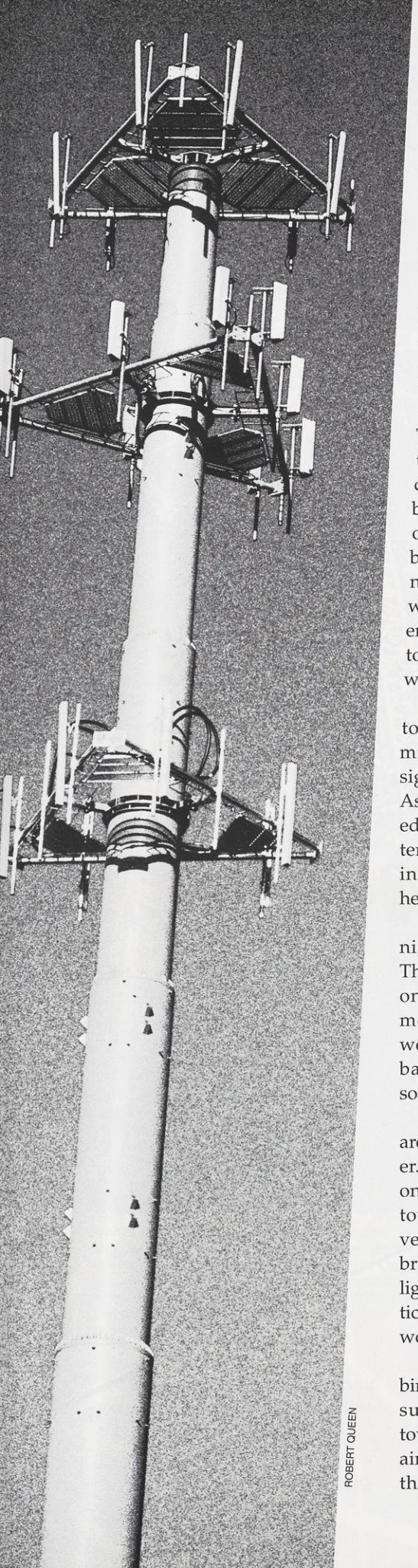
"It's the cumulative sources of mortality piled one on top of another that is the cause for concern here," says Steve Ugoretz, an environmental impact project manager for the Wisconsin Department of Natural Resources who is representing the agency on a recently-

STEPHEN J. LANG

Especially on foggy nights, long-distance migrants like the red-eyed vireo *(right)* and magnolia warbler *(below)* may orient to high tower lights as false stars, and circle towers until they are exhausted or collide with wires, the towers or other birds.



STEPHEN J. LANG



ROBERT QUEEN

formed national group analyzing the tower kill problem.

Ugoretz, Evans and others believe straightforward solutions can be found, but cooperation among broadcasters, telecommunication companies, conservationists, and federal and state agencies is needed.

Tall towers send false signals

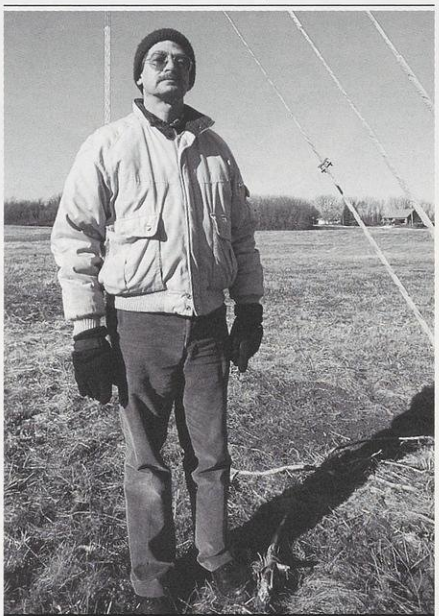
The lights on taller towers are thought to lead to the most bird deaths by confusing the different cues birds use on their journeys to nesting or wintering grounds. While some birds die in tower collisions on clear nights, most bird-tower deaths occur when there is fog or low clouds. Towers featuring flashing red lights appear to confuse birds more than those with white strobe lights do.

Towers 200 feet or higher must be lit to comply with Federal Aviation Administration (FAA) regulations designed to aid safe airplane navigation. As of June 1999, more than 40,000 lighted towers and tower farms were registered in the FAA database of obstacles in the U.S. that exceed 200 feet in height.

Most species of songbirds migrate at night, flying aloft at 1,000–2,000 feet. They rely on many aids to guide them on their journey, including the sun, moon and stars, landscape features, weak magnetic fields, polarized light, barometric pressure, low-frequency sound waves, even odors.

Celestial cues and landscape features are obscured in foggy or cloudy weather. In those conditions, birds must rely on other cues to orient themselves. Lit towers disrupt these cues, just as drivers are cautioned to avoid using their brightest headlights in fog because the light refracts off the airborne water particles, making the view of the road even worse.

Something similar may happen to birds when they fly into the lighted area surrounding a tower. Light from a tower refracts off water particles in the air. Birds use the increased visibility as their strongest visual cue for navigation. The birds keep the light at right angles to their flight to keep going in the same direction, similar to the way they would navigate in relation to natural sources of light, such as the polarized light the sun casts into the sky after sunset. The birds become reluctant to leave the lighted area.



ROBERT QUEEN

It's the cumulative sources of mortality piled one on top of another that is the cause for concern.

Steve Ugoretz

The numbers of birds caught in such a situation can run into the hundreds and thousands during peak migration periods. As more and more confused birds funnel into the lighted area, they mill round and round uttering distress calls. Death most often occurs when the birds run into guy wires supporting the tower, hit the tower itself, or collide with other birds.

Bill Evans has witnessed songbirds flying into guy wires. He's also recorded distress calls on his acoustical monitoring equipment at towers and other sites. "Those sounds just hit you inside," he says. "They motivated me to study this more closely and try to do something

BILL EVANS

(above) More than 970 birds died in collisions around one tower in New York State on a foggy October night in 1974.
(right) Shorter towers with antennas from several companies, changes in tower lighting, and self-supporting tower designs may help reduce bird mortality with towers.

about it." Evans runs a website, www.towerkill.com, devoted to sharing information and finding solutions to the bird-tower collision problem.

According to the Ornithological Council, of the five long-term studies that have been conducted at single towers 800 feet tall or higher, annual documented mortality ranged from 375 to 3,285 bird carcasses per year (20-year average). About half the birds were found dead over many months rather than at single night catastrophes.

Kills have been observed at towers all over the eastern United States, including Florida, Tennessee, Kansas, New York, New Hampshire and West Virginia. The most well-known series of tower kill incidents — documented in a set of data Evans calls "phenomenal" — occurred right here in Wisconsin as observed by Dr. Charles Kemper, a physician and bird enthusiast who is also a past president of the Wisconsin Society for Ornithology.

From 1957–1994, Dr. Kemper regularly collected dead birds at a TV tower in Eau Claire. During that period the kill totaled 121,560 birds of 123 species. A thousand or more birds were killed at this tower on each of 24 nights since 1957. A record 30,000 birds were estimated killed on one night in the mid-1970s.

"I originally began collecting these birds because they provided a wonderful tool to help us know when each bird species migrated," he says. "The staff at the station really weren't aware of the

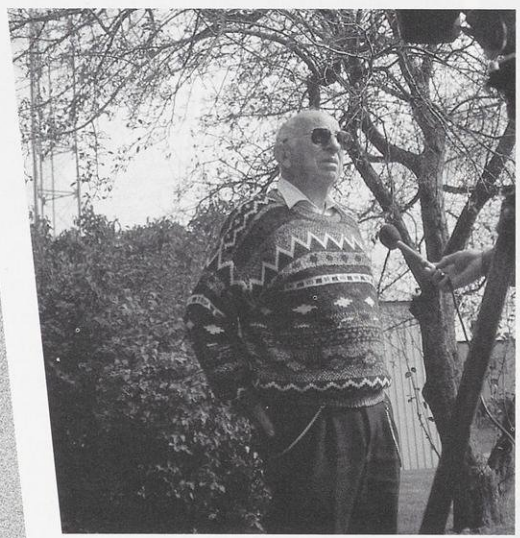
numbers of birds killed at their tower because the staff were rarely there at dawn back then, which I learned was the best time to pick up the birds before predators got them."

Dr. Kemper noticed bird deaths dramatically rose after the station put up a taller tower in 1956. The new one was about 1,000 feet high, twice the height of the previous tower. "One day the county public health department called because all these dead birds were being found near the tower site; they thought the birds might have been dying from a type of disease."

Dr. Kemper said he didn't inform Eau Claire TV staff of what he found over the years because he wasn't sure how important it was for them to know and he didn't want to embarrass them by telling them. Today, WEAU has two towers — the old, 960-foot one within the city and the station's main, 2,000-foot tower located 30 miles away in rural Fairchild.

Cheri Weinke, manager of WEAU-TV for 19 years, says to her knowledge very few tower-bird kill incidents have occurred at her station in recent years, an observation shared by Dr. Kemper, who says bird deaths at the Eau Claire tower dropped after the 1960s for unknown reasons. According to some ornithologists, the drop could be due in part to the overall decline in migrating songbird numbers monitored since then. Dr. Kemper says another factor could be the growth in the number of towers that has occurred since the 1960s, which could be dispersing bird deaths at towers over a wider area.

"Predators are very efficient at picking up these bird carcasses, so it's possible bird deaths may not even be noticed by TV station employees much of the time," he says. Kemper suggests predation could be another reason why few birds are being found at the Eau Claire tower. "A colony of gulls established itself near that tower in recent decades, and they may be scavenging the bird carcasses before anyone else sees them," he says.



STEVE UGORETZ

From 1957 through 1994 Dr. Charles Kemper collected and documented birds dying in collisions at the Eau Claire TV station tower behind him. Only recently have birders, agencies and broadcasters started talking to develop ways to reduce the threat to birds while sustaining growing demand for communications airways.

ROBERT QUEEN

Birds get caught in an invisible network

The number of bird deaths could go up around Wisconsin and the U.S. because more towers, including taller, lighted ones, are being constructed or retrofitted to serve the broadcast and telecommunications industries. At the current rate of construction, the Ornithological Council says the number of towers in the U.S. will likely double to 80,000 by 2010. A similar expansion is underway in Canada and Latin America.

The Telecommunications Act of 1996 is partly responsible for the U.S. tower explosion by accelerating construction of a massive telecommunications infrastructure. According to industry information in a Federal Communications Commission (FCC) news release, numbers of customers using mobile phone services, which rely on "personal communication system" (PCS) towers, already has rapidly increased from 24 million subscribers at the end of 1994 to over 78 million in 1999.

The wireless gold rush is well underway in Wisconsin, says John Pohlman, an environmental reviewer with the DNR's Bureau of Endangered Resources. Company representatives who have contacted him talk about trying to locate a PCS tower every five miles to improve transmission to customers.

Pohlman uses information in the DNR's Natural Heritage Inventory (NHI) to evaluate the impact of proposed projects around the state, such as tower sitings, and to protect rare resources. The inventory maintains data on the locations and status of rare species, natural communities, and natural features in Wisconsin.

"Requests for checks of our Natural Heritage Inventory from the telecommunications industry have been very heavy, especially over the last year," he says. "They're the number one request we get by far. Volume is so high we've trained some of the industry consultants to handle initial NHI screenings themselves so that the DNR examines only those that require more analysis."

Pohlman says PCS towers pose little threat to rare plants or animals in terms of disturbing the soil. "A lot of these towers are located in previously disturbed areas, with most located along major roads," he said. As might be expected, volume is highest in southeastern Wisconsin where the state's population is highest. He has found that the height of some proposed towers is increasing, but the number of towers going up is being minimized somewhat because telecommunications equipment is being sited on existing structures about half the time.

"The main environmental problem we are concerned about with telecommunications towers is the death of birds and bats," he says.

Racing a deadline to modernize

Digital TV will add even more towers to the landscape, including taller ones. Digital TV (DTV) is a new broadcast technology that will transform TV, allowing broadcasters to offer free TV with movie-quality picture and CD-quality sound. Digital technology will also enable the rapid delivery of a large amount of informational services over TV sets and free up the valuable broadcast spectrum for use by other informa-

tion and communication services.

According to the FCC, which regulates interstate and international communications by radio, television, wire, satellite and cable, all TV stations will need new transmitter, antenna and production facilities. Some TV stations will have to modify their towers or build new ones for their DTV antennas. Broadcasters may need to get local or state government approvals regarding zoning, structural engineering, construction safety and other issues.

DTV towers are already poking into the sky around the U.S. because of aggressive federal deadlines driving the digital conversion. Stations making up the top 10 television markets — reaching 30 percent of U.S. households — were given until May, 1999 to go digital; stations in the next 11 to 30 markets, which reach another 53 percent of U.S. households, were given until November, 1999.

Wisconsin TV stations occupy smaller markets and have more time to comply with federal deadlines. John Laabs, director of the Wisconsin Broadcasters Association, says Wisconsin has 40 commercial and noncommercial television stations that must adopt digital transmission by May, 2002 for commercial stations and a year later for noncommercial stations.

"Each station will have to decide for itself whether it needs to build a new tower, use its existing one or team up with other stations that also need digital antennas," he says. "Those decisions will be based mostly on competitive factors and cost."

Laabs says not all stations broadcasting in Wisconsin will need to build a new tower. Some stations, such as several in Madison, will use a "candelabra," which consists of one tower carrying multiple antennas for multiple stations. Some new towers could be taller if a station decides to be more competitive by broadcasting its signal a longer distance. He predicts the total number of TV transmission towers in the state following the digital conversion will approach 50 to 60 from the current 40.

The digital shift does not come cheap. Smaller stations will need to invest $3 million to $6 million, Laabs estimated, while the price tag at Milwaukee stations will total around $6 million to $12 million.

A similar digital transition for radio is less clear, except that it won't be as costly, Laabs said. The FCC has not okayed a single standard for transmitting radio digitally, so stations may decide to do it on their own for competitive reasons or wait for an FCC mandate.

Broadcasters and customers left in the dark

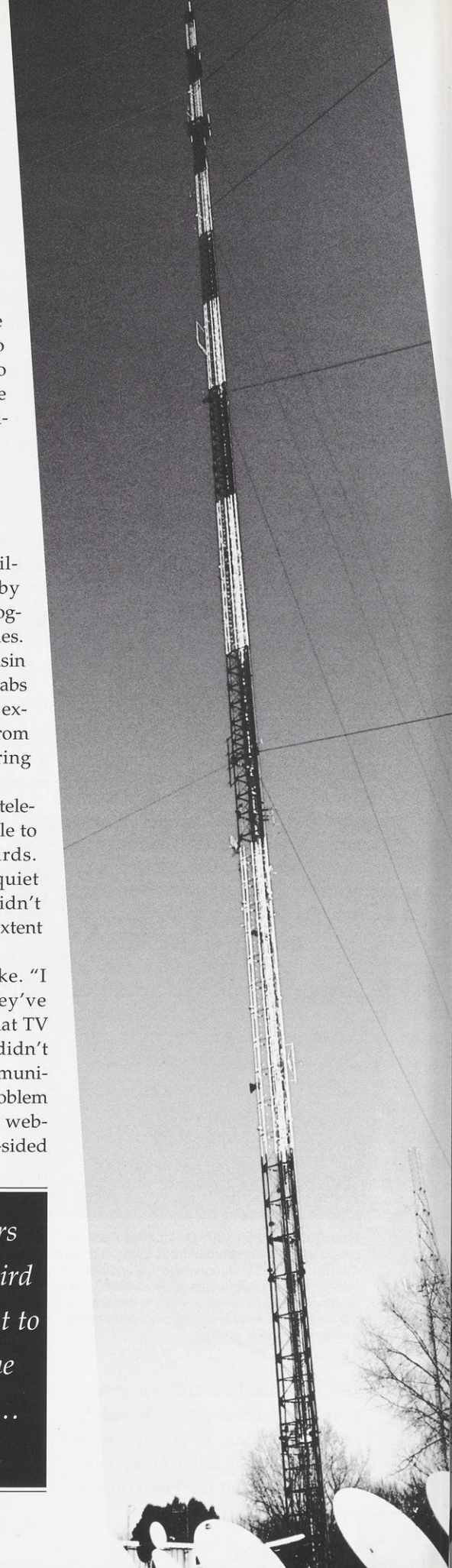
Despite all the information available about bird deaths caused by towers, the problem was little recognized outside ornithological circles. In 12 years as head of the Wisconsin Broadcasters Association, John Laabs said he never knew the problem existed until he got a call in 1999 from the DNR's Steve Ugoretz inquiring about the issue.

Bird expert Sam Robbins says television stations didn't want people to know that TV towers killed birds. "People who man towers kept quiet about these bird deaths. They didn't want to alarm the public on the extent of this problem," he said.

Bill Evans has a different take. "I blame the ornithologists — they've known for more than 50 years that TV towers kill birds, but they sure didn't make the broadcast and telecommunications industries aware of the problem until recently," he says. Even his website says the situation "has blind-sided

People who man towers kept quiet about these bird deaths. They didn't want to alarm the public on the extent of this problem...

Sam Robbins



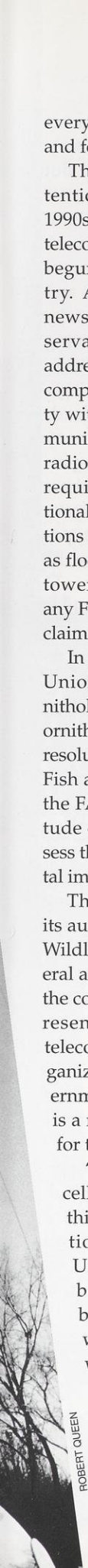
everyone — conservationists, industry and federal agencies alike."

The problem finally came to the attention of federal agencies in the late 1990s, even though new broadcast and telecommunications towers had already begun sprouting up all over the country. A 1998 issue of Bird Calls, the newsletter of the American Bird Conservancy's Policy Council, notes that addressing the tower kill issue has been complicated by a separation of authority within the FCC, where wireless communications fall under one bureau, and radio and TV in another. The agency is required to pay close attention to National Environmental Policy Act regulations covering such environmental risks as floodplains or historic sites, but bird-tower deaths have entered into few if any FCC licensing decisions, the council claims.

In 1998, the American Ornithologists' Union, the Association of Field Ornithologists, and the Cooper and Wilson ornithological societies approved a joint resolution strongly encouraging the U.S. Fish and Wildlife Service to work with the FAA and FCC to study the magnitude of the tower kill problem and assess the need for a national environmental impact statement.

