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SPECIAL REPORT: 75 years of Devil's Lake State Park

WISCONSIN NATURAL RESOURCES

$3.00

July/August 1986

Volume 10, Number 4

Snakes are nice

Wild silk moths

Grow gourmet mushrooms on the back 40

Great Lakes Trail—An Early Drive from Illinois into Wisconsin. By Artist Robert A. Scott, P.O. Box 43, Hales Corners, WI 53130.

Whoopee-Ti-Yi-O in Wisconsin

Deana Hipke, editorial intern

Wisconsin, long the home of farmers and dairy cows, once for a brief time took a fling at horseback cowboys and longhorn steers. That was in presettlement days, 150 years ago when the drover's cry of "Round 'em up, move 'em out" echoed down the dunes of Lake Michigan.

According to accounts in William R. Smith's *History of Wisconsin* (1855), the first cattle were driven into the state in 1825 by Colonel William S. Hamilton, son of Alexander Hamilton. Hamilton had contracted with the government to supply provisions for troops stationed at Fort Howard. This was before Wisconsin came into her own as a territory. With no railroads, and no steamships operating on Lake Michigan at that time, the only way to provide troops with meat was to bring live cattle overland.

Hamilton left Springfield, Illinois with four men and 700 head of cattle in June 1825. Traveling northward, he and his crew forded the Mackinaw, Illinois and Fox Rivers to reach Chicago. From there they proceeded overland to Milwaukee. This first portion of the trip was probably the most trying for both men and beasts. The rivers were very high, and the drive was set back almost immediately when a man drowned crossing the Mackinaw. At Chicago, there was another loss. This time one of the herd was purposely drowned by a hungry citizen who had schemed to buy the carcass for himself.

It must have been a lonely journey. The region was mostly inhabited by scattered Indian tribes and the only person Hamilton met at Milwaukee was Solomon Juneau, who had a trading post there but was sorely in need of provisions himself.

From Milwaukee, the route followed immediately along the scenic Lake Michigan shore. At one point Hamilton met Colonel Ebenezer Childs who, along with a party of men, was out netting whitefish near Manitowoc. When they reached Manitowoc, which was little more than an Indian village then, Colonel Hamilton headed the drive inland toward Green Bay. He delivered his cattle at Fort Howard nearly a week before the contracted date of July 4, 1825 and returned to Springfield by the same route as he had come.

Hamilton's cattle drive may well have been the prototype for all romantic and exciting tales of drovers and coyboys that blossommed later in the Wild West of fact and fiction. At any rate, it's a fact that firmly establishes the importance of Wisconsin in the story of how the West was won.

Two years after he completed this cattle drive, Colonel Hamilton settled in Wisconsin and began a career in lead mining and smelting at Wiota, in what is now Lafayette County.

Cover: A Polyphemus moth scans the air with its antennae in search of pheromones. See story on page 7.
Photo by Al Hillery

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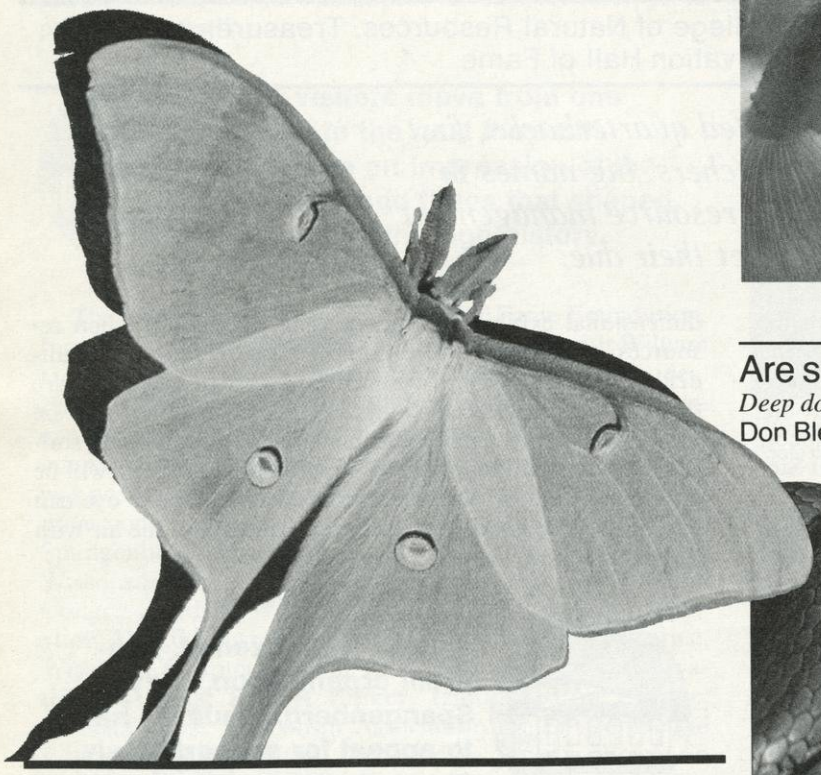

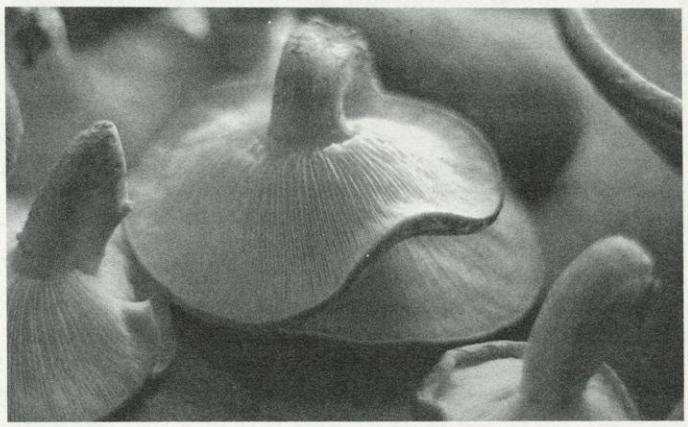

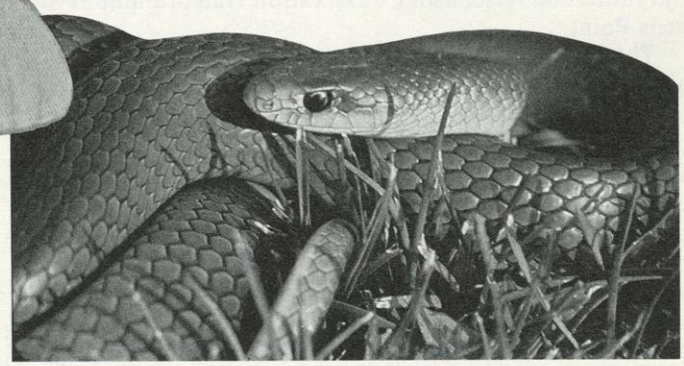

FEATURES:

SPECIAL REPORT

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THE WISCONSIN CONSERVATION HALL OF FAME

Donald Last, UW-Stevens Point College of Natural Resources, Treasurer,
Wisconsin Conservation Hall of Fame

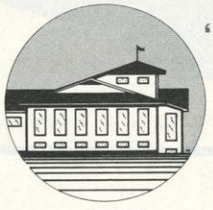
Just like the vaunted quarterbacks, first basemen and pitchers, big names in Wisconsin natural resource management finally get their due.

Imagine yourself on a wooden raft actually feeling the flow of the Wisconsin River beneath your feet, or hearing above you the wild call of a string of geese in flight. Then, suddenly, facing a hologram of "spaceship earth" that appears before you in the hall. No! Not Disneyworld or Epcot, but rather the Wisconsin Conservation Hall of Fame at Stevens Point.

The fact that a Wisconsin Conservation Hall of Fame really exists might come as a surprise. But it's a reality at least as important as similar institutions devoted to football, baseball, bowling or whatnot. The Conservation Hall of Fame is presently located in comfortable but temporary quarters at the Visitor Center of the Schmeeckle Reserve on the UW campus at Stevens Point.

The Reserve is a 200-acre natural area used for research, teaching and outdoor recreation. Owned by the UW-Stevens Point Foundation, it is open to anyone who wishes to hike the trails and boardwalks, use the fitness and exercise stations, or fish the lake. Natural history tours and programs are available there year round with staff and students on hand in the Visitor Center to help explain the indoor exhibits, which are changed quarterly. The reserve is named in honor of Fred Schmeeckle who originated the well known undergraduate conservation program at UW-Stevens Point (UWSP). It is a fitting spot for the Conservation Hall of Fame, which will be housed in a major addition to the Visitor Center scheduled for completion in the next two or three years.

According to Earl Spangenberg, Chairman of the Conservation Hall of Fame, "The two story addition will include a theater on the lower level and some very unusual and exciting exhibits on the upper level." Spangenberg says that upon entry visitors will be thrust back in time 2000 years to experience the silence of a virgin white pine forest. Intermittently they will hear the quintessential sound of the wilderness, the howl of a Wisconsin timberwolf. This three-dimensional exhibit will represent a bygone era when resources of the state were abundant, diversified, and undefiled. Next, the visitor will move to a small theater where the story of resource management in Wisconsin will be briefly told. Then, on to another lifelike display with soil-stained water cutting into a land whose main feature will be a checkerboard of blackened stumps as far as the eye can see. In the background, a thunderstorm will fill the air with light and sound.



"We are a tax-exempt, non-profit organization," says Spangenberg, "thus we have to appeal for support solely from private sources."

As visitors move from one area to the next they will receive an impression of the people and times that shaped the state through history. Resource users and resource abusers will be introduced and their impacts explained. Periods of exploitation will contrast with periods of resource protection. In one particularly striking exhibit, the headlights of a game warden's 1930 sedan will shine off into a distant encampment where carcasses of 50 deer hang from trees, victims of a violator. Visitors will be able to slide into the seat of the car and relive that moment in time. Over the static of a dashboard radio, they will hear a newscaster tell the story of still other confrontations between dedicated law enforcement personnel and poachers.

"We are indebted to Dave Aplin, a resource management graduate student, for putting together the exhibit plan," Spangenberg says. "His ideas are not only innovative but they are practical as well."

Spangenberg has hopes of raising $100,000 for the new building by early 1987. The construction of the exhibits he feels could be underwritten with additional donations from major corporations or foundations. "Those who have visited the Experimental Aircraft museum at Oshkosh or EPCOT will realize the importance of such exhibit sponsorship. Wouldn't it be great if we could get some of our Wisconsin business leaders to contribute generously?" he asks. Besides donations from corporate sponsors, Spangenberg points to the need for support from other organizations such as conservation clubs, youth groups, garden clubs, service clubs, those interested in recreation and tourism, as well as private citizens. To date, generous gifts have been received from the Quaker Oats Foundation, the Stevens Point Brewery, The Bill Cook Chapter of the Izaak Walton League and the statewide Ikes. Spangenberg emphasizes it is unlikely that state funds will ever be used on the project. "We are a tax-exempt, non-profit organization," says Spangenberg, "thus we have to appeal for support solely from private sources."

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The Wisconsin Conservation Hall of Fame Foundation, Incorporated was organized on April 28, 1984 with William Horvath one of the key persons in development of the idea. Early in 1984, he contacted almost two dozen statewide organizations to explain his proposal and to determine their interest in becoming charter members. Because the response was positive, by-laws were drafted and a nine member executive committee elected. Serving as members were: Earl Spangenberg, American Water Resources Association, Wisconsin Section; Bill Murphy, Wisconsin Conservation Congress; Al Hill, Wisconsin Parks and Recreation Association; Donald Last, Soil Conservation Society of America, Wisconsin Chapter; Bill Horvath, Association of Conservation Districts; Robert Elliker, Izaak Walton League; Michael Gross, Wisconsin Association for Environmental Education; Kirk Beattie, The Wildlife Society, Wisconsin Chapter and Royal Cluberton, AFL-CIO Conservation Committee

In addition, current voting member organizations are the Dane County Conservation League, Musky Clubs Alliance of Wisconsin, Wisconsin Audubon Council, Wisconsin Bowhunters Association, Wisconsin Land Conservation Association, the Wisconsin Wildlife Federation, the Society of American Foresters-Wisconsin Section, and the Sierra Club-John Muir Chapter.