The Fish and Wildlife Service used its authority under the federal Fish and Wildlife Coordination Act to bring federal agency officials together to address the concerns. Also on the group are representatives of the broadcast and telecommunication industries, bird organizations, universities and state government agencies. The DNR's Ugoretz is a member of this group, which met for the first time last summer.

"Right now, Wisconsin has an excellent chance of getting a leg up on this issue to help contribute to a national consensus on solutions," Ugoretz says. John Laabs says he'd be willing to discuss migratory birds and tower collisions further with his organization's board and with the DNR. "If it really is an issue, then there ought to be a concern," he says. "My industry needs more information about this issue."



ROBERT QUEEN

Changing lights, heights and designs to make towers less of an attraction

Though the issue finally gained momentum late in the digital TV and telecommunications rush, solutions may not be far off, and some actions, such as co-location of towers, are already being taken. In general, solutions lie in making towers more "bird-friendly" by siting towers carefully, adjusting tower design where possible to eliminate the need for guy wires and adjusting tower lighting to make it less attractive to birds.

I blame the ornithologists — they've known for more than 50 years that TV towers kill birds, but they sure didn't make the broadcast and telecommunications industries aware of the problem until recently.

Bill Evans

Tower lighting — When fog or clouds dissipate around towers known to kill birds, observers have noted that the birds previously flying confusedly around the lit towers soon reorient themselves and fly off. That silver lining makes researchers believe that changes in tower lighting might spare birds even as more towers go up. Certain colors of lights or changes in flashing intervals may confuse birds less.

To conduct such research, the FAA could give tower owners permission to change lighting systems so researchers can compare effects of different types of lights and illumination intervals.

"We'd certainly change our tower lighting if the FAA and FCC allow us to make changes, but the lighting is there to protect people in airplanes, so we wouldn't do anything to adjust lighting without federal approval," WEAU-TV station manager Weinke says. Local residents must be factored into any lighting plan for towers located in or near residential areas, she notes, as certain types of outdoor lighting can be annoying to people.

Because stations already facing the high costs of converting to DTV may be reluctant to change lighting even with federal agency approval, John Laabs suggests regulators could perhaps give stations more time to change lighting rather than make any mandate immediate. "More time to comply would minimize the already high costs stations expect to experience in their digital conversion," he says.

Another possible solution the aviation and communications industries could explore, Dr. Kemper suggests, is the use of satellites to map tower positions and heights, possibly reducing the need for tower lights while still ensuring aviation safety.

Tower height and design — Guy wires are the main cause of bird death at tower sites, so reliance on self-supporting or other tower designs may offer solutions. Lower tower heights remain a possible option as well. Dr. Kemper believes the FCC should consider towers less than 500 feet tall, which may spare many birds, though little formal research has been conducted on the impact of shorter towers on bird deaths.

"The federal government already has a policy against tall towers," he says. Although there is no absolute height limit for antenna towers, both the FCC and FAA frown upon structures over 2,000 feet above ground as being "inconsistent with the public interest" and a hazard to air navigation. Local opposition already has arisen in some states where very tall TV towers are being proposed. The burden is on applicants to overcome the federal agencies' position. DTV stations do not always require very tall towers, the FCC says — the height requirement is no different than for analog TV (the kind currently being broadcast).

Tower sighting — Tower owners

could co-locate their equipment where possible. Federal regulation does not mandate the co-location of communication antennas nor does it require that communication companies show that no other existing structures suitable for antenna siting are available. Since broadcast towers are very expensive to build, stations already try to consolidate towers at existing sites, Weinke said. WEAU won't be building a new tower, she says; the station plans to retrofit one of its existing towers to provide digital television.

Tower sitings in sensitive areas also could be limited. While the DNR in Wisconsin has little or no regulatory authority over tower siting, the agency has encouraged telecommunication representatives to consider alternatives if a tower siting proposal may affect natural resources. "One firm wanted to locate a new transmitter near the southern unit of the Kettle Moraine State Forest. We worked with the company and in a few phone calls, found a nearby existing tower that was satisfactory," Pohlman says. After a few months and an ownership change, a deal was worked out and the original firm ended up co-locating its equipment on the existing tower.

The federal Telecommunications Act of 1996 forbids towns from barring towers completely and denying access. But the law does allow local governments great leeway in restricting the height, appearance and location of towers. A Portage County ordinance that went into effect last year to protect birds and other natural resources prohibits telecommunications facilities from being sited in floodplains, wetlands, shorelands and conservancy-zoned districts.

Bird-tower research — Standardized surveys coordinated across many towers in a flyway or multistate geographic region could help researchers determine the magnitude of the tower kill problem and discover which types of towers and lighting systems are the least harmful. Tower owners also could give scientists permission to study bird mortality at their towers, and the FCC could require owners to allow tower research to generate enough national data to evaluate the effectiveness of various prevention methods.

"A couple years of research could yield fairly simple solutions that could spare the unnecessary death of lots of birds," says Bill Evans. He hopes industry could help pay for some of the research.

Steve Ugoretz says nonprofit birding and conservation organizations may also wish to contribute to these study efforts to conserve bird populations in North, Central and South America, and prevent more songbird species from becoming threatened or endangered.

Wisconsin — home to many distinguished bird experts and thousands of bird lovers — has a strong history of taking actions to protect wild birds and their habitats. Ugoretz believes cooperation among broadcasters, telecommunication companies, government agencies, bird experts and the public can shape an intelligent national policy soon so actions can be taken this decade. □

Wendy K. Weisensel works for DNR's Bureau of Communication and Education in Madison.

STEPHEN J. LANG

Wilson's warbler, one of the beauties that makes bird watching an enjoyable, widely-enjoyed activity and a big business.

Why care if some birds die at TV towers?

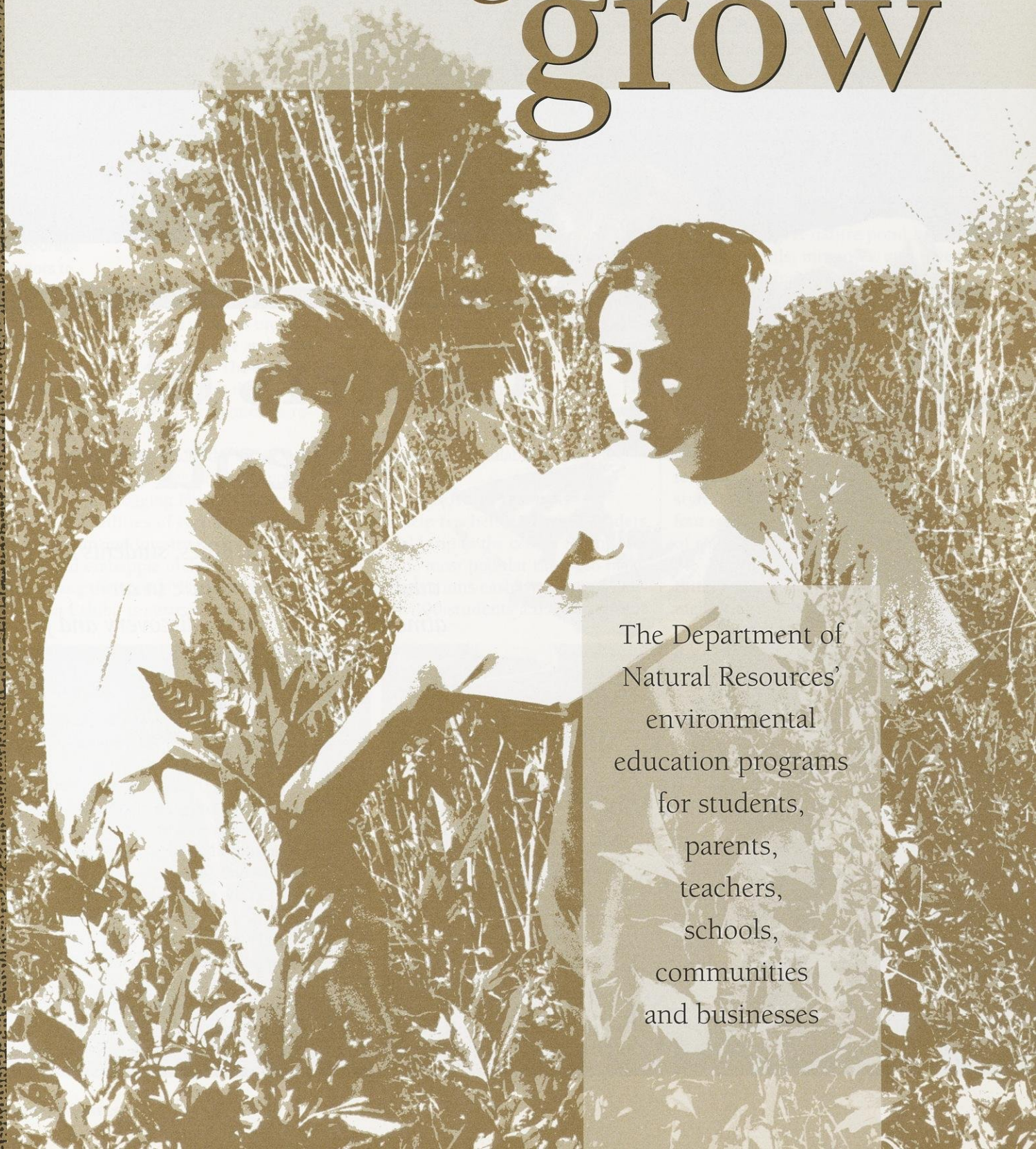
Birds are critical links in native ecosystems. Wild birds pollinate plants, distribute seeds and eat enormous numbers of insects. According to the Ornithological Council, on average, a pair of adult warblers removes caterpillars from more than a million leaves in the two to three weeks from the time the pair's young hatch until they leave the nest. This behavior provides enormous benefits to forestry and agriculture.

Birds are big business. While broadcast and wireless technologies take up a lot of people's leisure time, money, and support highly competitive industries, birds and birding also involve a lot of people and pack a financial wallop in Wisconsin and nationally. The 1996 federal Fish and Wildlife Service outdoor recreational survey reports that more than 1.65 million Wisconsin residents over age 16 participated actively in wildlife watching, photography, bird-feeding and maintaining natural areas for wildlife. Most of this activity was directed toward birds.

The dollar amount spent in Wisconsin for wildlife watching activities totaled nearly $913 million and did not include amounts spent on fishing ($1.1 billion) and hunting ($855 million). Trip-related expenses for wildlife watching amounted to $436 million, while equipment such as binoculars, bird feed, film and cameras accounted for $476 million.

Birding is reportedly second only to gardening as the most rapidly growing leisure interest in the U.S. The number of bird-watchers in the U.S. grew 155 percent between 1983 and 1995. The FWS survey states that 62.9 million Americans participated in wildlife watching and spent $29.2 billion doing so.

Learning to grow



The Department of Natural Resources' environmental education programs for students, parents, teachers, schools, communities and businesses

Pack your bag

Every trip outdoors can be a journey of discovery for the observant, but environmental education is much more. It's a way to feed the natural curiosity that starts in childhood by examining bugs, watching birds, chasing frogs, blowing dandelion seeds or picking up turtles.

At the Department of Natural Resources, we encourage children to discover the connections among animals, plants and the resources that sustain them. We help them develop values and attitudes. And we try to give them the skills and tools to act as environmental stewards.

We provide education in many ways. Our skilled park naturalists lead interpretive programs; volunteers teach youth and adults how to safely hunt, fish and use recreational equipment; special centers teach outdoor skills; and staff make classroom visits. Still others draft teaching materials to incorporate forestry, air, water quality, wildlife and fisheries management into classroom disciplines.

In this special section, we explore a range of environmental education programs and methods the DNR Communication and Education staff employ to engage the public in natural resource protection and environmental problem-solving. Here you will visit our environmental education centers. You'll learn about programs that reach out to Wisconsin's 57,700 teachers in their classrooms. You'll see how we encourage environmental monitoring to learn more about community health and the local environment. We'll take you online to show how technology can reach us and teach us. And we'll introduce you to our partners in business and communities who are equally committed to a healthy environment and a robust economy.

Bon voyage. — *David L. Sperling, editor,* Wisconsin Natural Resources

Stream study on Rowan Creek near Poynette.

(front cover) **Lake Holcombe FFA students monitor a test plot to control purple loosestrife with leaf-eating beetles.**

BRIAN GUTHMAN

ROBERT WALLEN

ENVIRONMENTAL EDUCATION CENTERS

Centers of attention

At two special facilities, students and adults can focus on nature in an atmosphere of learning, discovery and fun.

MacKenzie Environmental Center

Located just 20 miles north of Madison near Poynette, the MacKenzie Environmental Center (MEC) has something for everyone. Visitors can hike the nature trails, walk through three museums, view native Wisconsin animals, learn about prairies, climb a fire tower, or have a picnic. There's a lot to see and it's free!

Over 40,000 people visit the center annually. Some come on organized day trips, others stay overnight at our resident center, and families stop in just to get away from the stress of everyday life.

Let's tour the center. The main nature trail begins at the large parking lot as you enter the grounds and leads past the fire (observation) tower. Look to your left to see American bison on a 20-acre range. The trail leads past the white-tailed deer pen and directly into the wildlife exhibit area, where you'll see several species of native mammals and raptors.

ROBERT WALLEN

Exhibits encourage visitors to examine how they fit into the natural world.

MacKenzie Environmental Center

Address:	W7303 County Highway CS Poynette, WI 53955
Open:	Grounds and trails open dawn until dusk every day year-round.
Exhibit hours:	8 a.m.–4 p.m. Monday through Friday (November through April) 8 a.m.–4 p.m. every day including holidays (May through October)
Office hours:	7:45 a.m.–4:30 p.m. Monday through Friday
Phone:	(608)635-8110
Fax:	(608)635-8107

Of special note is the black bear cub enclosure. Almost every year, orphaned or injured cubs are brought to us for care and rehabilitation. The cubs are the only animals in our exhibit that can be taught to survive on their own once released back to the wild.

The trail winds through the conifer arboretum, past the fern garden and continues on to the Logging History Museum, Aliens & Oddities of Nature Museum, maple syrup and forestry exhibits, nature pond and crabapple orchard — a must-see during the spring! The Conservation Warden Exhibit is currently under development.

If hiking is your game, drive to the south parking lot and enjoy each of five trails that begin here. Two are paved and fully accessible to those with mobility impairments. A guidebook for each trail describes the points of interest.

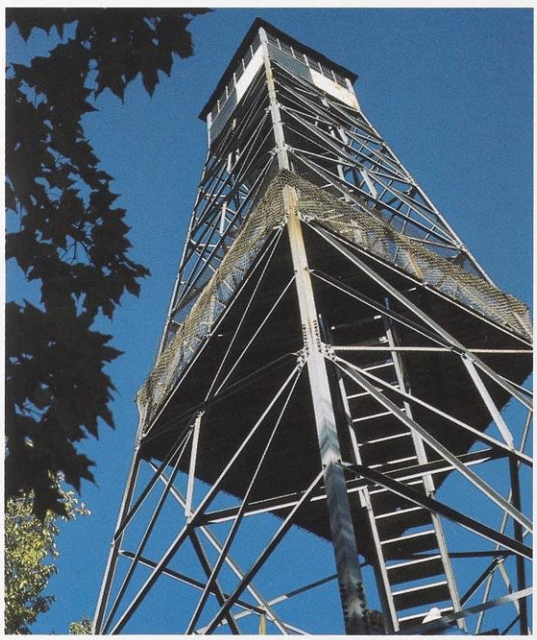
Now, bring out that picnic basket, because the large picnic area is not far away. A covered pavilion, accessible toilets, tables and grills are available for your use.

A NOTE TO TEACHERS

We can help teachers and group leaders plan a field trip to the center. Spring and fall are the most popular times, so make your reservations early! We limit attendance to 300 students a day to prevent overcrowding. A nature pond has mud turtles, cattails, minnows, and invertebrates your group can examine.

Teachers wishing to spend more time on environmental studies may find the MEC residential program especially convenient. You'll have access to a newly renovated lodge complete with classrooms, library, commercial kitchen, multipurpose area, and a beautiful fireplace for the quiet times. Sleeping quarters are bunkhouse style with each of four sections capable of sleeping 20 people. The typical stay is three days and two nights. Fifth through

(left, below) **There's a lot to see at MacKenzie. Enjoy the fire tower view. Observe native mammals and birds.**



(BOTH PHOTOS) ROBERT WALLEN

eighth graders are the primary audience. All programs and activities are preplanned with our education coordinator. At least one DNR educator is available every day to assist where needed. Past workshops have included Project WILD, Project Learning Tree, constructing a birchbark canoe, and building snowshoes.

For program information, fees and registration details, please call (608) 635-8105.

Events for everybody

Join us in July for a guided tour of the center's restored prairies. Are you interested in mushrooms? The Friends of MacKenzie Center conducts a "mushroom walk" in September.

Have you ever made or tasted real maple syrup? Here's your chance! A maple syrup program has been a MEC ritual every spring for the past 10 years. As many as 800 students learn the history of maple sugaring, tree structure and value, the photosynthetic process, and see how sap is boiled down to make syrup.

Around the third Saturday in March, the public is invited to our Maplefest. The day begins with a terrific pancake breakfast at the resident center sponsored by the Poynette Optimist Club. Then, enjoy a short video on the syrup-making process followed by a guided tour of the sugarbush and evaporator. Try some sap tea, or savor maple syrup on vanilla ice cream. And don't miss the dill pickles swimming in syrup!

For information and dates for all special events, call (608) 635-8110.

We hope to see you at MEC soon! — *Derek Duane directs the MacKenzie Environmental Center at Poynette.*

Havenwoods State Forest and Environmental Awareness Center

As you travel through Milwaukee to get to Havenwoods State Forest, you don't expect to find it here — 237 acres of green, water, trails and a bit of quiet sandwiched between the typical city features. But this little haven in the city has become a busy center for people of all ages to learn about the environment and to reconnect themselves with the land.

COURTESY OF HAVENWOODS ENVIRONMENTAL AWARENESS CENTER

At Havenwoods, DNR educators help plan or guide class field trips to explore nature.

Looking over the property today, you'll see very few signs of the prison, the military facilities, missile base or the landfill that were once here. Quiet trails now wind through open fields, scattered woods and around a small pond and creek adjoining the Havenwoods Environmental Awareness Center — a 10,000-square-foot facility housing classrooms, visitor services, an auditorium, workspace and restrooms.

At the center, groups of city kids who have little experience with nature can attend field trips led by Havenwoods naturalists during spring, summer and fall. They meet snakes, toads and turtles close up, which helps develop a connection to animals, and an awareness to treat them with respect. Besides focusing on urban wildlife, Havenwoods educators lead trips on insects, plant ecology, sensory awareness, pond ecology and more. There is no charge for group pro-

Fresh maple syrup is a sweet reward for learning.

ROBERT WALLEN

Havenwoods State Forest and Environmental Awareness Center

Address:	6141 N. Hopkins Street Milwaukee, WI 53209
Open:	Grounds and trails open 6 a.m.–8 p.m. every day year-round.
Center hours:	7:45 a.m.–4:30 p.m. Monday through Friday, and on Saturdays when programs are in session.
Phone:	(414) 527-0232

grams, but groups need to make arrangements in advance. Call the center to get a list of school programs.

Havenwoods and the Home Horticulture office of the Milwaukee County Extension welcome people to develop green thumbs at the forest. Area residents can rent one of our 20 small gardens to raise their own produce through our Shoots 'n Roots program. Buds 'n Sprouts, our youth gardening program, brings six groups of kids to Havenwoods once a week during summer to plant, tend and harvest gardens. Every week the kids sample newly ripened veggies and listen to a garden-related story. Naturalists conduct activities in ecology, economics, botany, health and nutrition related to growing and eating food. The program aims to help the children develop a positive lifetime skill, connect with nature, and treat the earth with care. Contact the center director by mid-May if you're interested in this program.

(below, right) **Havenwoods provides inviting green space in Milwaukee for classes, hikers and young gardeners in the Buds n' Sprouts program.**

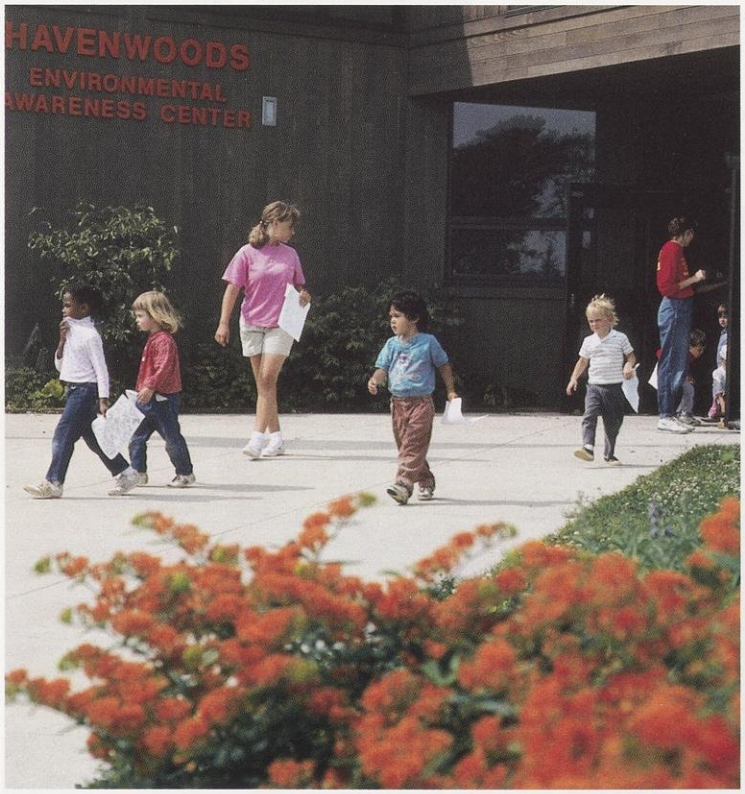
Teacher training

Many of the center's activities and services are geared to meet state standards for environmental education (EE). Local college students studying to be teachers take EE methods classes to help meet their training requirements. In our Project WILD, Project Learning Tree, and WET workshops, teachers learn how to integrate EE concepts in all academic subjects.

Starting this spring, Havenwoods will join local nature centers in hosting a core of environmental education courses by UW-Milwaukee for teachers specializing in EE while pursuing master's degrees.

Havenwoods is a resource center for teachers and youth leaders. We have an extensive lending library of activity/curriculum guides, videos and teaching materials ranging from rubber animal footprints and magnifiers to collecting nets and groundwater models. Groups with kids ages 6–12 benefit from borrowing our Eco-Explorer kit on trees.

Havenwoods truly is a center for learning valuable life lessons. Kids from youth organizations regularly come here to volunteer on the grounds. Neighborhood children spend summer days exploring the woods and ravines. College students who've attended EE classes at Havenwoods often come back as teachers to participate in school field trips with their students, and to attend workshops to build on their skills. — *Judy Klippel directs the Havenwoods State Forest and Environmental Awareness Center in Milwaukee.*

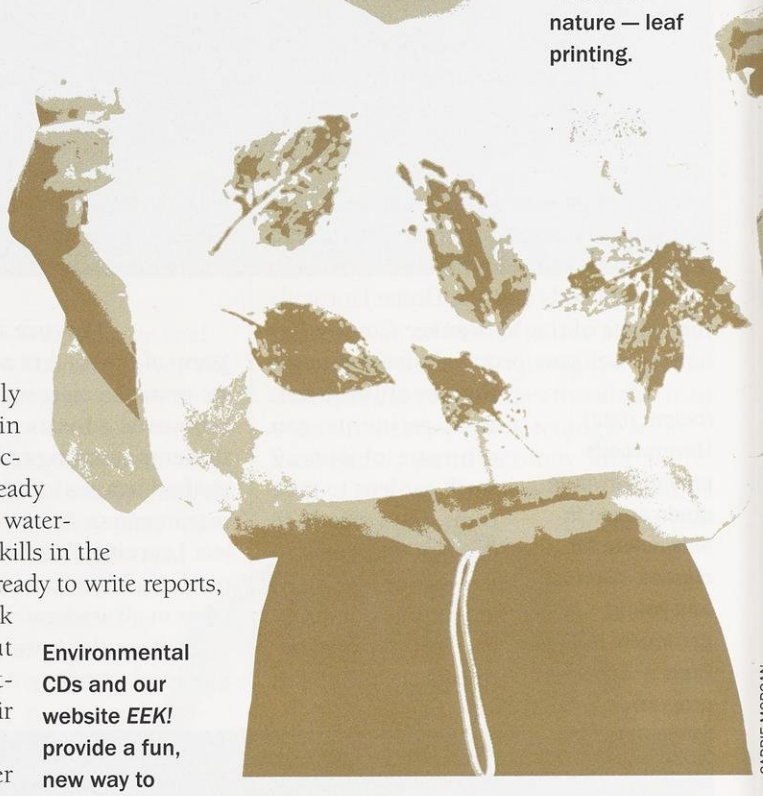


BOTH PHOTOS COURTESY OF HAVENWOODS ENVIRONMENTAL AWARENESS CENTER

Making connections

The Internet, the World Wide Web and interactive CDs open up new avenues for teaching and learning about the environment.

The art of nature — leaf printing.



CARRIE MORGAN

EEK! I need to know…

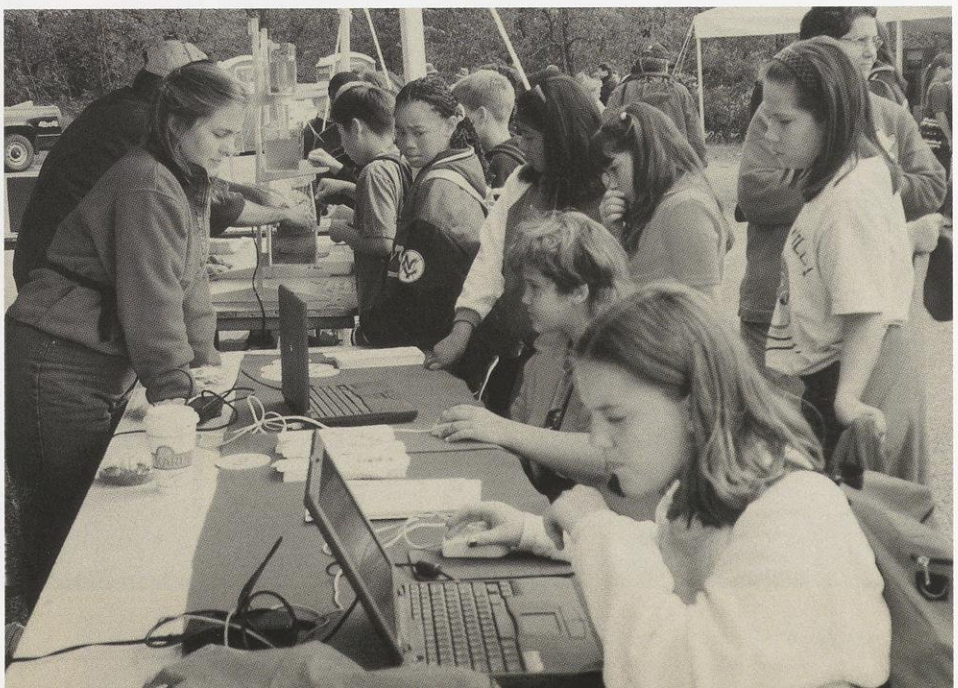
"Hi, my name is Carol and I'm a teacher at Jefferson Middle School. We're studying aquatic macroinvertebrates and I'm wondering if you have any materials to help me and my students learn more about these critters?"

Her question couldn't have been more timely. I had just finished updating *EEK! Environmental Education for Kids*, the DNR website for children. And we had just added a "Water Critter Key" to the web pages. This key, along with a practice worksheet, helps kids "key out" or identify critters they're likely to find in Wisconsin waters. After practicing online, they're ready to head out to local waterways and try their skills in the field. When they're ready to write reports, they can head back to *EEK!* to find out more about the critters they found, their habits and habitats.

The aquatic critter key is only one of the many items kids can find on *EEK!* Want to

Environmental CDs and our website *EEK!* provide a fun, new way to reach, teach and talk with students at school or home.

www.dnr.state.wi.us/eek/



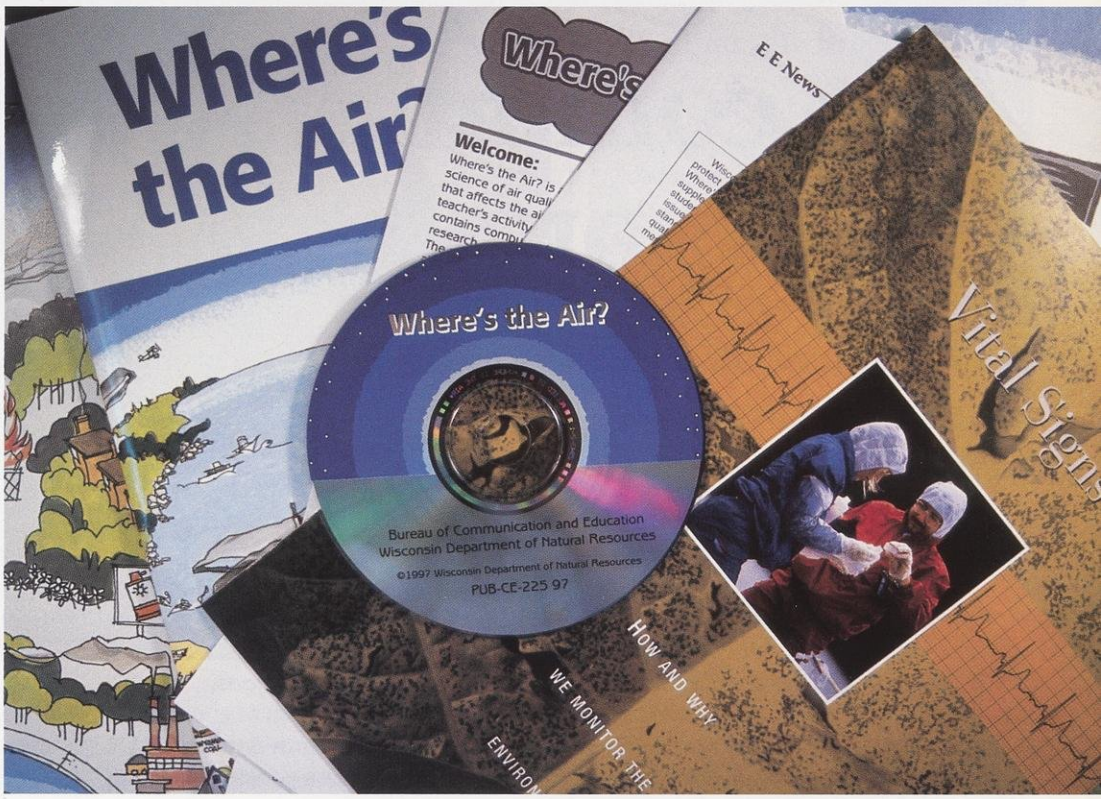
COURTESY OF CARRIE MORGAN *(FAR LEFT)* ROBERT QUEEN

know more about composting with worms or air pollution? Need information on wildlife or endangered species in Wisconsin? Want to hear Wisconsin frog calls? Or are you just looking for some fun online? *EEK!* has all these things and more.

Designed as an online resource for students and teachers, *EEK!* provides information on environmental topics and natural resources. It's a place to learn more about careers with the Department of Natural Resources, make seasonal observations about nature, and share nature stories and artwork with other site visitors. Teachers can find information and activities on the "Teacher Pages."

Children and their parents often visit the site from home, as a recent e-mail to *EEK!* illustrates: "My mom loves this site — we are home schooled and she gets great ideas of things for us to do. Thanks."

Whether you're looking for homework help, activity ideas, or just want to learn more about the environment, come give *EEK!* a try. In the words of an enthusiastic young site visitor listening to the call of the spring peeper: "This is way cool." — *Carrie Morgan edits* EEK!



ROBERT QUEEN

A kit containing posters, a CD game, teacher's notes, websites and research updates help schools investigate air quality in communities.

Air on disc

Click. Computer-animated oxygen atoms bounce into view and carom wildly off the sides of the computer screen. "Welcome to the Stratospheric Ozone Game," responds a computerized voice. "You are entering a world where you directly affect ozone depletion by the actions you take."

The game is one activity on the interactive "Where's the Air?" CD-ROM, the DNR's first multimedia education product. Students 10 and up can boot up and learn about air chemistry, then explore how people affect air quality by the choices they make. Each game on the CD requires reading about a problem and making some decisions. After each choice, the user is catapulted to a 'consequences' screen, which shows the result of each decision.

Teachers frequently comment that the CD's "choice-consequence" approach based on situations students face every day makes the experience realistic — and memorable.

Animated characters help the student explore different types of transportation and compare effects on the ozone layer and smog (ground-level ozone). Students learn about health issues related to each air quality problem, such as cataracts and skin cancer caused by loss of stratospheric ozone.

The website *EEK!* is regularly updated with air education activities so students and teachers can continue to learn the latest in air science.

The CD is part of a kit that contains a poster, teacher's activity guide, and other resources. Free kits were sent to every public school, private school and public library in Wisconsin, to members of the Wisconsin Partners for Clean Air (a group of businesses and organizations committed to voluntary air clean-up) and to teachers who attended "Where's the Air?" workshops.

DNR has been awarded a second U.S. Environmental Protection Agency grant to create a new CD-ROM kit, "Easy Breathers," for high school students.

"Easy Breathers" will teach the science and engineering of how car and truck engines work, and the biology and chemistry of how engine emissions affect air quality. The kit will use interactive games, activities and links to the Internet. Students will investigate how air pollution damages healthy ecosystems and people, and explore alternative fuels and technologies.

Students from John Marshall High School in Milwaukee are collaborating with the DNR to produce a video as part of the kit. The CD, poster, study guide, and other kit components will be released in spring 2001. To order a kit, contact me at Easy Breathers, CE/6, P.O. Box 7921, Madison, WI 53707, e-mail: voilem@dnr.state.wi.us. — *Mittsy Voiles is an air and waste communication and education specialist with the DNR.*

The community as classroom

In city neighborhoods and rural townships alike, students and teachers are leaving their blackboards and desks behind to let learning grow outdoors.

Beyond school walls

Today, teachers are moving away from textbook-driven, teacher-led instruction to more hands-on approaches that involve students in their own learning. Rather than reading about research, students are conducting it.

The Department of Natural Resources provides resource materials and training on a variety of topics. Come meet several schools that are actively involved in community environmental projects.

Lake Holcombe High School FFA tackles purple loosestrife

In the early 90's, purple loosestrife, an exotic plant that displaces native wetland species and degrades wildlife habitat, reached epidemic populations on the north end of Lake Holcombe in Chippewa and Rusk counties. The Lake Holcombe High School Future Farmers of America (FFA) took on the challenge of trying to control its spread.

"The FFA and the Lake Holcombe Improvement Association, started pulling 50 pickup loads a year of purple loosestrife plants," says FFA member Julie Smith. This type of cultural control is effective with very small populations, but something else was needed to attack the large areas of loosestrife along the shore.

FFA Advisor Brian Guthman, in cooperation with the Department of Natural Resources, started a biological control project using an imported European beetle that eats loosestrife. To raise enough beetles for the project, the FFA group started with 25 loosestrife plants, placing 10 beetles on each. Soon the beetle population grew to more than 1,500 per plant. The FFA released the insects at strategic sites to eat away at the purple loosestrife. Several study areas are being monitored and it appears the beetles are very effective.

The FFA is educating other groups about the program, and recently conducted a training session at the Wisconsin Lakes Association Convention.

The Lake Holcombe FFA received the Wisconsin Adopt-A-Lake Award for its work on control of purple loosestrife, water quality testing, and the construction and installation of more than 300 fish cribs.

BRIAN GUTHMAN

FFA members raised and released thousands of beetles to control purple loosestrife encroaching Lake Holcombe in Chippewa and Rusk counties.

Purple loosestrife biological control

Purple loosestrife, first introduced in the United States as a garden perennial in the 1800s, is now widely dispersed throughout Wisconsin. The Department of Natural Resources is seeking groups to rear, release and monitor leaf-feeding beetles to reduce purple loosestrife populations. Teaching materials are available for schools and educators. Contact Brock Woods at (608) 221-6349.