As indicated in its constitution, Hall of Fame has four main goals:

1. To foster cooperation on conservation achievement among organizations of similar interests.
2. To annually recognize one or more individuals who have made significant contributions to the conservation movement in the state.
3. To develop a permanent display facility to commemorate individuals who are recognized.
4. To engage in educational, scientific, literary, and historical pursuits on the conservation heritage of the state.

The owl exhibit attracts young and old alike.
Photo courtesy of UW-Stevens Point

Selection of inductees follows a year-long cycle that starts in spring when member organizations are solicited for nominations. By fall, all names have been submitted and research on nominees is begun. Biographies are completed and forwarded to a Board of Governors composed of five persons, each of whom is appointed by the executive committee for a staggered two year term. Board of Governor membership is limited to persons, who, because of experience, scholarship, or achievement, understand and appreciate the historical significance of natural resource conservation in Wisconsin.

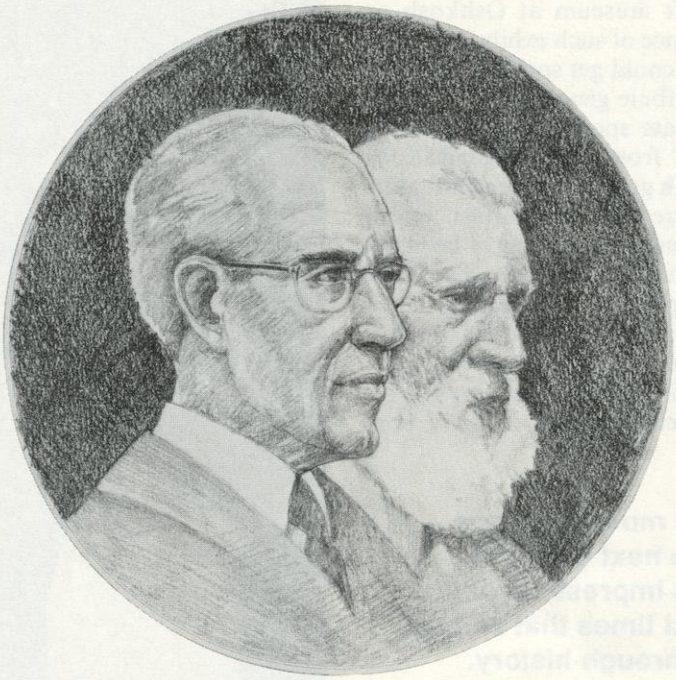
The board currently consists of Baird Callicott, Harold Jordahl, Clarence Schoenfeld, Dan Trainer, and Leo Walsh. All are faculty members at either UW-Madison or UW-Stevens Point. Among the criteria they use to evaluate nominees are the scope of impact, state, interstate and national; range of resource interest and the value of the nominees' contribution from an historical perspective. The Board annually completes its work in February. In March, member organizations vote on whether to induct the board's selection. Selected during the first year (1985) were Aldo Leopold and John Muir. This year Gaylord Nelson and Ernie Swift were inducted.

Persons wishing to receive an informational brochure, those who want to find out more about individual or organizational membership and those interested in making a tax-deductible contribution should write to **Earl Spangenberg, President, Wisconsin Conservation Hall of Fame Foundation, Box 942, Stevens Point, WI 54481-0942.**

The honored

ALDO LEOPOLD
(1985)

Trained at Yale, as a US Forest Service employee he worked to establish the Gila Wilderness Area in New Mexico. The first chairman of the UW Department of Game Management, Leopold first enunciated the principle of a sustained annual yield of game animals. He was the author of *A Sand County Almanac,* a treatise on land ethics and human ecological conscience. Leopold served as a director of the National Audubon Society, on the council of the Society of American Foresters, and as Vice-President of the American Forestry Association. He helped found the Wilderness Society, the Wildlife Society and the Ecological Society. Leopold was born in 1887 and died in 1948.



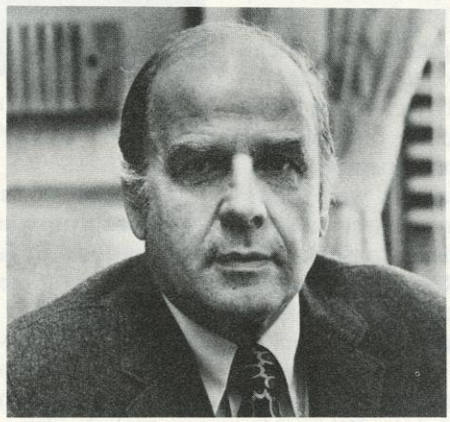
Aldo Leopold and John Muir.
Photo courtesy of UW-Stevens Point

JOHN MUIR
(1985)

Born in Scotland, Muir emmigrated to Wisconsin where he became a student at the University of Wisconsin. He wrote his famous nature journals during extensive travel on foot between Canada and Mexico. After settling in California, Muir helped persuade Congress to create Yosemite National Park. He also persuaded Teddy Roosevelt to set aside Petrified Forest and Grand Canyon National Monuments. The founder and president of the Sierra Club, he was the author of 10 books including *The Mountains of California* and *The Story of My Boyhood and Youth.* Muir was instrumental in passage of the National Forest Reserve Act, which established 15 forest reservations. He was born in 1838 and died in 1914.

GAYLORD NELSON
(1986)

As Wisconsin Governor, Nelson promoted efforts aimed at forest management, protection of the Lake Superior shoreline and the control of water pollution. As US Senator from Wisconsin, he helped pass the National Environmental Policy Act, laws to control strip-mining, and to establish water pollution control standards. He originated the idea of a national "teach-in" on the environment to increase awareness of threats to fragile life-support systems. As a consequence of EARTH DAY 1970 and the many EARTH WEEKS which followed, a significant number of environmental laws were enacted. Now retired from politics, Nelson carries forth his interest in resource management and protection as counselor for The Wilderness Society. He was born in 1916.



Senator Gaylord Nelson. Photo courtesy of the Legislative Reference Bureau

Former Conservation Department chief, Ernest Swift. DNR photo

ERNIE SWIFT
(1986)

Swift's conservation career began as a game warden for the Wisconsin Conservation Department. He directed the agency from 1947 until 1953. During his tenure more than 70 conservation bills were enacted. Swift felt strongly about the need for resource managment based on scientific study. Under his leadership, biologists for the first time were hired by the department to assist with game management decisions. Swift served for a time as a top administrator in the US Fish and Wildlife Service. Later he became executive director of the nation's largest citizen conservation group—the National Wildlife Federation. He was the author of *Conservation Saga* and several other books. Swift was born in 1897 and died in 1968.