COURTESY OF BRIAN HENRIKSEN

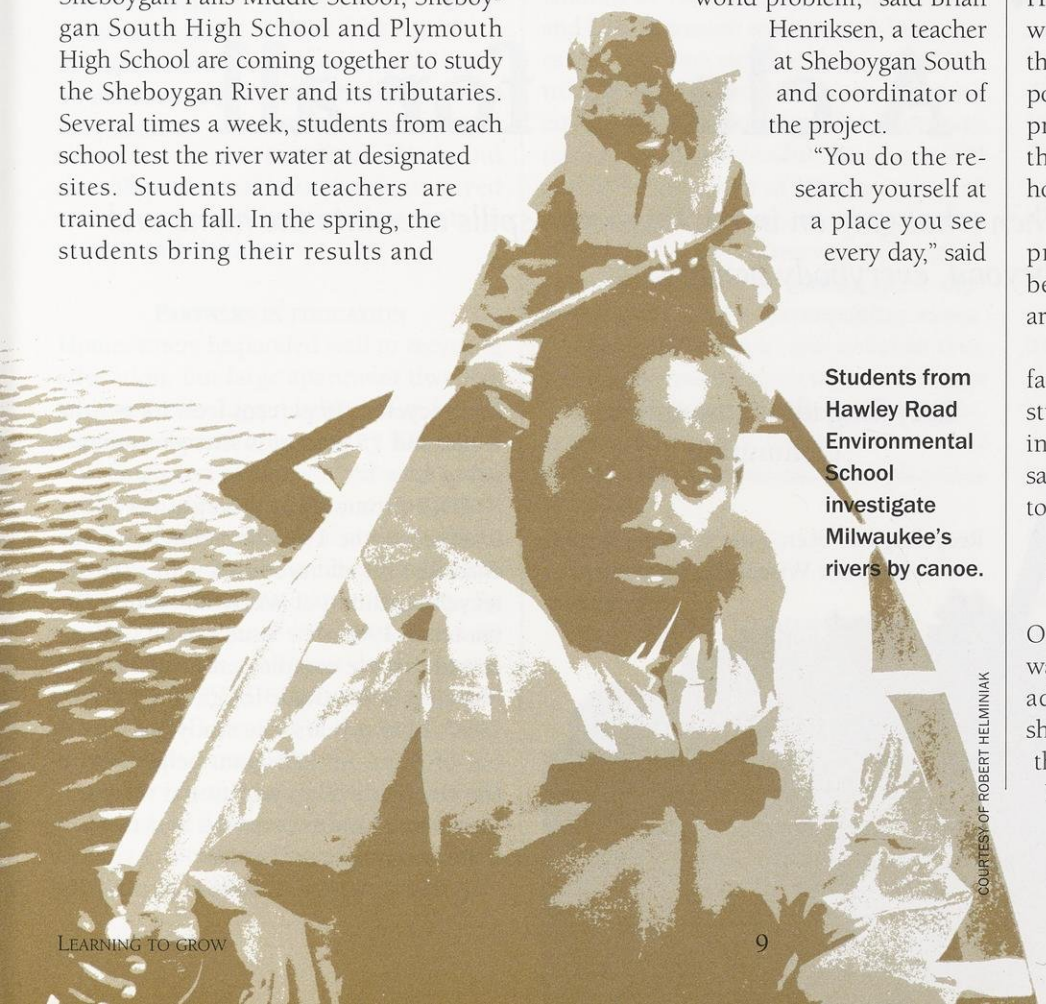
Sheboygan South students test the river regularly to monitor the water's health.

Sheboygan River Consortium tests the waters

Students from Horace Mann Middle School, Kohler High School, Sheboygan Falls Middle School, Sheboygan South High School and Plymouth High School are coming together to study the Sheboygan River and its tributaries. Several times a week, students from each school test the river water at designated sites. Students and teachers are trained each fall. In the spring, the students bring their results and suggestions to improve water quality to a Student Congress. Local decision-makers, parents, and the general public are invited to attend.

"The project is appealing to students because the assignment analyzes a real-world problem," said Brian Henriksen, a teacher at Sheboygan South and coordinator of the project.

"You do the research yourself at a place you see every day," said Noemi Moralez, a Sheboygan South senior. "It makes you want to go out and find a solution for that problem."



Students from Hawley Road Environmental School investigate Milwaukee's rivers by canoe.

COURTESY OF ROBERT HELMINIAK

Hawley Road Environmental School gives Milwaukee a helping hand

What do the Doyne Landfill Site Study, Jacobus Park Pond, the Menomonee River Study and the Henry Aaron Wetland Park have in common? All involved elementary students from Hawley Road Environmental School.

The students recently worked with the Milwaukee Metropolitan Sewerage District to plant over 500 native flowers in the Henry Aaron Wetland Park. The school will be the caretaker of the site. "When they become involved, students see a purpose for studying," said Robert Helminiak, principal. "And with a hands-on project, the students see their progress and see how they helped."

The students and staff also added prairie and butterfly gardens in raised beds next to the sidewalk and parking area of their school site.

This year the second graders and their families will travel to the Tomah area to study wolves. "We want parents to share in this experience with their children," said Estelle Vollmer, environmental educator at the school.

Butler Middle School investigates mercury

Oconomowoc Lake is the only body of water in Waukesha County that has a fish advisory. The advisory suggests who should limit or avoid eating northern pike that are 18–26" in size. Teachers at Butler Middle School used this advisory as a springboard for a teaching unit on mercury after attending a training session conducted by the Pollution Prevention

Take the first step

"Taking Action!" contains more than 50 pages of ideas and ways you, your school or organization can become involved in finding solutions to environmental problems. To request a copy, e-mail Betty Prescott at prescb @dnr.state.wi.us or call (608) 264-6280.

Partnership and the Department of Natural Resources. Students went into their community, looked for possible sources of mercury, and interviewed local business people, members of the dental and medical fields, and local area builders. The students returned to the classroom, role-played those professions and then proposed solutions to reduce the amount of mercury in the community.

Eau Claire students go wild over bear

Orphaned or injured bear cubs are brought to the MacKenzie Environmental Center to a special cub enclosure that provides plenty of cover and little visual contact with humans.

The cubs naturally begin hibernating when the weather cools and daylight and food supplies diminish. In the spring, once the vegetation begins to green up, the cubs are awakened, sedated, and transported to remote locations in central Wisconsin. High school students from the Eau Claire area assist a DNR biologist in administering a mild sedative to the cubs, drawing blood, taking measurements, and fitting the cubs with radio collars before they are released. These same students track and document the behavior of the cubs until they again hibernate the following fall. Another mild sedative is then given, the radio collars are removed, measurements taken, and the young bears are truly on their own.

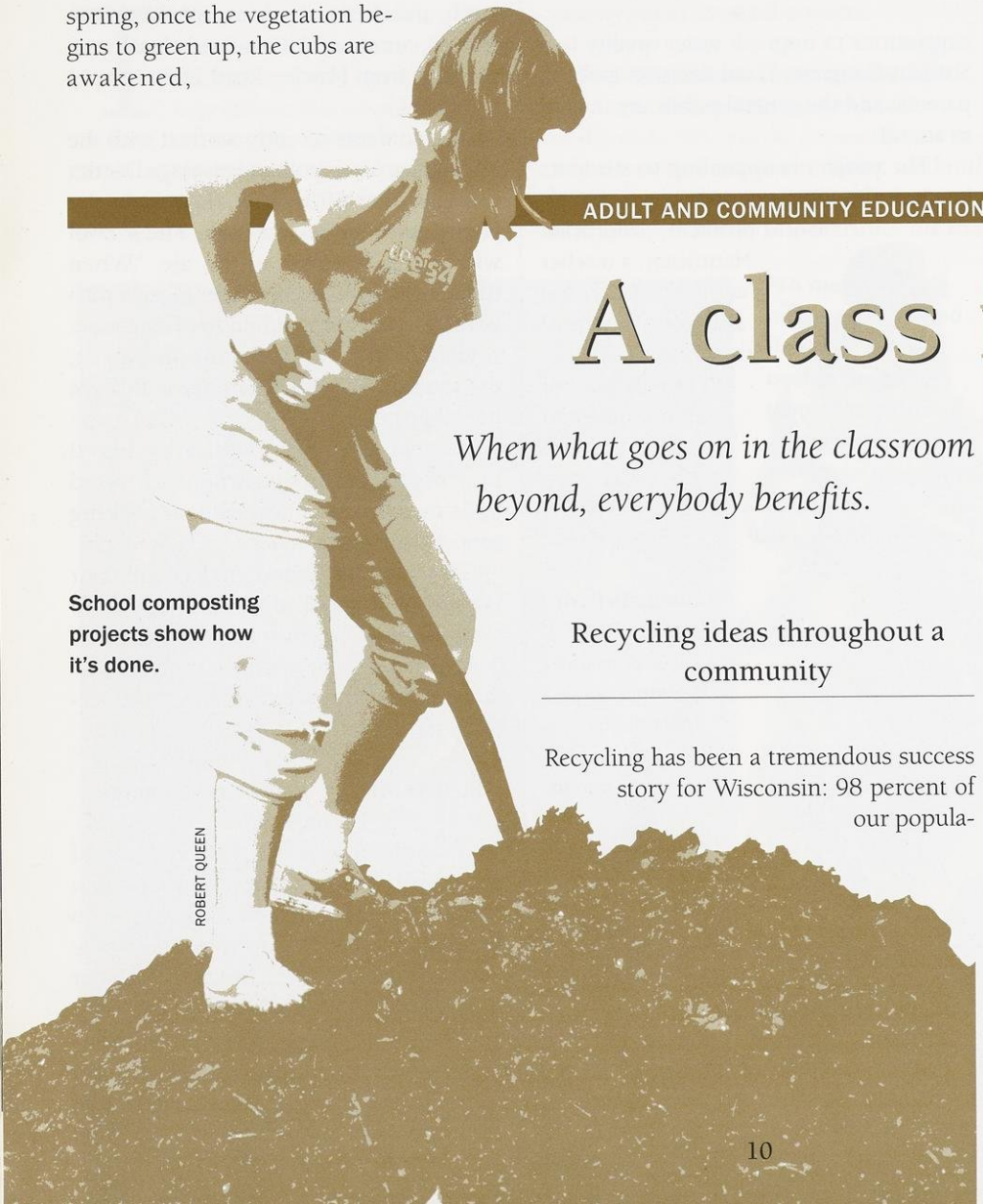
In similar projects, other schools are using their computers to track the movements of deer and Blanding's turtles equipped with radio transmitters —*Al Stenstrup, DNR education outreach specialist.*

Wildlife Manager Mike Gappa partners with several western Wisconsin schools to radio-collar black bears and track their movements via school computers.

ADULT AND COMMUNITY EDUCATION

A class for all

When what goes on in the classroom spills over into the home and beyond, everybody benefits.



ROBERT QUEEN

School composting projects show how it's done.

Recycling ideas throughout a community

Recycling has been a tremendous success story for Wisconsin: 98 percent of our population recycles, 96 percent feels it's worthwhile, and 75 percent is strongly committed to it.

DNR promoted and taught recycling long before the 1990 Recycling Law was enacted. Our efforts started with a special recycling edition of *Wisconsin Natural Resources* in 1985. The issue was so well received that we complemented it with the *Recycling Study Guide* for grades 4–12 in 1987. In two years, the study guide was out-of-print. An EPA grant helped revise the *Guide,* develop additional teaching tools, and conduct surveys and teacher training throughout the state.

A 1989 survey of school principals

ROBERT QUEEN

Children are resilient, but they play hard outdoors for long hours and their lungs are still developing. That makes kids susceptible to air pollution and lung disease.

showed 62 percent of schools recycled an average of two items; by 1992, 92 percent of the schools were recycling an average of at least four items.

Kids brought home the recycling lessons and behaviors learned at school. We found that 36 percent of households surveyed were getting recycling information from school-aged children.

Partners in education

Homeowners responded well to recycling education, but large apartment dwellers and businesses lagged behind from lack of instruction and opportunity. DNR and UW-Extension offices worked with apartment and business associations, trash haulers, and local units of government to develop and distribute handbooks, host workshops and lead open houses. By 1994, 79 percent of businesses and 88 percent of large apartment dwellers were recycling. By 1998, 87 percent of the businesses and 91 percent of the large apartment dwellers recycled.

As recycling matured, local government assumed more responsibility for recycling education. The impact was profound: In 1990, 83 percent of the households recycled an average of three items; in 1992, 86 percent recycled an average of four items; and in 1998, 98 percent recycled an average of seven items.

When yard waste was banned from landfills in 1993, local government, DNR and UW-Extension worked with businesses like hardware stores to develop and distribute information. Volunteers educated citizens on composting. The effort was tremendously successful: Between 1990 and 1995 over half of Wisconsin's yard waste — 290,000 tons — disappeared! Where did it go? It never left peoples' yards. Residents were leaving grass clippings on the lawn and composting leaves.

Recycling has been successful in Wisconsin because residents of all ages learned two important lessons: *how* to recycle and *why* they should do it. — *Joel Stone, DNR's recycling and water programs educator.*

Learning to breathe free

Almost five million children in the U.S. experience breathing difficulties on a daily basis. The DNR Air Education program, in conjunction with the American Lung Association-Wisconsin Chapter (ALA) is working on a new project to help people understand how air pollution hampers children's ability to breathe.

A teacher's guide with six lessons and an activity book for daycare and preschool classrooms will help increase the knowledge of preschool children, their parents, and educators.

Asthma, a reversible chronic lung disease, is a growing problem in America that affects over 17 million people. Thirty-three percent of asthma sufferers are children under the age of 18, and that rate is rising. According to the ALA, incidence of asthma in children has increased 72.3 percent between 1982 and 1994, and children under the age of five have the highest asthma incidence rate.

Younger children are particularly at risk because their bodies and lungs are still developing. Children also breathe in more air per pound of body weight than adults do, which means they inhale more pollution. Because children spend more time outdoors than most adults do, they are more exposed to air pollution.

Ground-level ozone, sulfur dioxides, nitrogen oxides, acid aerosols, and airborne particles irritate the respiratory system. In high concentrations, ground-level ozone reacts in lungs to cause shortness of breath, coughing, wheezing and pain with deep breaths. According to the Centers for Disease Control and Prevention (1995), 25 percent of U.S. children reside in areas where ground-level ozone levels exceed acceptable standards. Southeast Wisconsin is one of those areas.

Ozone and other air pollutants plague rural areas as well when winds blow pollution across city, county, state and national borders. Rural areas also face pollution from open garbage burning and leaf burning, which produce particles, carbon dioxide and toxic materials.

Good air quality is important for people of all ages, no matter where they live. A better understanding of air pollution is the first step toward freer breathing for all. — *Sharon Boss is a DNR intern working on air pollution consequences for asthmatics and children.*

Sharing for success

DNR educators offer fresh ideas and new lesson plans.

Making the rounds

Hundreds of feet approach rapidly. As the rumble becomes a dull roar, DNR staff calmly stand their ground. Elk stampede? Nope, the exhibit area has just opened at a teacher convention. Elementary and high school teachers make a beeline to the DNR booth. Posters, study guides, fact sheets — every item on the table is studied, evaluated, and gleefully pocketed. Most materials are free or cost very little.

At convention workshops teachers can get curriculum materials such as Project WILD and Project Learning Tree from DNR staff, and receive training on incorporating environmental education into all subject areas, from science to the arts. DNR educators who offer workshops get ideas and suggestions from participants, and return in following years with new materials.

DNR educators staff annual conventions sponsored by the Wisconsin Education Association Council, Wisconsin Society of Science Teachers, Wisconsin Elementary and Middle Level Science Teachers, and regional conventions, too. Stop by our booth! — *Mittsy Voiles*

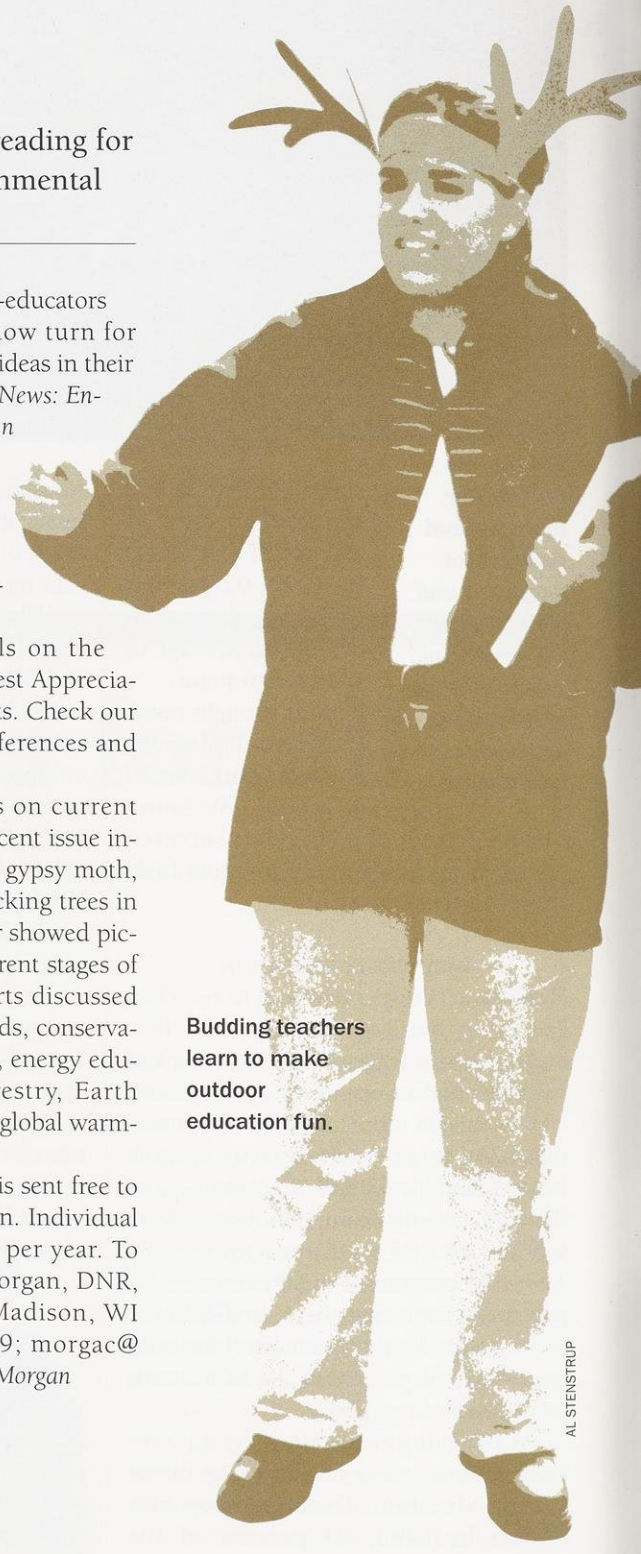
EE News: Required reading for up-to-date environmental educators

Where do e-educators in the know turn for the latest ideas in their field? *EE News: Environmental Education in Wisconsin,* of course! *EE News* is published quarterly to keep educators informed about special events, projects and activities.

Look here for details on the Arbor Day poster or Forest Appreciation Week writing contests. Check our announcements for conferences and classes.

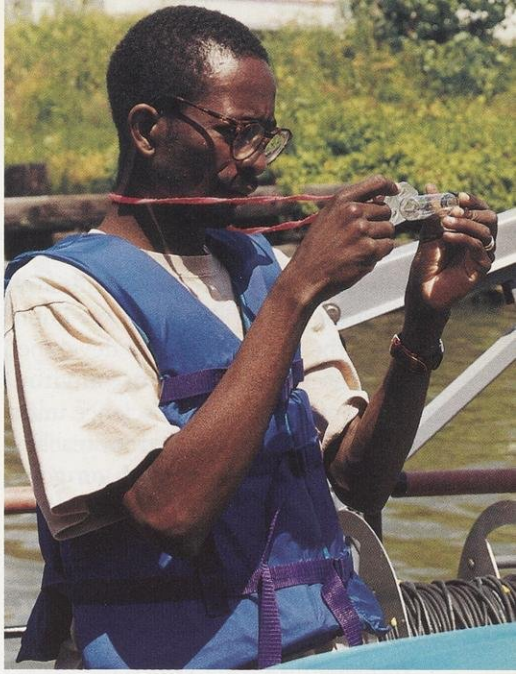
Special inserts focus on current topics and activities. A recent issue included a guide about the gypsy moth, a non-native species attacking trees in Wisconsin. A color poster showed pictures of the moth at different stages of its life cycle. Other inserts discussed prairies, land use, wetlands, conservation heroes and heroines, energy education, sustainable forestry, Earth Day/Arbor Day activities, global warming and climate change.

One copy of *EE News* is sent free to every school in Wisconsin. Individual subscriptions are $5.00 per year. To order, contact Carrie Morgan, DNR, CE/6, P.O. Box 7921, Madison, WI 53707; (608) 267-5239; morgac@dnr.state.wi.us — *Carrie Morgan*



Budding teachers learn to make outdoor education fun.

AL STENSTRUP



Community partnerships have long reach. *(left)* **Russian educators complete an air quality lesson from Wisconsin.** *(above)* **Teachers investigate the Milwaukee River aboard the research vessel *Pelagos*.**

The Earth Day Flag — a sign of success

More than 600 Wisconsin schools and classes have flown an Earth Day Flag to proudly recognize their participation in a local Earth Day Project. Under the direction of a teacher or youth group leader, students learn about an environmental topic, then complete a project that reinforces classroom knowledge with practical experience. More than 60,000 students have participated in the Earth Day Project since the Department of Natural Resources' program began in 1995. To receive an information packet, please e-mail Jennifer Richards at richaj@dnr.state.wi.us or call (608) 267-2463.

Connecting with educators

Wisconsin educators come in many shapes and sizes: urban preschool to rural high school teachers, scout and 4-H leaders, nature-center naturalists, tech-school instructors and college professors. All share a passion for helping students learn and smile, and a constant desire to improve their teaching skills. The Department of Natural Resources provides a spectrum of programs for educators to expand their knowledge of education and the environment. We're pleased to share our expertise!

Project Learning Tree (PLT)

PLT, first introduced in Wisconsin in 1977, provides tools to bring the outdoors into classrooms and students into the outdoors. PLT uses the forest to increase students' understanding of our complex environment; to stimulate critical and creative thinking; to develop the ability to make informed decisions on environmental issues; and to instill the commitment to act responsibly on behalf of the environment.

A complete revision of materials in 1993 and new modules for middle school and high school students keeps PLT on the cutting edge of education. The DNR forestry bureau continues to provide excellent supplementary materials on champion trees, sustainable forestry, forestry economics, gypsy moth and forest health to make PLT more relevant in Wisconsin.

Each year more than 1,000 Wisconsin educators attend PLT workshops and engage participants in activities they can use with their students.

Project WILD and Aquatic WILD

Project WILD is one of the most widely used conservation and environmental education programs among K–12 educators. Since introduced in Wisconsin in 1985, more than 30,000 educators have completed a workshop.

Project WILD's 160 activities teach children about the interrelationships among people, wildlife and the environment. They emphasize how to think, not what to think.

Wisconsin Project WILD has tied reading into a series called "WILD in the City." The program consists of four-page booklets that focus on different types of urban wildlife from Canada geese to bats and ants.

Project WILD emphasizes using school grounds for environmental learning, encouraging students, teachers and area residents to plan, construct and use the area surrounding the school for natural areas, ponds, butterfly gardens and other nature projects.

To discover more about PLT and Project WILD call (608) 264-6282 or e-mail Al Stenstrup at stensa@dnr.state.wi.us.

Community partnerships

Many partnerships protect natural resources and provide students with active learning that is meaningful and beneficial to the community. Some examples include:

Wisconsin Lake Schooner — The year 2000 will launch the floating classroom, the Wisconsin Lake Schooner. Under construction since 1994, the 137-foot schooner will have a fully equipped, modern scientific laboratory and classroom. "Students aboard the schooner will be more than mere passengers," said William Nimke, the vessel's education director. "They will participate in ship operations and research Lake Michigan water

quality issues." The Department of Natural Resources has been a proud partner and supporter of the schooner program since its beginning.

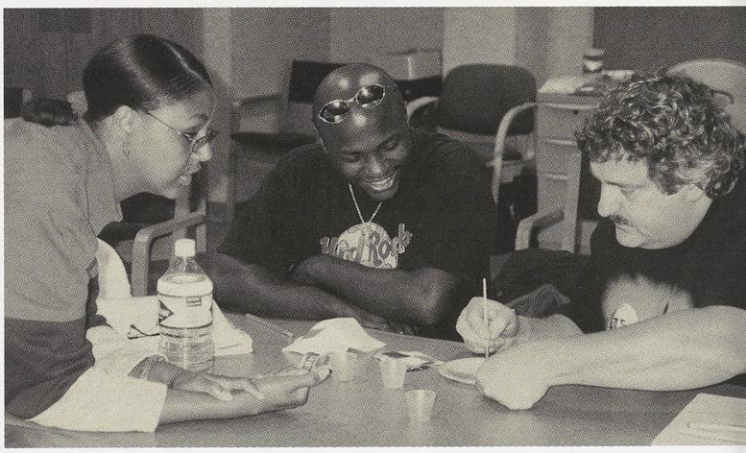
Milwaukee Urban Systemic Initiative — In partnership with Milwaukee Public Schools, the department has developed education materials to infuse environmental topics into several science units. Workshops were conducted for teachers throughout the district, with on-going follow-up for the educators.

All teachers of a grade level will use the new teaching units and *all* students in that grade will be involved in this special set of activities.

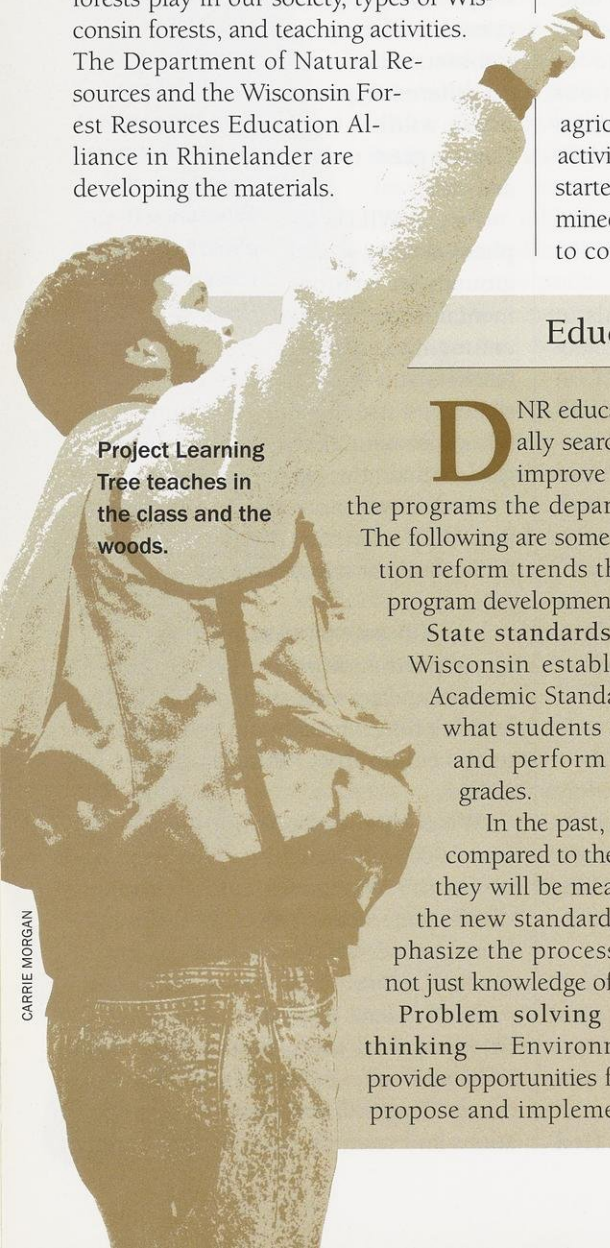
Wisconsin Forests Forever — That's the title of a new CD that will be available to Wisconsin educators in the summer of 2000. The CD will highlight the role forests play in our society, types of Wisconsin forests, and teaching activities. The Department of Natural Resources and the Wisconsin Forest Resources Education Alliance in Rhinelander are developing the materials.

Asthma and air quality — The Sixteenth Street Community Health Center, the Wisconsin Health Education Center, Milwaukee South Division High School and the DNR recently completed an intensive study of asthma and air quality. Students at South Division High developed and completed an asthma survey. Results showed what efforts were needed to increase awareness of asthma and its relationship to indoor and outdoor air quality. Experts from the Wisconsin Health Education Center and the DNR conducted teacher training on the issue.

Gypsy moth materials — Working through UW-River Falls, selected agriculture teachers developed teaching activities on the history of the gypsy moth, started community monitoring, and determined what action, if any, should be taken to control moth populations. Other projects completed with the agriculture teachers included materials on watersheds, sustainable forestry and mercury. The departments of Natural Resources and Public Instruction, and the Wisconsin Association of Vocational Agriculture Instructors have been active partners in the programs. — *Al Stenstrup*



In the Green Square Game, teachers take on the twin challenges of inventing a new product while minimizing waste.



Project Learning Tree teaches in the class and the woods.

CARRIE MORGAN

Education for the new century

DNR educators continually search for ways to improve the quality of the programs the department offers. The following are some of the education reform trends that guide our program development:

State standards — In 1998, Wisconsin established Model Academic Standards to define what students should know and perform at different grades.

In the past, students were compared to their peers. Now they will be measured against the new standards, which emphasize the process of learning, not just knowledge of facts.

Problem solving and critical thinking — Environmental issues provide opportunities for students to propose and implement solutions. DNR environmental education programs do not advocate a particular solution, but rather encourage students to investigate issues from all sides, make their own informed decisions, and take action to implement solutions.

Interdisciplinary teaching — Environmental issues are by nature multifaceted; they provide rich opportunities for teaching across the curriculum. DNR programs encourage crossing disciplines to enrich learning experiences.

Community learning — Using the community to explore real issues promotes learning for students and residents alike. Beginning learners forge a connection, or "sense of place" with where they live. After studying their immediate surroundings, students apply the base of experience to broader issues, leading to a broader understanding of causes, connections and consequences. Programs aim to involve and empower students in community life. This is important as surveys show 50 percent of North Americans live as adults within 50 miles of their birth place.

Lifelong learning — Critical and creative thinking, decision making and communication skills are essential for active and meaningful learning throughout life. Rapid change in society will require that all people, young and old, continue to learn. We're educating for a lifetime. — *Al Stenstrup*

A knowledge economy

With innovative business programs and partnerships, Wisconsin is at the forefront of national and international environmental progress.

Exporting environmental know-how

Wisconsin businesses are the nation's tenth largest exporters of environmental expertise and the United States is the world leader in providing environmental technology for such basic human needs as safe drinking water, sanitation and safe foods. There's equally strong global demand for tools and techniques to measure climate change, improve wildlife habitat, conserve natural resources and measure biodiversity.

Wisconsin firms have an international reputation for first-rate technology, engineering and management solutions. The Wisconsin Department of Natural Resources has joined with the state Department of Commerce's International Division and the Milwaukee Export Assistance Office of the federal Department of Commerce to form a team called the Wisconsin Environmental Industry Export Forum (WEIEF) to help Wisconsin firms market their environmental knowledge, goods and services.

WEIEF acts as a one-stop shop to find financial and technical assistance, and make contacts with other state businesses with similar interests. In March, WEIEF will help six Wisconsin firms — Northern Environmental, Beckert Environmental, Aquarius, Key Engineering, DMT and Quest Technologies — attend a major international environmental trade show called Globe 2000, where 10,000 visitors from 75 countries will meet exhibitors who make pollution controls, design wastewater treatment devices, and develop hazardous and solid waste management systems.

WEIEF links Wisconsin's technical educators, machinists and policy makers to sell state consulting and manufacturing expertise to the worldwide customers seeking environmental services.

For more information about the Wisconsin Environmental Industry Export Forum, contact: Susan Dragotta, Wisconsin Dept. of Commerce, e-mail: sdragotta@commerce.state.wi.us; Paul D. Churchill, U.S. Dept. of Commerce, e-mail: omilwau@doc.gov; Sara Burr, Wisconsin Dept. of Natural Resources, e-mail: burrs@dnr.state.wi.us. — *Sara Burr manages air quality business education for the Department of Natural Resources.*

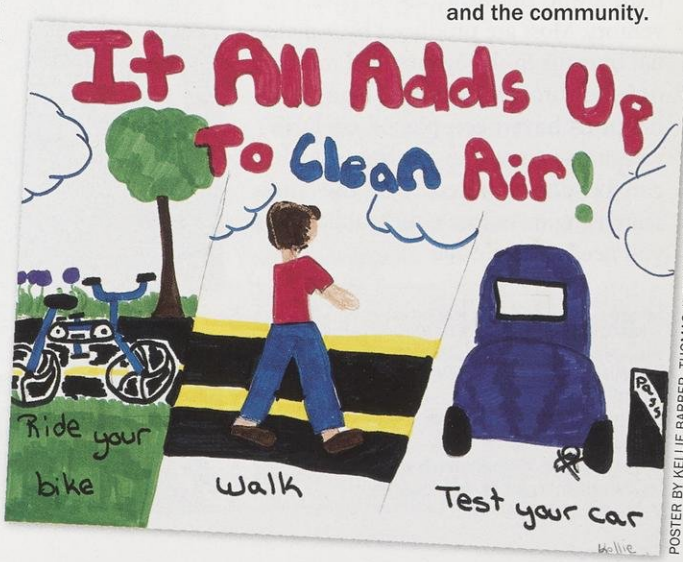
It all adds up to cleaner air

Wisconsin Partners for Clean Air is a coalition of 260 groups, employers, schools and local governments in southeastern Wisconsin. The partners are dedicated to reducing air pollution through voluntary actions. The program is considered one of the more effective voluntary efforts nationally, and has attracted the attention of the U.S. Environmental Protection Agency and the U.S. Dept. of Transportation for engaging communities and companies to achieve air quality goals.

The partners received a substantial federal grant to run a public information campaign during 2000 and 2001, including print ads, television and radio ads, and a variety of public relations tools. The campaign slogan, "It All Adds Up to Cleaner Air," will emphasize actions individuals can take to protect air quality.

Lots of air emissions are a consequence of consumers using cars and small engines on hot summer days. Solutions are easy: For example, on hot summer days drivers should gas up their cars in the evening, maintain vehicles in top performing condition, combine errands, share rides and take the bus.

Educators with the DNR's Bureau of Communication and Education worked with the partners to attract federal dollars, and promote the campaign with the Wisconsin Department of Transportation (DOT). A DOT grant will fund running clean air ads during peak drive times and news hours during ozone action seasons for the next two years. — *Sara Burr*



"School + Business = Clean Air" brings schools and companies together to share ways to keep air clean at work places, schools and the community.

POSTER BY KELLIE BARBER, THOMAS JEFFERSON MIDDLE SCHOOL

Dipping into the learning well

Pull up a bucketful of good advice, up-to-date literature and helpful contacts from the Department of Natural Resources.

Teachers, quench your thirst with Educ'Ade

What's green, sounds like a sports drink for teachers, and has 100 titles? It's Educ'Ade, DNR's quencher for knowledge-thirsty educators.

Educ'Ade is an order form for DNR's most popular publications. This year's version lists study guides, activities, fact sheets, posters, coloring books, book marks and brochures covering air, water, waste, parks, wildlife, fish, forests, and endangered resources. Some are available in classroom quantities. Most of the publications listed are free.

Get a copy of Educ'Ade by calling (608) 266-6790 or writing the Department of Natural Resources, Bureau of Communication and Education, Box 7921, Madison, WI 53707.

Educ'Ade lists only 100 of the more than 2,000 publications in DNR's inventory. Most are produced by individual bureaus in the agency and must be ordered through each one. Many publications have been placed on DNR's website — www.dnr.state.wi.us — and can be downloaded. Use the site's search engine to locate the publications you need. — *Joel Stone*

More paths to knowledge

The Department of Natural Resources offers many ways to learn about the outdoors. Here are other avenues worth exploring:

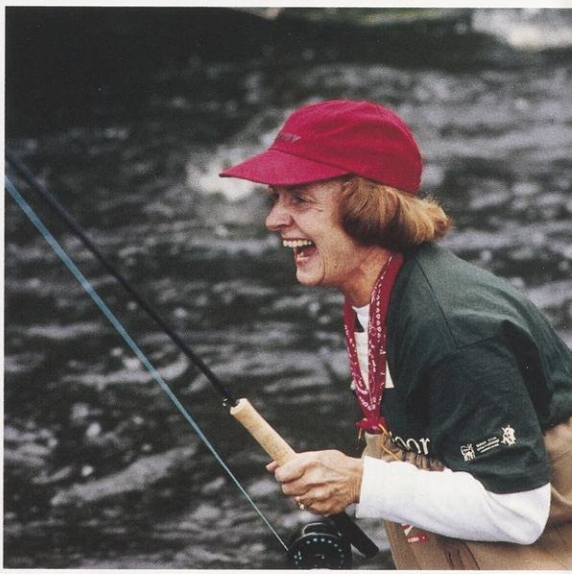
Take a recreational safety class — Thousands of volunteer instructors teach how to be skillful and respectful when hunting, trapping or operating motorboats, all-terrain vehicles and snowmobiles. Contact your local conservation warden or Recreation Safety Chief Bill Engfer, (608) 266-0859 for information on courses in your area.