WISCONSIN'S *wild silk moths*

Cecropia moth.

The author says
things will be okay
in Wisconsin and the rest of the world
as long as
these exquisite creatures
are here to remind us
of nature's beauty.

Allen M. Young, Curator, Invertebrate Zoology, Milwaukee Public Museum

All silkmoth photos by author unless otherwise indicated

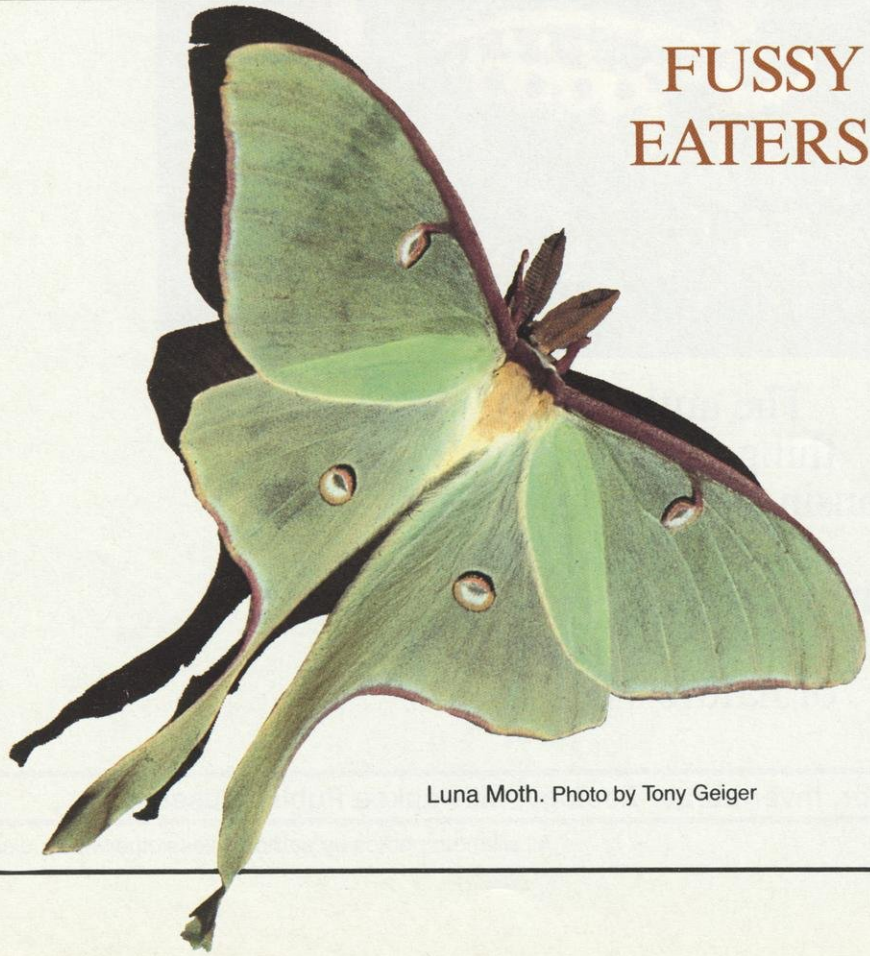
Adult Polyphemus. Its caterpillars prefer to eat birch, willow, oak and elm leaves. Photo by Al Hillery

Wisconsin's gorgeous wild silk moths such as Cecropia, Polyphemus, Luna, and Promethea add a delectable and joy-filled dimension to the rituals of spring and summer. Anyone lucky enough to see the clockwork emergence of one of these moths from the cocoon witnesses the absolute, the very apogee, of the awakening of natural beauty in the north. Their existence is proof of the life-bestowing properties of the fertile Wisconsin soil, which provides a breadbasket of green nutrients for the moths as well as for many other creatures.

In early summer, a fleeting nighttime glimpse of a Polyphemus or related species propelling itself toward a street light with undulating, helicopter-like flutters is a cherished, unforgetable encounter. Especially the wings, which when fully expanded are about the size of a man's hand. In mid-winter, stalking the large cocoons through the white Wisconsin landscape is quiet and solitary. For me, always a time for reflection, an anesthetizing tonic for one's problems.

The silk moths astound us because they come through the winter despite strong winds and hungry rodents, buffered against freezing temperatures by a natural antifreeze in the bodies of the pupae. Also truly astonishing and unique are their large size and beautiful color patterns. Because they blend into the natural landscape and are integral parts of the food chain, they seldom become superabundant for sustained periods. They are almost always our beautiful silent partners from the insect world.

Just as we see more stars, planets, and whole constellations in the night sky near the Equator, so too do we encounter a virtual endless stream of insects in the tropics, including silk moths. There, they are active throughout the year, but in Wisconsin the various species carefully synchronize their annual life cycles to northern weather patterns. At least one, the Cynthia Silk Moth, accidentally introduced from tropical Asia into the New York area more than a hundred years ago, typifies a maverick able to survive the eastern seaboard's mild winters, but not the severe ones of Wisconsin. Our sustained freezing temperatures kill the tropical pupa. In New York, the Cynthia moth's caterpillar was also lucky that one of its food plants, the Ailanthus or Tree of Heaven grew in waste places nearly everywhere as a successful weed. This tree also occurs in midwestern cities like Milwaukee, but the



Luna Moth. Photo by Tony Geiger

FUSSY EATERS

The population of silk moths is dwindling in some urban areas. A shift in distribution is occurring because of changes in features of the landscape, most notably the kinds of vegetation. For example, suburban sprawl in Milwaukee over the past 30 years may have reduced abundance of the natural food plants of the Promethea Moth, which in turn eventually leads to a reduction in numbers of the insect. Wild silk moths are finely-tuned "ecological" barometers of what we do to the environment. They are very sensitive to availability of food plant supplies, because each species can exploit only a certain range of plant species as caterpillar food. The gustatory tastes of each species differ. If forced to eat an incorrect food, the caterpillar may refuse it and die, or else have stunted growth or die later if it eats it.

A good candidate for survival even in urban areas is the cosmopolitan Cecropia, one of the most widely distributed species. I remember once in

moth does not. On more than one occasion in Milwaukee, I have deliberately placed healthy Cynthia Moth cocoons in my backyard for the winter, only to find that all died by spring, victims of the local deep freeze. The same was true of a near relative, the Atlas Moth, which with a wingspan of more than 14 inches is the world's largest. This tropical Asiatic species not only failed to surive in my backyard, it also defied other Milwaukeeans like Robert Veenendahl and James Neidhoefer.

The large Atlas caterpillars greedily gobble up endless amounts of fresh lilac or ailanthus leaves. On more than one occasion, I confess, I have been caught in the act of snitching fresh leaves from bushes and trees in neighbors' yards after exhausting my own supply. It didn't take long to gain a reputation as Milwaukee's west side lilac robber. Yet people were usually very understanding when I explained.

Our resident Wisconsin caterpillars all bear the same signs of bon appetite'. When full grown, they are thick, green creatures, usually longer than a man's thumb and adorned, particularly the Cecropia, with colorful tubercles arranged in rows on the body. In spite of such markings, these heavy green jewels remain well concealed in the foliage, out of sight of predators like birds. Talk about artists of deception! Even though very large, they blend in beautifully. If we set out deliberately to find one, chances of success are practically nil. Yet, they are there! Even with the camouflage, though, caterpillar survival is tricky business. The deck is stacked in favor of a quick demise.

In Wisconsin, it is very seldom that whole trees are denuded by silk moth caterpillars because a cornucopia of natural enemies keep densities quite low. Numerous wasps and flies use either larvae or eggs to parasitize the caterpillars. Larvae burrow into the flesh, devouring precious tissue that eventually weakens the caterpillar and kills it. Some wasps deposit a single egg inside the moth's egg. That single egg then hatches into many wasp larvae which devour the soupy contents!

A variety of other predatory insects and birds hunt the caterpillars. Once, in Milwaukee, I received an excited phone call from a person whose lilac bush was loaded with large "green worms." Would I come out and see them? Were they dangerous? They turned out to be the almost full grown caterpillars of the Promethea Moth, a species that has become very scarce around here within the last two decades. They are one of the few late afternoon flying silk moths. The males are black and the females cinnamon brown. They pass the winter in oblong silvery or gray cocoons, dangling as slender ornaments from lilac, wild cherry and a few other trees. I visited the site, and volunteered to move the caterpillars, a real prize, to my place. Complete disaster ensued! I carefully transferred every one to my lilac bush that afternoon. Within two short days, all were gone, victims of that fanatical gourmet, the blue jay. Just think of all that gooey protein stuffed inside those fat caterpillars. It's no small wonder they attract birds.

Despite many natural factors that keep populations in check, sometimes there are runs of good years when

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graduate school at the University of Chicago, walking up and down the tracks of the Illinois Central Railroad between Hyde Park on the South Side to the Loop and finding thousands of Cecropia cocoons on an assortment of trees. These caterpillars feed on a great range of trees and shrubs, including maple, wild cherry, ornamental fruit trees, willow, boxelder, sumac, dogwood, and others. Virtually all northern cities have stands of these plants, if only along railroad tracks and in vacant lots.

I recall the very first Cecropia cocoon I ever found. I must have been about 10 years old and living in Briarcliff, a northern suburb of New York City. For months I had mercilessly thumbed a little *Golden Nature Guide to Insects,* always looking at the picture of the Cecropia cocoon and telling myself that someday I'd find one. It was big game to me in those days and still is! A branch of the old New York Central Railroad snaked its way through the picturesque hills of Westchester, coming close to our house. One bleak winter day I trekked up and down a three-mile stretch of that track and spotted my first Cecropia cocoon firmly attached to a high branch of a wild cherry tree. It was snowing that November day and I remember almost tripping into a swampy area crusted over with very thin ice as I was about to make a grab for the cocoon. To cap it all, a train came roaring by at that very moment, giving me a fright I still remember and the cocoon turned out to have a dead pupa, judging from the rattle it made when shaken. But I still have that Cecropia cocoon, even though it never hatched.

Others of our wild silk moths such as the Polyphemus and Luna are more fickle in their food plant preferences than Cecropia, selecting only a few plant species in an area. The Polyphemus exhibits a strong taste for willow, oak, elm, and birch in Wisconsin while the Luna is very much restricted to some nut trees such as hickory and butternut. As you might have guessed by now, the Luna ranks as one of our more elusive species. Seeing one of the pale green beauties with long tails on its hindwings as it helicopters along in the night is an unforgettable sight. In Door County a few short years ago, one evening I gave my wife a fright by suddenly swerving the car to the side of the road. A magnificent Luna had come into view of my headlights and I stopped to retrieve it.

The Polyphemus Moth gets its name from the one-eyed giant of Greek mythology. On the upper side of each rear wing is a large, steel-blue eyespot. Polyphemus, with its stout tan wings, is a strong flier, commonly seen darting in and out of the splayed light rays at shopping centers on summer evenings. The caterpillar is easily recognized by its accordian-like body and loud clicking noises made by the mandibles when disturbed. Like all saturniid moths, the Polyphemus too is harmless and worthy of our utmost respect and kindness.

certain moth caterpillars become unusually abundant. This may be due to a late spring, creating a sizable lag between the peak time when birds breed and the appearance of tasty larvae. Or a very wet, warm season can promote luxuriant vegetation, which increases the potential food supply and gives caterpillars more protective cover. Adult numbers, on the other hand, are not so much a function of weather and natural enemies. In the flight stage, silk moths don't eat at all and are sustained entirely by fat reserves built up in the caterpillar. The adults generally live less than two weeks, just time enough to mate and lay eggs. This absence of feeding, which tends to be unique, could have evolved because of the short, quick breeding period. If the moths stayed around very long their large size and colorful appearance might have attracted hoards of predators and wiped them out. Most other kinds of moths and butterflies have to eat as adults. They often depend heavily upon carbohydrate fluids such as nectar and fruit juices to give them flight power in the search for mates and specific food plants for their eggs. Some even require proteins from pollen and nectar to manufacture their eggs. Such species tend to have long lifespans.