Take a hike — State park naturalists hold interpretive talks and guided walks during the camping season to share the natural highlights of park properties. Contact the interpreters at the park office or by calling Chief Naturalist Debbie Beringer, (608) 267-9351.

Learn outdoor skills — Orienteering, snowshoeing, hunting and camping skills are just a few of the offerings at DNR skills centers in Grantsburg (715) 463-2896, Babcock (715) 884-2437, and Horicon (920) 387-7877.

Meet water basin educators — UW-Extension educators provide a community contact point to learn more about local water quality issues. Contact the basin educators through Robin Shepard, (608) 262-1916.

Delve into a discipline — Genny Fannucchi, DNR forest resource educator, (608) 267-3120; Mary Kay Salwey, DNR wildlife education specialist, (608) 685-3744; Theresa Stabo, DNR aquatic education specialist, (608) 266-2272; Pam Packer, Water Action Volunteers, (608) 264-8948.



Pick up a new outdoor skill like safe boating or fly-fishing. Lifelong learning is healthy and fun.

(BOTH PHOTOS) ROBERT QUEEN

PRODUCED BY THE DNR BUREAU OF COMMUNICATION AND EDUCATION
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A peaceful harvest

Skidding logs with horses is quiet, economical and ecological.

Story and photos by Paul Scott

"Step up, buddies." Dick and Dan leaned into their work. Muscles flexed and we were under way. The felled tree made a swishing sound as the team dragged it through the soft snow, partway across a frozen lake, then into a lane that curved through a black spruce swamp.

Dick and Dan are English Shires. Black with red highlights, they sport four white fetlocks between them. Dick weighs 1,800 pounds and stands 17½ hands high. Dan is a tad lighter and smaller. Together they're a lot of horseflesh. The buddies and their owner/teamster, Russ, were helping me move some felled tamaracks. I wanted to build a 300-foot boardwalk, and tamarack is the most weather-resistant wood that I have in any abundance.

Our finest tamaracks grow along the edge of Lake Bog-bound, a 6-acre spread of water on the south forty. Russ suggested that I fell the trees so that the tops lay on the lake. That way, he could back up to the trees and skid them out without having to take the team into dense brush.

It worked slick. Russ backed the horses to a downed and limbed tree. Dan had reservations about backing up, but he did it. The horses stood still while I wrapped a chain around the top of a felled trunk and hooked it to the cart located behind the team and on which Russ stood.

"Step up." The team dragged the tree onto the frozen lake and stopped. I unhooked the chain. Russ took the team to the butt end of the tree. Using a peavey, I raised the tree butt,

slipped the chain around it and hooked the chain to the cart. I kept the chain as short as possible, trying to raise the butt end to give the horses a bit of leverage. "Step up," and the tree made that swishing sound through the snow. Some of those trees were fairly large, up to 17-inches in diameter. D&D never complained.

It took two days to move the trees. The buddies skidded them from the lake, down a 45-rod lane, then 20 rods to an improvised landing east of our garden.

For small jobs and on soils where heavier mechanical skidders can compact soil, horse-drawn teams can provide a practical alternative for moving logs from the logging site to paved roads.

Horses allowed us to retrieve a truly handsome tree, large and straight, that was a bit too far into the bush and tilted slightly in the wrong direction. I felled it anyway, confident that we would figure a way to drag it out. We did. It required seven chains for a total of 90 feet. We made the connection with scarcely a link to spare. Lucky thing I collect old chains and maintain them in good repair. I had to cut through the ice on the under side of the trunk in order to free it from the frozen rock-hard grip. That tree either had to come out whole, or we'd leave all but the nearest eight-foot log, for we had no more chain. The horses could come no closer as they were breaking the ice over a bottomless strip of bog. Of course, every foot of chain reduced the advantage the horses had. Still, they dragged that tree onto the lake without strain.

I've since sawn the trees into logs and transported them to a neighbor, a high school teacher who operates a sawmill as a sideline. The band type sawmill stands in a corner of his hayfield.

D&D impressed me as calm, cooperative beasts willing to do their best for their human partner. Watching Russ work with them, I realized that "team" properly referred not only to a brace of horses harnessed to one another, but rather to matched horses and teamster working together. Matched because, as Russ explained, the horses are paired according to size, speed and temperament. Russ respected his horses, and they trusted him completely. They were more than willing to work hard for him. When they jangled the harness, or steam rose from their flanks, or they panted, or at any other sign of tiredness, Russ let them rest. At break, they lunched on hay. Me? I was too busy for lunch.

I admired Russ's skill in turning the team and cart right around on our one-lane road. My pickup requires two Y-turns to reverse itself in that same spot. When turning sharp, Russ sometimes encouraged the buddies by making kissing sounds. Their ears would prick up and they'd tighten the turn. It was a pleasure to see what the three teammates could accomplish together.

Horse teams may be nearby

When planning this project, I had no idea how to find a teamster to skid the logs. I called members of the local riding club and other horse associations. Everybody was helpful and, somewhat to my surprise, I soon had the names of three teamsters. Two lived some distance away, but the other was within 15 miles of me. That cut the travel expense and made the enterprise affordable. It turns out that Russ is a bison rancher who also owns about 20 draft mules and horses. Fairly often, a visitor will find him using animal muscle instead of gas-powered machinery in the day-to-day operation of his ranch.

I wanted to have those logs moved by horse rather than by skidder for two reasons. First, a skidder would require a drag area wider than the existing lane. I didn't want to cut several score of black spruce that I had no need to remove. As it turned out, I felled only the trees that I had marked; no others were cut or damaged. Second, there are places under the snow where the bog soil does not freeze. I worried that a skidder would expose and compact more of this soil.

Heavy horses are lighter on the soil

George Host, Ph.D., of the Natural Resources Research Institute in Duluth,

Dick and Dan easily moved heavy tamarack from the lake edge of a frozen bog that was inaccessible to machinery.

The draft horses cut a narrow path down an old logging lane while pulling their load.

Minn., is researching the effect of logging machinery on different types of soils. The concern is compaction. There has been little corresponding research on soil compaction due to logging with horses. Host hypothesizes that the compaction rate would be much less severe when using horses than when using conventional machinery. The machines leave a wider, more uniformly compacted area.

Biologists once believed that the freeze-thaw cycle of seasonal changes would reverse soil compaction following logging. Research by Host and his colleagues at a number of sites in the Great Lakes states shows that this is not true, at least in the relatively short term. They used a sort of cart called a *wobble wheel* to simulate the compaction that results following logging. The sites chosen spanned a variety of soil types. Seven years of follow-up observations reveal that freeze-thaw cycles have not reversed compaction. Soil types at the various sites show little or no recovery. Aspen growing on such sites are only 75 percent as tall and their biomass (weight) was about half of those on the control plots. The research shows that forest productivity declines in areas with compacted soil.

Compaction occurs quickly. Much of the damage occurs in the first 4–5 passes with equipment. The recommendations, therefore, are for loggers to keep their machines on established routes and to avoid making that first pass on uncompacted soil. Newer — and terribly expensive — machines exert much less pressure per square inch of soil. And techniques, such as driving over a bed of slash (branches trimmed from felled trees), may further reduce compaction.

While continuing to monitor the soil and tree growth at these experimental sites, Dr. Host and colleagues are preparing to mount a Global Positioning System on a skidder. They will then use a computer to map where the skidder actually goes. This will enable them to sample soil affected by the movements of a working skidder.

The Sustainable Woods Cooperative of Spring Green, Wis. uses horses in its forestry management. Doing so costs the co-op about twice as much as using conventional machinery. (It also uses small winches and "pre-haulers" — logging implements more common in Europe and northeast Canada designed to lessen the environmental impact of logging, that also add to the cost of business.) The horses prove especially valuable on steep slopes where minimal impact means less erosion. The co-op offsets the increased cost by adapting a market value approach — acting as landowner, forester, mill owner and marketer rolled into one entity. Above all, says director Jim Birkemeier, selective cutting becomes economical. Loggers can afford to keep skidders out of the woods when the soil is wet and vulnerable to damage. A horse can snake out a single log and leave only a narrow trail. A skidder would drag a dozen full length trees, require a wider area and could do considerable damage to trees along the sides of its path. The trees it drags can break saplings and scrape the bark off larger trees.

During the last trip down the lane, I told Russ about the property history. A hundred years ago, a landowner made a road through the woods to the lake to cut ice for his ice house, which lay a mile to the north. He transported the ice with a team of horses. (I didn't tell the other part of the story that the team broke through the ice and drowned.) Parts of that old wagon road still exist, but the lane we traveled is the best-maintained portion. That old settler laid out the road with economy. A team of horses could fit, but barely. In places, only a hand span separated the animals from the trunks of trees on either side, trees that predate the road.

I felt happy to see horses working in the lane. I've had a skidder in my woods many times. I didn't, however, want to send one over the swamp and into this lane. Skidders are noisy and inevitably leak oil. Besides, you can't look one in the eye and recognize the intelligence looking back at you. Nor can you hear the quiet swishing sound that a horse-drawn log makes through soft snow on a bright winter day. □

Paul Scott writes from South Range, Wis.

Lighting the outer limits

Parks Friends kindled interest to restore Wisconsin's oldest public lighthouse on Lake Michigan.

Story and photos by Tim Sweet

The simple charm of the Pottawatomie lighthouse with the restored lantern room in place. From the air the lighthouse and the automated beacon erected in the late 1980s are clearly visible.

On a rugged 137-foot bluff off the tip of Door County, a bright beacon has warned mariners from the east to steer clear of Rock Island's crags and shoals on their way into Green Bay since 1836. Credited as the first federal lighthouse built in Wisconsin on Lake Michigan, the Pottawatomie (or Potawatomi) Lighthouse only lasted 22 years; it was razed before wind and rain toppled the gray, square 30-foot tower constructed with faulty mortar.

The present lighthouse replaced the original structure in 1858. The building was a solid, sturdy duplex that housed the keeper on the first floor and an assistant who occupied the second story. Crafted of island limestone, the 33x31-foot structure featured an 8x8-foot square wooden tower rising out of the ridgeline of a red, tin-covered roof. A nine-sided lantern room housed a 4th order Fresnel lens. This optical beauty produced a light that was visible in clear weather from a distance of 14 nautical miles.

In the early years, lighthouse families tended their post year-round. A succession of keepers' families enhanced the grounds with an outhouse, chicken coop, barn, gardens, apple trees and lilac bushes. Cisterns in the basement collected water from the roof to provide drinking water. Wild foods and the gardens' bounty were supplemented with annual shipments of supplies.

When I first visited the lighthouse in 1989, I was disappointed to find that the

lantern room and the lens had both been removed from the keepers' quarters. Piecing together several versions of the story, the lantern was taken down sometime between the 1960s and 1980. Condensation from poor ventilation caused the lantern to rot from the inside out. The Fresnel lens was crated up and placed in the station's basement. Unfortunately, it was stolen and its whereabouts still remain a mystery.

The Coast Guard erected a steel tower immediately west of the old light station in the late 1980s to hold an automated, solar-charged, battery-powered beacon that requires very little maintenance.

In 1989, the Department of Natural Resources, which manages Rock Island as state parkland, rebuilt the 1858 tower, added a red tin roof on the lighthouse, and constructed a new chimney. A few years later, a contractor tuckpointed the mortar joints between the native dolomite. These improvements sealed the structure from the elements and set the stage for some organization to take over the next phase of restoration.

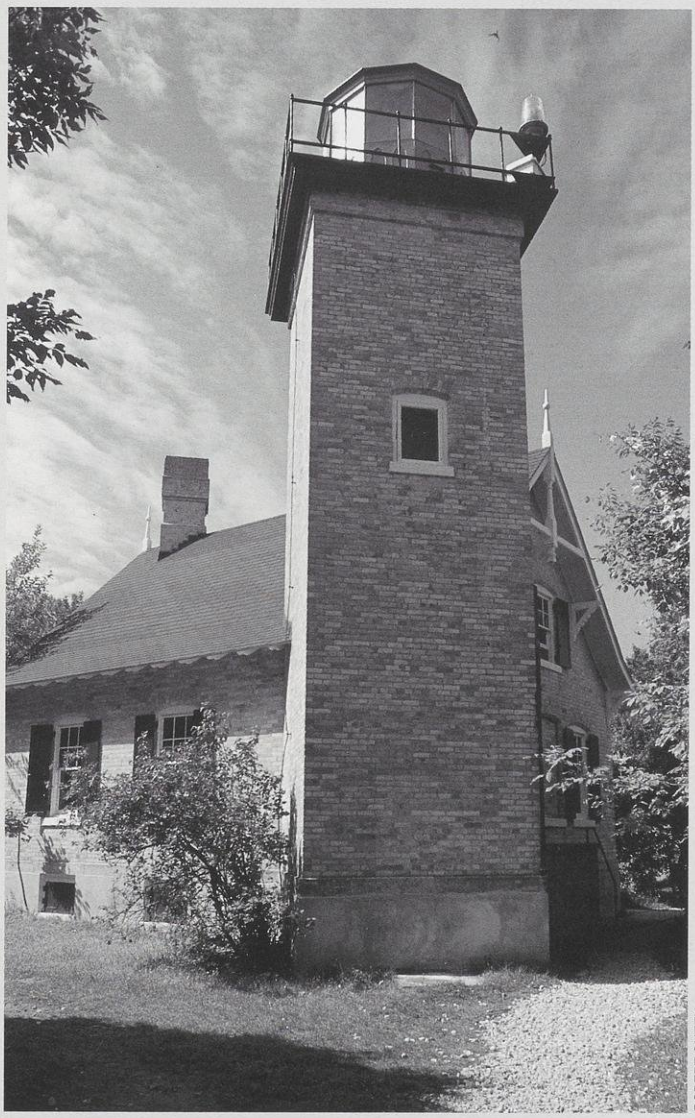
In 1994, the Friends of Rock Island (FORI) formed to aid the DNR in enhancing the natural beauty and historic significance of this unique state park. FORI decided to direct part of its energy to restoring the Pottawatomie Lighthouse and reconstructing the missing lantern room.

Tony Hodges of Sturgeon Bay came to Rock Island on a camping trip during September of 1997. On a tour of the lighthouse, a park naturalist mentioned that the FORI was trying to find someone who could design, build, and install a new lantern housing. Hodges offered his services and was hired to begin design work during the winter of 1998. This project was funded by a state Stewardship Fund grant matched by donations from individuals and corporations.

DNR Landscape Architect Dan Rogers and the late Tom Jessen were instrumental in working to preserve the exterior of the 1858 structure. Rogers also researched the building's history at the National Archives in Washington, D.C. He located blueprints of the keepers' dwelling and elevations that included the house, tower, and lantern, but there were no separate detailed plans Hodges could follow to reconstruct the lantern itself.

Hodges' drawings for the project were done from scratch and included none of the original lantern components, since he did not know they existed. One day in conversation with Rogers, Hodges learned that the original cast iron windowsills from the lantern room were still on site at the lighthouse. Rogers wondered if there would be any way to use these in the reconstruction. The sills, when pieced together, formed the base of the roof and the nine-sided top of the parapet (waist-high wall of the lantern).

To "do it right," Hodges decided to scrap his first set of plans and use the original pieces as models to make the project more historically accurate. He explained, that after finding and inspecting two existing 1858 nine-sided lanterns, he had a good idea of how they had been built. "I also learned where the (original designs) were having problems." Since many of the missing cast iron pieces would have to be joined into one steel weldment, Hodges



ROBERT QUEEN

Restoring old sentinels like the Eagle Bluff lighthouse in Peninsula State Park preserves both Great Lakes history and clean, elegant architecture.

Saving other Great Lakes lights

Lighthouses still dot the shorelines of the Great Lakes. Door County boasts more lighthouses protecting its coast than any other county in the United States.

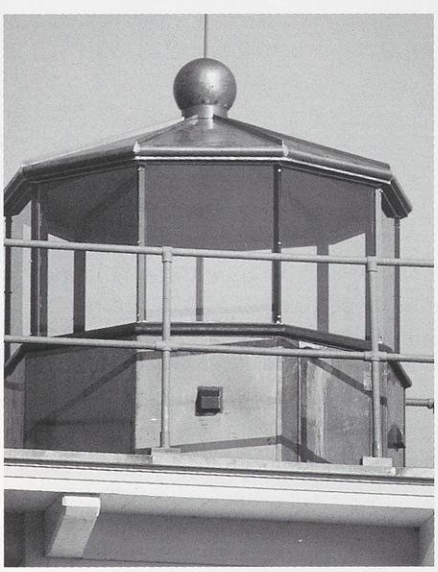
Sherwood Point Light near Sturgeon Bay was the last manned lighthouse on the Great Lakes. It was automated in 1983.

When lighthouses were first built in the region 100–150 years ago, whale oil and later kerosene lamps made having a live-in keeper necessary. Now automatic lights (complete with self-changing bulbs), satellites, and other high tech navigational aids have all but eliminated the need for lighthouses and their keepers.

The Coast Guard is relinquishing responsibility for many of the stations that were once under its jurisdiction. Some of the properties, including four Door County lighthouses at Cana Island, Eagle Bluff (in Peninsula State Park and operated by the Door County Historical Society), Pilot Island and Plum Island, have been temporarily returned to the Bureau of Land Management (BLM). Historical, environmental, and financial plans for each of the properties has started. DNR's Dan Rogers at the Green Bay office, is beginning to form plans for the Plum and Pilot island properties.

The Department of Natural Resources and the federal BLM are interested in forming partnerships with non-profit historical preservation groups to spearhead a drive to restore the historic buildings on Plum and Pilot islands. Such a group called Death's Door Watchstanders, Inc. is just forming now. Its name honors those who stood watch over the dangerous passage between the tip of Door County and Washington Island. Contact the group through the Friends of Rock Island.

The lantern room and housing was built in Hodges' workshop, dismantled, and transported by truck, trailer, ferry, boat and pickup to Rock Island. Pieces were hoisted in place 41 feet in the air using a homemade crane.
(right) Coppersmith Frank Luckenbach skillfully hammers protective pieces into the restored lantern rooftop.