Aerodynamically female giant silk moths are awkward fliers, sort of wobbly egg factories, which makes them easy targets for birds and other predators. The whole mating strategy seems to have been built around this handicap. The female usually remains close to where she emerged, somewhat concealed amidst foliage, emitting a natural perfume that attracts males. A mating act may last a day or longer, after which the female then flies to seek out food plants on which to deposit her burden of eggs. Most species place the eggs singly on the leaves of the correct food plant. They are guided through the complex world of plant smells by highly selective odor-detecting receptors on their antennae, head, and legs, which tell the moth when she has encountered the correct plant.

As caterpillars mature in late summer, decreasing day length triggers internal changes in body chemistry which alter behavior. They stop eating and begin spinning a cocoon, the first step toward the pupa stage. Each species has its own pattern of cocoon construction. Cecropias build spindle-shaped or baggy cocoons attached lengthwise to branches of a tree or bush. The exact factors affecting construction of one kind of cocoon or another remain obscure, but are known to be unrelated to eventual sex of the adult or kind of food plant.

Polyphemus moths build tough, compact, oval cocoons, sometimes wrapped in a leaf and dangling woefully from a twig, only to eventually drop into the leaf litter and be hidden as winter progresses. The Io and Luna build papery thin, dark brown cocoons usually on the ground amidst leaves, but sometimes attached to twigs or sides of buildings. Prometheas construct slender, silvery cocoons, securely fastened at one end to the food plant where they are easy to spot after the last leaves have fallen away. In the East, the Cynthia Moth constructs a cocoon very similar to that of the Promethea. So does the massive Atlas in its native Asian habitats. Regardless of species and behavior of cocoon construction, the transformation from caterpillar to pupa is the same in all cases. The caterpillar condenses in length and then sheds its cuticle or outer skin for the last time. This molt takes place within a few days after cocoon construction is completed. If the caterpillar has been parasitized, sometimes the pupa cavity is filled with fly pupae or larvae, which then wriggle out and drop to the ground for pupation.

Miles of silk may be contained in a single cocoon of a wild silk moth, but because the industrious caterpillar cuts the thread with stout, shear-like mandibles in the building process, the unraveled silk is useless. There are too many small pieces. Commercially, such silk is difficult to use. The domesticated silkworm, not even a near relative of the saturniid moths, produces a single strand, uncut, that is easily unraveled by boiling cocoons to loosen the gum-like adhesive that binds the thread together.

Even tropical species build strong cocoons, indicating the structures are not necessarily designed for cold protection, although they certainly help. It is more likely these tough-walled lodgings of pure silk protect the tasty contents against clawing or pecking predators such as rodents, other small mammals, lizards, and birds. Nevertheless, it is not unusual to come upon cocoons of Cecropia or Promethea with neat holes in them made by hungry sapsuckers or woodpeckers seeking out a plump, juicy pupa. Mice sometimes wreak havoc on Cecropia cocoons near the ground.

We can see that wild silk moths are important links in the food chains of environments. They provide sustenance for many animals, including insects, other arthropods, birds and mammals. They are also of some impact on plant populations since their caterpillars devour large quantities of leaves, the structures green plants depend upon for photosynthesis. The very fact that the numbers of these beautiful moths in an area tends to average out over cycles of many years, is evidence in itself that they are well integrated participants in the food chains of forests and fields.

They are also a source of endless fascination to those of us who know them. There are many reasons. Perhaps it is their astounding and outright beauty and the respect they instill by making it through tough winters, giving us that spark of hope for rebirth that comes each spring. They are ethereal living gifts out of the night. Whatever attracts us, one thing I know for sure, once you're hooked on our wild silk moths, you stay caught. There's no abandoning ventures into the yard, the woods, or the neighborhood street in search of cocoon and caterpillar. The quest to discover anew something exquisite, beautiful, and ephemeral beckons continually. These delightful denizens of the spring and summer darkness, in their own way, really do say that "all's right with the world." I hope some come your way soon.

Promethia caterpillar. Photo by John Baker

Mature Polyphemus larva eating willow.

Young Cecropia caterpillar eating wild plum.

Parasitized Polyphemus caterpillar. Photo by John Baker

A captive female Cecropia attracts a male and mating occurs through the cage.

Eggs are deposited on the cage wire after mating.

A Cecropia moth emerges from its cocoon.

One wonders how many Cecropia moths have emerged in Wisconsin classrooms over the years. I have seen the gleam in a child's eyes when they see a Cecropia Moth clinging to its cocoon. It is a gleam of unspoiled interest and respect for a living creature.

But merely watching moths emerge is not the only way to enjoy them. You might keep some cocoons out-of-doors in a screen cage and let them emerge according to the natural timetable. You can easily distinguish females by their large, feathery antennae. Female moths can be kept in the cage and soon males will converge from the wild and mating will ensue, even through the screening if the gauge is big enough (quarter-inch).

In this manner it is easy to obtain fertile eggs, and you can then raise your own moths. Female moths often plaster the cage with hundreds of eggs! Supply the caterpillars with fresh cuttings of their food plant and little else is needed. Sometimes you can put the baby caterpillars on a food plant in your yard and watch them grow over the summer. When the moths emerge the following spring, they can be released into the wild. But don't be disappointed if numbers dwindle because of natural enemies! Once I encouraged a

The Cecropia cocoon is the baggy type.

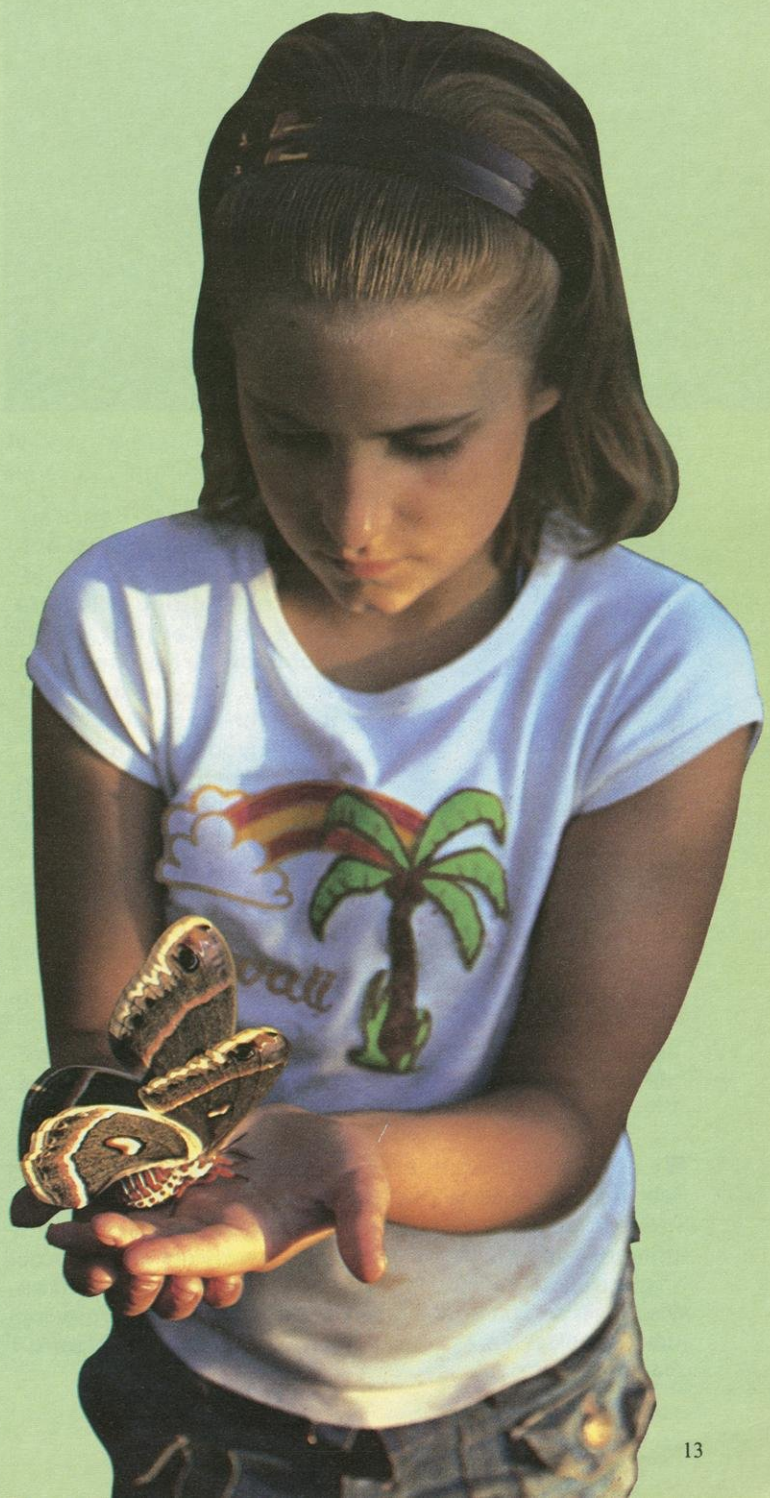
friend to place a hundred very small Atlas Moth caterpillars on an Ailanthus tree in his yard. Within two days, all were gone, the victims of yellow jacket wasps! My friend took the sad news remarkably well, considering that he had received the precious cargo of eggs from Asia only a few days before!

Scientists have reared wild silk moths such as Cecropia to answer questions about the ways in which hormones in these insects, regulate growth and metamorphosis, the process by which one life stage changes over to the next. The exceedingly large body size and ease of rearing in captivity are two features that make these moths ideal organisms or models to explore such fundamental questions.

Pioneering studies of Carroll M. Williams of Harvard University and his students in the 1950's and 60's have evolved into new approaches using the tools of molecular biology. Using these moths as "test" organisms, biologists can learn a lot about how growth is regulated in insects and other animals. Some studies use them to look for the biological basis of food plant choice and how this behavior changes opportunistically in various species including the Promethea Moth.

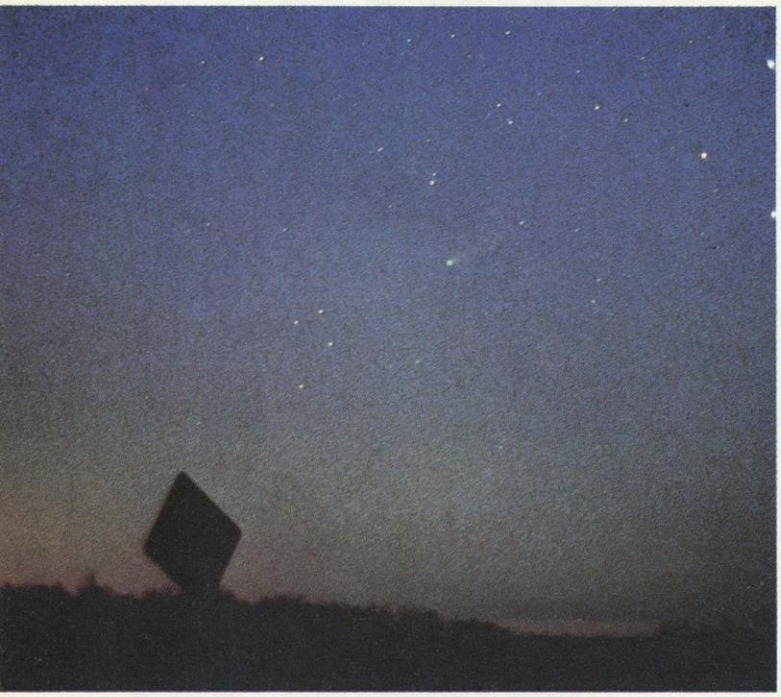
Once on a frigid December day in my early years of silk moth experiences in New York when I had a paper route, I discovered a large, dark brown cocoon attached to a vine on the side of a house belonging to one of my customers. I knew right away it was a Luna and took it home. The following March, one day I was in bed with influenza and feeling pretty down. I was just in the midst of reading Lewis Carroll's rhyme "You are old Father William" in *Through the Looking Glass* when I heard a pronounced rattling come from the cocoon box tucked under a shelf in the toasty room. The Luna had emerged! As many school teachers and parents have learned, wild silk moth cocoons brought indoors invariably emerge well before the natural emergence period out of doors, which, in much of Wisconsin is from early June to late July. While a critical number of freezing days are necessary for the pupa to eventually break its dormancy and continue on its way into becoming an adult moth, the precise timing of the emergence, once development is completed, resides in the succession of warm days. Having the cocoons indoors is like a mother hen sitting on her eggs! Out they come, ahead of schedule! But that first Luna was something else. What a sight! I still have that moth and the cocoon!