Tony Hodges' design copied the original framework and modeled the remainder from historical patterns, but his is more watertight!

improved the design to better exclude water. "I upgraded the wood from yellow pine to northern white ash, which is rot-resistant, and I modified the copper roof structure to prevent condensation."

The new lantern room was built in Hodges' Sturgeon Bay shop with hours of help from his son, Ben. In June of 1999, Hodges numbered each part of the lantern, dismantled it, loaded it onto a trailer, and hauled it to the tip of the Door Peninsula where he drove onto a car ferry bound for Washington Island. The pieces were then taken to Jackson Harbor where Rock Island property manager Mark Eggleson and his crew brought them across the last mile of open water in the park boat, then moved them up logging roads in a pickup truck to the lighthouse.

Assisted by project volunteer Marshall Paulsen, Hodges hoisted the components 41 feet up to the gallery deck using a homemade crane fashioned from an aluminum extension ladder and a battery-powered winch. The installation took nine days. The copper-clad parapet and roof, along with the ventilation ball and flashing details were skillfully crafted and put in place on the lantern by coppersmith Frank Luckenbach.

The restoration was so well done that the Friends received an award from the Wisconsin Trust for Historic Preservation. But their work isn't done. The Friends are interested in bringing the interior of the keepers' quarters and the lighthouse grounds back to their original beauty. Cost estimates to restore the interior of the structure including plastering and painting walls and ceilings, sanding floors, repairing doors and other millwork total $65,000. We're looking for partners who can help us seek grants and conduct an archaeological study of the site to restore the privy, the oil house, and a nearby smokehouse.

The DNR is planning to construct bathroom facilities adjacent to the lighthouse as soon as this summer. FORI has set an ambitious goal of finishing all interior work on the building by 2002 so public tours by a resident interpreter can be regularly scheduled each June–August. Tours of the building and tower, featuring a climb to the new lantern room, are currently offered by a FORI volunteer every Friday (weather permitting) during the summer from 11–3 p.m.

For more information, to offer financial support or to join the restoration effort, contact Friends of Rock Island State Park , 126 Country Club Drive, Clintonville, WI 54929, (715) 823-6873, http://www.wctc.net/~cmarlspc/. □

Tim Sweet is president of the Friends of Rock Island and lives in Clintonville, Wis.

A Cooper's hawk family album

When a family of seldom-seen "Coops" takes up residence in a Plover backyard, an adult student takes notice.

Jim Nicewander

(left) Author Jim Nicewander holds the banded male "parent" of the Cooper's hawks that fledged a family in the woodlot next to his Plover home.
(right) Two of the five nestlings that were banded and observed from June through August.

The combat would fit perfectly in a TV show with an ugly title like *Nature's Death Battles:* Four young Cooper's hawks are ganging up on a gray squirrel in a vicious struggle in the matted leaves under the oaks and maples. The birds are about six weeks old and almost as big as crows, so their prey is in the fight for its life.

There's little cover except for a brush pile a foot or two high running the length of the woods. The squirrel runs toward a rail fence at the trees' edge, but a hawk flaps past him and blocks that path. He darts back toward the brush pile, and another Cooper's responds accordingly.

The birds seem awfully young to be hunting cooperatively, but they're doing well at containing the squirrel, who's proving to be a formidable foe. He's fending them off by biting, jumping, kicking, scratching and flailing away with everything he's got.

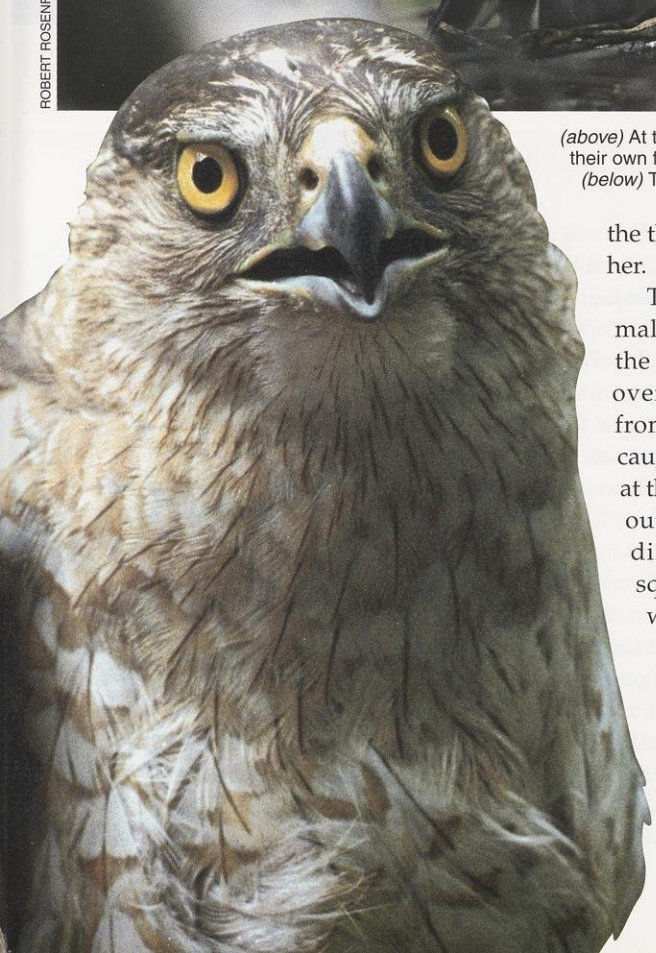
That fierce defense — and his attackers' apparent inexperience — are all that's preventing the squirrel from becoming a meal. When the hawks do engage him in direct "talon-to-claw" fighting, he appears to inflict more wounds than he receives.

The brawl intensifies, and the birds try to move in even tighter, right into the thrashing teeth and claws. In that instant, an adult female hawk — "Momma Coop" — swoops into the woods about a yard off the ground and right through the fight. Her abrupt intervention breaks up the battle, and the squirrel seizes the opportunity to escape into the brush pile.

The adult Coop continues her flight into a tree overlooking the brush, within just a few yards of a human observer who is covered by camouflage. The bird seems to pay no attention to him.

Three of the juveniles join the adult in an adjacent tree. After a couple of minutes, she swoops down onto the brush pile, flushes out a chipmunk, catches it with her powerful talons and flies off;

ROBERT ROSENFIELD (BELOW) JIM NICEWANDER



(above) At three weeks, these juveniles already start looking like mature hawks. They can also tear off their own food from prey brought to the nest by an adult.
(below) The "mother" hawk kept an eye on the juveniles, but rarely was seen with them.

the three closest juveniles follow her.

The fourth young hawk, a male, has been watching from the ground. He wings his way over to the brush pile, not far from where the adult had just caught the chipmunk. He picks at the sticks a while and flushes out another chipmunk, a less difficult adversary than the squirrel. The hawk catches it with little problem and begins tearing it apart and eating it on the spot.

Two of the other juveniles return and perch in branches about 25 feet away from the male and his meal. He continues consuming his catch, stopping only to mantle — raise his wings like a shield to hide and protect his prey from other birds.

The young Cooper's hawk finishes off the chipmunk and flaps to the top of the brush pile. Using his beak, he removes the chipmunk residue from his talons and feet and then cleans his beak by brushing it against some sticks.

With that completed, he flies out of the area, followed by one of the two remaining birds. The last one glides down to where the male had finished eating and pokes and scratches around the bloodied twigs and leaves. When she finds nothing that holds her attention, she flies off toward the others.

Beneath the camouflage

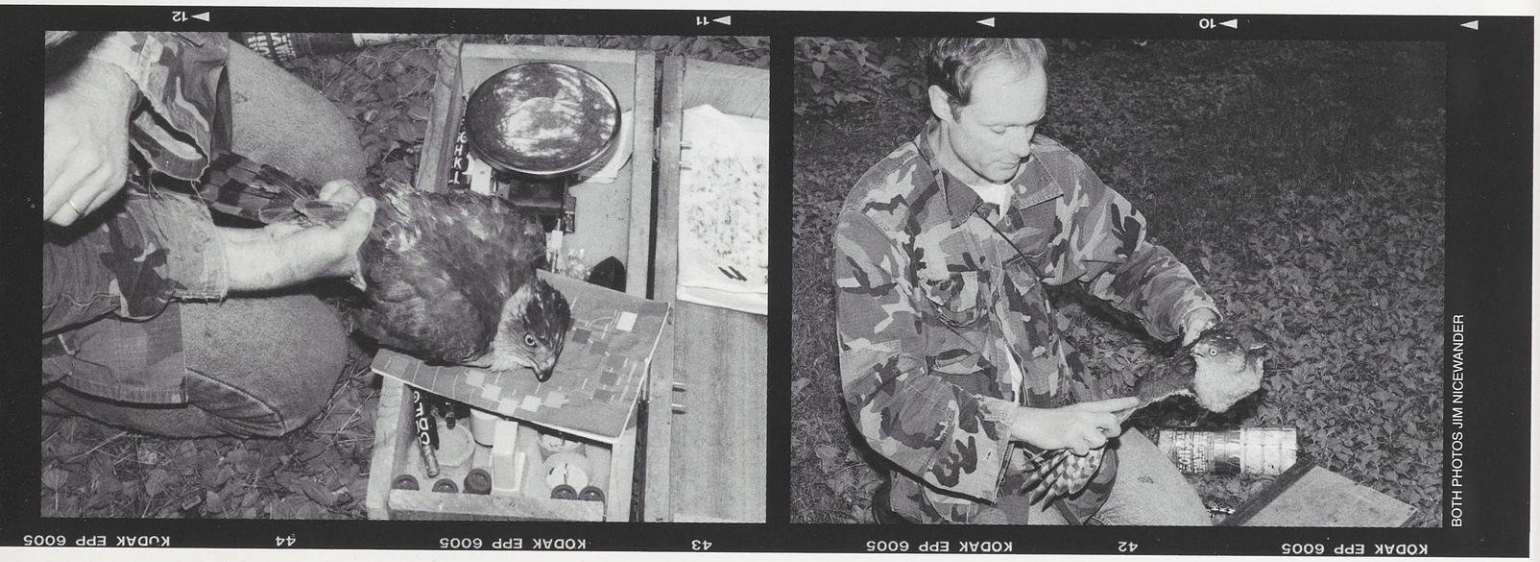
The human observer in this real-life drama was not a research scientist, but me — a decidedly unscientific school administrator who just happened to be in the right place at the right time. The right place was not wilderness, but merely the woods on our two-acre parcel in a subdivision in Plover, in the heart of Wisconsin.

I had not gone looking for the hawks; they just found likable habitat, and I happened to be there. I'm no Cooper's hawk expert! Indeed, my sole previous experience had been a conversation with my father back in the 1950s on our farm in Waupaca County.

As a kid back then, I spent many summer hours watching large, soaring hawks ride thermals over our fields. They were redtails, and nearly everybody called them "chicken hawks," though my dad didn't think those big hawks were the chicken thieves. He said the real robbers were the "Coops." But he said they hadn't been around our place in a long, long time, and I never did get to see one on the farm.

More than 40 years later, here I was, watching a whole bunch of Cooper's hawks. It happened only because a series of fateful occurrences converged that summer:

As fate (version 1) would have it, a second semester course called *Raptor*



Several attributes are measured in Rosenfield's Copper's hawk research. *(left)* Eye color and weight are noted; *(right)* wing and feather characteristics of this adult female are documented. Rosenfield's detective work indicates that hereditary factors contribute to which Cooper's hawks will become successful breeding birds; an unusual finding in raptor ecology where the birds' habitat, behavior and environment were thought to determine breeding status.

Success on the wing

For a long time we knew less about Cooper's hawks than we did about many other North American raptors. The birds are relatively secretive in their habits and habitat, making them more difficult to study than red-tailed hawks, American kestrels, or even bald eagles.

Our knowledge about Cooper's hawks has been enriched by the research of Dr. Robert Rosenfield, a biology professor at the University of Wisconsin-Stevens Point, and his colleagues. Rosenfield's primary research partner over the years has been fellow scientist John Bielefeldt of Sturtevant. Their study of Cooper's hawks in Wisconsin began in 1980, and it's been so successful that other researchers in other raptor studies have adopted many of their methods.

The project began with banding birds — about 2,400 individual hawks to date. At the time they are banded, the adults are weighed, the wing and tail feathers are measured, eye color is recorded (an approximate index of age in the males), and the molt (sequence of replacement of worn-out feathers) examined. The records are compared with data on the hawks' offspring. The study has yielded a mother lode of data, and since the start of his research, Rosenfield has had a part in about 30 published papers on the species.

Rosenfield's 20-year project is by far the longest on-going study of Cooper's hawks, and one of the farthest reaching: He has collaborated with fellow researchers in northwest North Dakota and in British Columbia, where populations of the hawks rival those in Wisconsin.

"Ultimately, we're trying to find answers to questions like what environmental or ecological factors influence the hawks' breeding," says Rosenfield. "What things contribute significantly to their success? In this research, I see myself as sort of a sleuth trying to uncover some answers to those things."

His detective work has yielded some important results. One of Rosenfield's most recently published papers presented data indicating that hereditary factors significantly contribute to which Cooper's hawks become most successful breeding birds. That irrefutable determination of genetic links, as compared to purely environmental causes and effects, is an unconventional finding in the world of raptor ecology.

As his study has progressed and the data has taken on

Ecology had been offered at UW-Stevens Point, right up the road from my place. It was all about hawks and other Wisconsin raptors, so I signed up as a middle-aged, non-traditional student, just for the excitement of learning some science to go with my memories.

As fate (version 2) would have it, halfway through the semester, we spotted a couple of hawks hanging around our place. How fortuitous: having some real live birds to observe as I studied them in school.

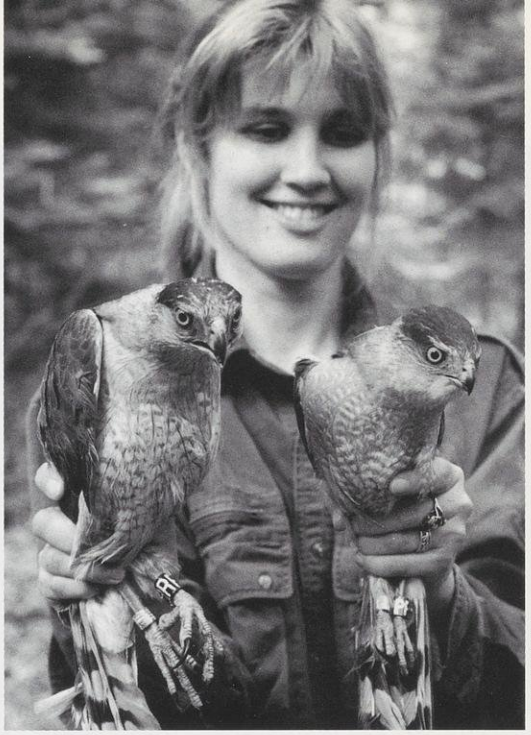
As fate (version 3) would have it, we learned that the raptors in our woods were Cooper's hawks. Great, I'd finally get to see some authentic chicken hawks!

And then as fate (version 4) would have it, my professor was Dr. Robert Rosenfield; not only a gifted teacher, but a world-recognized researcher and authority on Cooper's hawks.

The hawks in our woods had a nest in a large white pine about 100 feet behind the house, and they hatched five young ones in it. The parents and offspring all became part of Dr. Rosenfield's research when he trapped and banded them in late June. Then, when the little ones fledged and left the nest in mid-July, we thought we had seen the last of them. However, we soon found out they had staked a claim on our woods as their own homestead, and they stayed until early August.

Dr. Rosenfield said we had a unique opportunity to observe immature Cooper's hawks for an extended period, something that few people get to see. We made more than 80 observations of the young hawks' activities during their 3½ -week stay.

As the hawks grew in age from about six weeks to ten weeks old, their loud and frequent calling would trigger our observations. We would hear them outside and I would don some camouflage and slip out to watch them.



JIM NICEWANDER

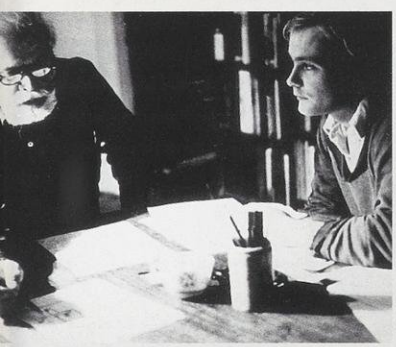
Raptor Ecology student Carrie Walczak shows a pair of adult Cooper's hawks. The larger bird on the left as you view the photo is the female.

Watched like hawks

The young Cooper's hawks displayed a wide variety of behaviors, ranging from solitary resting to dynamic group activity. Here's a representative sample of the kinds of things we saw.

Gender differences: The juvenile hawks did not all look alike. I remembered from class that Cooper's hawk females are about one-third larger than males. The males in our group were not only smaller, but their coloration was noticeably different. While juvenile Cooper's typically have vertical streaking on the breast, markings on these males appeared significantly more pronounced than on the females.

Absence of adult hawks: Some studies have suggested that after fledging, young Cooper's hawks periodically get fed by the parents. We never saw an adult bird feeding a youngster.



COURTESY OF ROBERT ROSENFIELD

Continuing the mentoring tradition. Rosenfield *(right)* discussing his thesis work in 1982 with Frederick Hamerstrom at the renowned ecologist's Plainfield home.

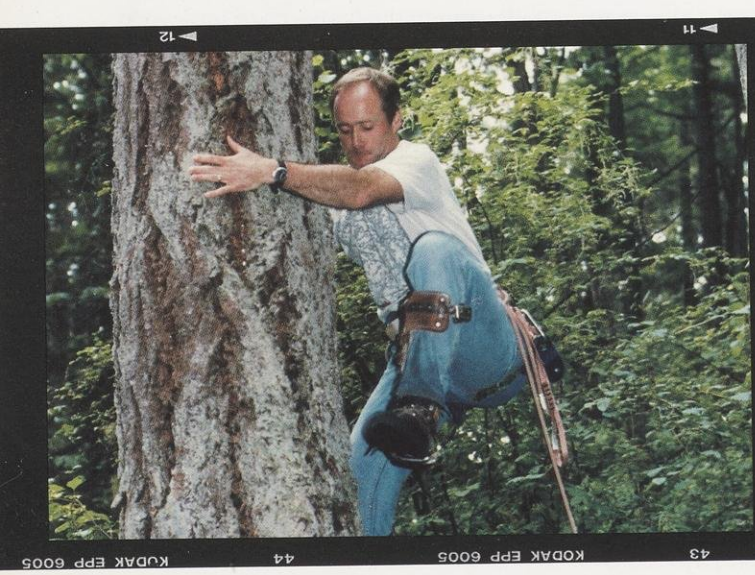
more long-term significance, Rosenfield has become convinced that the Cooper's hawk — declared as a threatened species in 1979 — is not in trouble in Wisconsin. As he and Bielefeldt put it in a recent paper, "The Cooper's hawk may...be one of the commonest diurnal [daytime hunting] raptors in Wisconsin...the Cooper's hawk has retained or possibly regained — we do not know which — its former status as one of the state's most numerous nesting hawks." Their research was instrumental in getting the Cooper's hawk downgraded from threatened status to a "species of special concern" in 1989.

To motivate students, Rosenfield brings his studies right into the classroom — following in the footsteps of renowned researcher Frederick Hamerstrom, who was not only Rosenfield's academic advisor, but his mentor as well.

"One of the great things about our research is how it provides so many educational opportunities for our students, especially our undergraduates," Rosenfield says. "It's exciting to get them enthusiastic about helping us work with the data we are amassing.

"Because our Cooper's hawk research is known both internationally and locally, the UW-Stevens Point campus benefits directly when our students participate in it. They help the project and for many, this is their first real contribution to hard science; it helps kick-start them into careers as scientists. It motivates them in invaluable ways that their reading and my teaching can't accomplish," he says. "That educational part of it all gives me unspeakable gratification," Rosenfield says. "It makes our projects much more valuable than if they were just research."

(above) Rosenfield's Raptor Ecology students get hand's-on experience learning how to handle hawks, band them and make field observations.
(below left) Raptor researchers have to stay in shape to stay in touch with their subjects.
(below right) An adult female incubates her nest atop a white pine.



We only saw an adult with the juveniles two times. The first instance I've described, and a second time when two young hawks aggressively chased one another through the woods, calling loudly at each other. They landed on the same branch and began pushing and jostling one another, barely keeping their balance. The adult female flew to the tree the young hawks were in, landing on a branch just above the battling juveniles. They immediately stopped fighting and flew off as soon as she touched down on her perch.

Frequent flyer exercise: Routine behavior for the young hawks during most of our observations involved groups of the birds just flying back and forth within the woods. The hawks swooped into the woods, flying only a yard or so above the ground, rising above the bushes and descending again, following the contours of the ground cover. One hawk and then another would take the lead, all of them staying within a couple yards of each other.

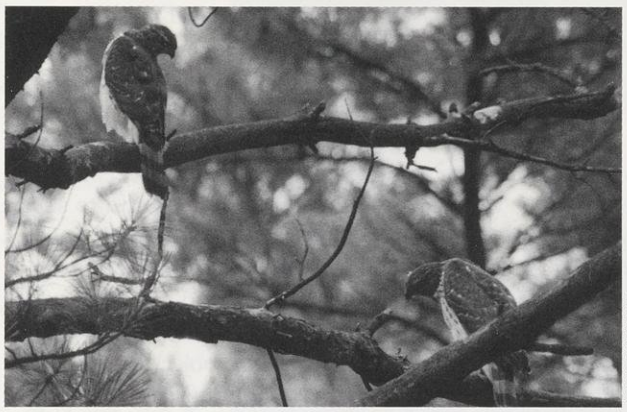
When they landed, they frequently settled for just a few seconds before taking off again. There was usually much loud *"eeeee-eeeee"* calling among them, and for long periods, individual birds would not get more than four or five yards away from one another for more than a few seconds during these maneuvers.

ROBERT ROSENFIELD

Physical contact between hawks: At times, the hawks physically challenged one another. In one instance, two females stayed right beside each other, less than a yard apart. They hopped from branch to branch as a pair, first one and then the other initiating the move. There was frequent and considerable physical contact between them, with a great deal of wing flapping and pushing at each other, though the behavior did not appear hostile.

Hunting and feeding activities

We observed many instances of the juveniles trying to catch prey animals. Some incidents revealed that the birds were still learning; other times they showed a remarkable adeptness at catching food.



JIM NICEWANDER

Watching for chipmunks and other prey was often a group activity for the juvenile hawks.

Hunting postures: Typically when hunting, the young hawks firmly gripped a branch with both feet, sitting erect with the head held up. In this position, the hawks frequently turned their heads side-to-side and up-and-down.

One of the juveniles varied its hunting posture by hunching over in a vulture-like stance, taking on a "skulking" appearance, as if trying to get a better view of some prey.

A rough landing: One juvenile hawk flew into a dense thicket of branches after seeing a squirrel. Without sufficient space to completely clear the branches, one wing got caught and the bird could not keep its balance. It tipped off the branch and had to resume flying as it fell toward the ground.

Group hunting: In another hunting incident, four of the immature hawks group-attacked a chipmunk. They lunged at him repeatedly, but not in a well-organized attack. After a minute or so, one bird caught it, and flew out of the observation area with the chipmunk; the other birds followed.

Male hawk mantling over prey: In one of the most interesting observations, one of the males swooped down to the ground, and after a flurry of activity, flew up to a large branch overhead, carrying a chipmunk. He was quickly joined by two of his female siblings, one landing on his branch and the other right above him.

Those two birds called frequently and gradually worked their way closer to the male, which had begun eating his catch. When approached within a yard or so, he mantled over his meal until they backed off. One of the females finally flapped right up next to him and did not back off. Instead, she moved even closer, with physical contact and intense calling by both birds. She quickly retreated, but the male did not resume eating until she had turned her back to him.

Two females sharing food: Mealtimes weren't always contentious. In one instance, two female juveniles flew into the observation area, landing on low branches right above the brush pile. One swooped down to the brush, and after a brief commotion, hopped up to the top of the pile with a chipmunk.

The other hawk flew down and landed about a yard from the bird with the food. That hawk with the chipmunk began eating it, and the other moved closer. The eating bird mantled over her food, but put down her wings when the approaching bird reached in and tore off a piece of the animal and ate it. The two hawks continued to alternate their feeding until the chipmunk was totally consumed.

What we learned

The opportunity to hang around juvenile hawks for a few weeks was exciting and enlightening. It helped me connect to my younger years on the farm and see some of the hawks' interesting behaviors. By the time it was all over, I appreciated just how privileged we had been to be in the right place at the right time.

And for the record, in our weeks of watching the Coops, not once did we see them take a chicken! □

In addition to being a hawk-watching farm boy, Jim Nicewander is an administrator with the Stevens Point Area Public School District.

continued from page 2

JOHN PANUSKA

As wind rises over a stone fence, it speeds up and forms an eddy on each side. Snowdrifts with sharp-edged cornices form on both sides. As the drifts grow, they alter the wind speed and direction. Eventually the fence is no longer a factor and snow piles near both sides to bury it. The snowdrift becomes smooth and streamlined and is said to be saturated.

A boulder or small clump of vegetation on level ground produces another form of snowdrift. If the boulder is about as wide as it is tall, air flows around it as well as over it. Air blowing around its sides speeds up, scooping out pockets of snow and depositing it on the stone's leeward side. Different sized stones alter the shape and size of the snowdrift formed. A very narrow boulder may cause the wind to scoop out snow completely around it and not leave a leeward drift. On a larger scale, look for scoops around parked cars and house corners, all produced by wind blowing around an object.

Wind force also influences the forming snowdrift. As snow crystals tumble along, the structure of each crystal breaks down losing its individual identity (unlike drifting sand whose grains remain the same). As drifts form, the crystals coalesce, forming a uniform snow mass. The stronger the wind, the greater the force to compact the snow into harder-packed drifts. These can be mined for snow bricks and used to build children's snow forts or winter survival shelters.

By studying snowdrifts, we can learn about wind and its impact upon the land. On a personal level, snowdrifts always bring out the little girl in me. I find it impossible to step over a drift. I must plunge in kicking my way through it! I can't resist the lure of a large drift like the one formed by a snowfence. I must see if it will support my weight so I can walk higher than the fence. The feeling is glorious! □

Sure-footed Anita Carpenter climbs the drifts and kicks the snow on winter walks near her Oshkosh home.

Readers Write

ANOTHER GREAT RIDE

I'm a steam locomotive enthusiast, so I enjoyed your coverage of fall train trips in the October Wisconsin Traveler. I would also like to mention the Kettle Moraine Railway in North Lake, south of Hartford. The train offers trips on Sundays, June through September, on Saturdays and Sundays in October, and on Friday–Sunday of Thanksgiving weekend. The 8-mile round trip takes about 50 minutes. The station is convenient to southern Wisconsin and Northern Illinois visitors and a portion of the Ice Age Trail crosses the property. You can enjoy the sights and sounds of the countryside by combining a train trip and day hike here. Call (414) 966-0516 or write Steam Train, P.O. Box 247, North Lake, WI 53064.

Richard C. Wilson
Des Plaines, Ill.

UPDATES

More dam removals

The 150-year-old Shopiere Dam near Beloit was removed last October because the dam had repeatedly failed. Owners left the area more than 20 years ago and removal was far cheaper than renovation. In surveys before the dam was removed, biologists found 40 fish species below the dam and only 20 species above the structure on Turtle Creek, which feeds into the lower Rock River. Smallmouth bass density below the dam was roughly 578 per stream mile and only 63 above the dam. Removal is expected to better distribute fish along Turtle Creek and the lower Rock River and provide more places for bass fishing.

Early trout season

The Natural Resources Board has approved recommendations of an Early Trout Season Task Force and authorized hearings to establish early season catch-and-release trout fishing west of Highway 51 and south of Highway 23 (with the exception of listed sensitive streams). Anglers will be limited to artificial baits and barbless hooks. The season would open March 1 and closes five days before the general opener on the first Saturday in May.

"This alternative turned out to be the one everybody could live with," said Larry Claggett, DNR cold water fisheries biologist and task force co-chair. "It largely continues the current early season in most of the state and satisfies concerns about protecting streams in northeastern Wisconsin."

Air those cabins

Cabin owners are advised to air out their cabins and outbuildings well, pack away food stuffs in airtight containers and seal cracks to keep out mice that can carry a severe respiratory disease — hantavirus. Though only one case of hantavirus infection has been reported in Wisconsin, be aware that unoccupied cabins, campers, mobile homes and blinds can provide refuge for mice that carry the disease.

Hantavirus can be passed to humans though inhaling dust from dried rodent saliva, urine or feces. Infections are hard to treat and progress swiftly. Airing out cabins, wetting dusty surfaces with disinfectants and cleaning the cabin with a damp mop or sponge can minimize exposure.

When closing your cabin for the season or weekend, thoroughly clean the cabin, remove foodstuffs that might attract mice and use mouse-proof storage containers. For more information, contact the Wisconsin Department of Health and Family Services Communicable Diseases, (608)267-9003.

Deer harvest

Hunters shot an estimated 382,914 deer during the nine-day gun deer hunt, the third highest on record. The total compares to a harvest of 325,010 in 1998 and record harvests of about 398,000 in 1995 and 389,000 in 1996.

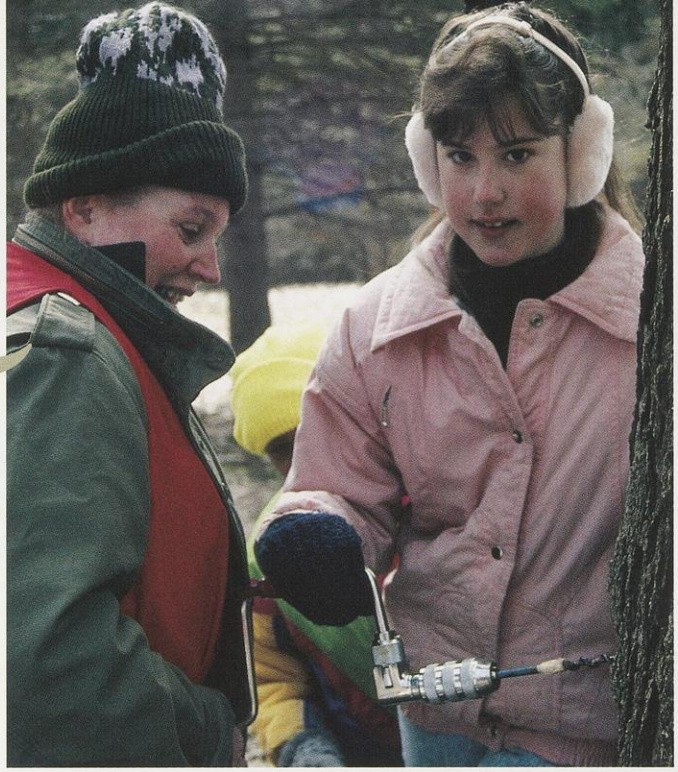
The hunt opened with a record two-day harvest of 184,339 on Nov. 20-21 in unseasonably warm, dry weather conditions and a second highest ever state deer population estimated at 1.6 million.

"Hunters came real close to hitting our preseason goal of 400,000," said Tom Hauge, director of DNR Bureau of Wildlife Management. "Given the conditions — lack of snow and warm weather — I think this is a pretty good harvest."

The harvest was up in northern Wisconsin more than 20 percent and more than 23 percent in western Wisconsin. Arrests were down 12 percent statewide, but the serious nature of violations increased. The largest increases were in hunting over illegal bait, hunting late (often over bait piles) and cabin hunting.

WISCONSIN TRAVELER

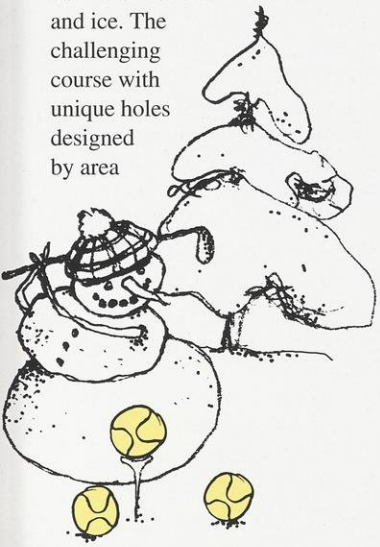
Sweetness, laughter and light



ROBERT WALLEN

(above) Students bore with a bit to set a spile and collect sap for syrup in early March. Sugaring lessons are available at several sites.
(below) Late winter is a great time to take a snowshoe hike or cruise the sugar maples in anticipation of the sweet season.

Wisconsinites have always excelled at sloughing off winter's less-than-endearing charms with a touch of whimsy, a good laugh, and a little sweetness. For instance: Come February 12, should you happen to be in Wausau with a 9-iron in your pocket, you might be invited to join a foursome at the **Ice Tee Classic.** From 10 a.m. to 2 p.m., intrepid golfers will whack the dickens out of bright yellow tennis balls over a 12-hole course carved out of snow and ice. The challenging course with unique holes designed by area



businesses promises to be, if not tougher than Augusta, then at least colder. 715/845-1966.

It's easy to laugh at the dark when the way's well lit, as anyone who's attended a **candlelight ski, hike or snowshoe night** can attest. Here's a list of a few of these popular events, but there will be more. Check with the state or county park nearest you for details. All events will be held from 6–9 p.m. unless otherwise noted…weather permitting, of course.

FEBRUARY 11

Red Cedar State Trail, Menomonie: Cross-country ski on two miles of candlelit trails to the spectacular Blue Ice Wall. The event kicks off Menomonie's Swiss Miss Winter Carnival, a weekend of activities including a horse and cutter parade, winter games, and sled dog racing. Warming fires and free hot chocolate. 800/283-1862, 715/232-1242.

FEBRUARY 12

Kettle Moraine State Forest – Pike Lake Unit, Hartford: Hike or ski by candlelight through wooded trails. 6–11 p.m. 414/670-3400.

Lake Wissota State Park, Chippewa Falls: Ski a 1- or 2-mile groomed trail through a winter wonderland illuminated by glowing candles. If you do not ski, a ¾-mile candlelit trail is available for hiking and snowshoeing. Refreshments sponsored by the Friends of Lake Wissota State Park. 715/382-4574.

ROBERT QUEEN

Mirror Lake State Park, Baraboo: Nordic skiing on state park trails lit by hundreds of candles. The park provides cooking grills and warming fires. 608/254-2333.

Lake Kegonsa State Park, Stoughton: Two miles of groomed and tracked ski trails lit by candle luminaries. Bonfire and cooking grills provided. 608/873-9695.

Gov. Nelson State Park, Waunakee: Cross-country ski trails illuminated by candlelight. Bonfire, grills for cooking, hot coffee and chocolate. Meet in the north parking lot. 608/831-3005.

Rib Mountain State Park, Wausau: Hike or snowshoe a 2.5 mile, moderately difficult trail. Limited number of snowshoes available. With refreshments and a heated shelter. 6–8 p.m. 715/842-2522.

To end the season on a sweet note, trek to a **sugarbush** and discover why Wisconsin is one of the top five maple syrup producers in the U.S.A.

At the **Gordon Bubolz Nature Preserve** near Appleton, you'll have two opportunities to get sap-happy. On March 4, you're welcome to "Adopt a Bucket" — personalize a sap bucket and take it out to the preserve's sugarbush, where you'll be shown how to tap a maple tree and hang your bucket to collect sap. Then, on March 18, it's "Maple Syrup Saturday" — the day you'll see the sugar making process and make your own maple syrup. Both events are held from 11 a.m.–4 p.m. and feature a taste of fresh maple syrup on ice cream. 920/731-6041. http://www.athenet.net/~bubolz/

Other nature centers also offer sugarbush tours and syrup-making memories. For dates and details, contact **Ledge View Nature Center,** Chilton, 920/849-7094; **Wehr Nature Center,** Franklin, 414/425-8550; **Riveredge Nature Center,** Newburg, 414/375-2715; or the **MacKenzie Environmental Center,** Poynette, 608/635-8110. □

Wisconsin, naturally

Olson Oak Woods State Natural Area

Notable: This site contains a large, classic example of a southern dry forest composed of white and black oaks, along with black cherry, bur oak, red oak, hickory, elms, and basswood. Scattered open-grown white oaks date to the 1750's. Nearly 300 species of vascular plants have been observed in the forest and more than 40 bird species have nested on the site.

How to get there: From the junction of U.S. Highways 18/151 and State Highway 69 in Verona, go south on 69 about 1½ miles to Riverside Road, then west on Riverside 2 miles to Fritz Road, then south on Fritz about 1 mile to a parking area on the east. The natural area is part of the Jackson School Forest, owned and managed by the Madison Metropolitan School District. *Wisconsin Atlas:* page 27, grid A7.

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