Hatch your own!



Thousands of Cecropia moths have emerged in Wisconsin classrooms over the years and always elicit a sense of wonder.

Readers Write



Halley's comet over Madison

◀I took this photo of Halley's Comet on the morning of March 21, 1986, about 20 miles southwest of Madison.
Michael Zuraw, Madison

■The March-April 1986 issue really looks sharp. I especially like the computer illustration of Halley's Comet.

I enjoyed seeing my wolf drawing in print on the back cover, but let me point out that it has a title. It's called "Ever After."
Katherine K. Rogers, Madison

■Compliments to Susan Bergquist, Kevin Connors, Robert Pitt and Jim Baumann for their recent articles on nonpoint pollution. They have done well to inform the public that nonpoint pollution is fast becoming a major problem in this country.

I have experienced the problem firsthand. Because of a developer's silty road building practices, a once beautiful wildlife pond on my property has been turned into a cesspool.
Ron R. Gorke, St. Joseph

■I believe that *Wisconsin Natural Resources* is the best, most informative magazine about Wisconsin. The illustrations are very clear and beautiful. The articles provide information about the problems Wisconsin has, as well as the beauty of our state. One of the articles on acid rain helped me with a report for school. It was very interesting, and it helped me to understand that we have to control all types of pollution.
Laurie Butzlaff, Harshaw

■The spelunking article featured last September-October brought to mind a cave mystery that I've wondered about for more than half a century.

I grew up (1912-30) on a farm about one and one-half miles south of Sylvan, on what was then US 14. As I remember, our well was 260 feet deep. It had been drilled through limestone. At a depth of 50 feet, the drill bit dropped six feet. In winter, air would come rushing out of the well so forcefully it could be heard in the house, some 100 feet away. That usually presaged a storm. When air rushed into the well, good weather was in the offing. If memory serves, the noise sometimes lasted 24 hours.

I always wondered if there was a large cavern underground or an opening miles away that could account for such an airflow. Considering the possible distances between high and low pressures, is a tube theory likely?
Robert R. Cook, Portland, OR

For air to move in or out of a well in the manner described, two things are necessary. One is that there be an air-to-air connection between the well and a cave entrance somewhere else. The other thing needed is wind aboveground.

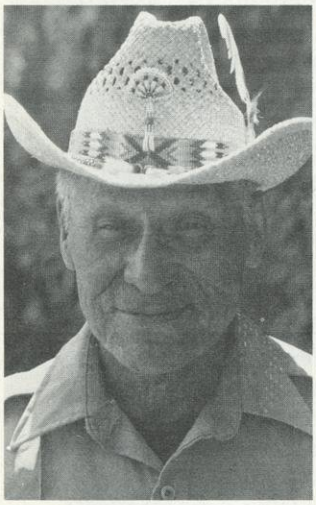
The cave entrance need only be cracks and crevices in a nearby hillside. Wind creates a difference in pressure between the cave entrance and the well hole. And, the pressure difference causes air to flow in or out of the well, depending on which direction the wind is blowing.

Cedar Waxwing. By Artist Bruno Ertz

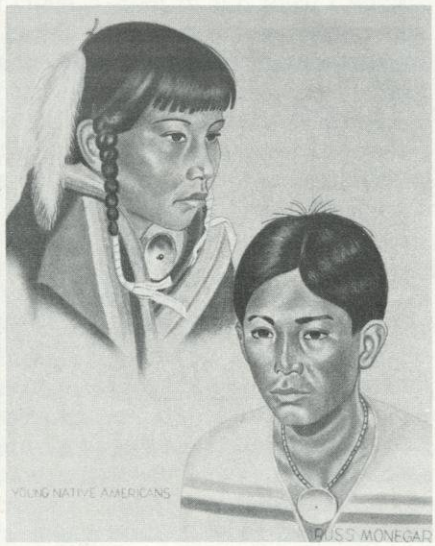
◀The January-February issue featured several outstanding examples of wildlife painting and sculpture from the Leigh Yawkey Woodson Art Museum in Wausau. Did you know that the Rahr-West Museum in Manitowoc owns a significant collection of paintings by native son Bruno Ertz, who is recognized internationally for his Audubon-like studies done in the early part of this century?
Richard Quick, Director, Rahr - West Museum, Manitowoc

Thank you for the information about Bruno Ertz (1873-1956), who rendered so beautifully the Wisconsin creatures of meadow and wood in which he took an abounding delight. His paintings hang in the collections of art connoisseurs in America, Europe and Asia—as well as at the Rahr-West Museum, Park St. at N. 8th, Manitowoc.

■I enjoyed the January-February issue very much. The reproductions of wildlife art were super! It would be wonderful to see more of Wisconsin artists' work in future issues.
Joan M. Schertz, Laona



Indian Artist
Russ Monegar



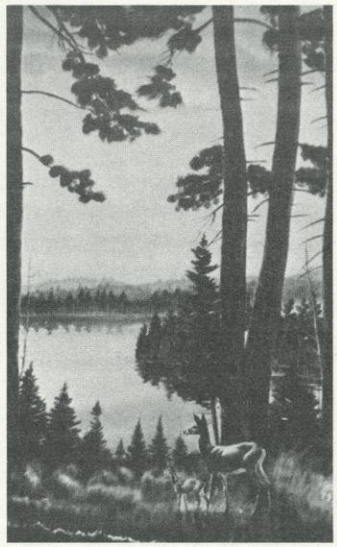
Young Native Americans.
By Artist Russ Monegar

▲In the January-February issue, I was referred to as "the late" Russell Monegar. The mistake was in the caption below my portrait of the late Chief Evergreentree, who was a star at the Wisconsin Dells Stand Rock Indian Ceremonial for many years. Perhaps you may have mistaken me for my late brother, Clarence Boyce Monegar. He was also an artist, until his untimely passing in June, 1969.

Please publish a correction in regard to my demise. I am now retired, and I have lived in Reedsburg for the past two years. I supplement my small income (social security) with occasional commercial art jobs, and I hope that later I will be able to enroll in an art correspondence course. I have had no art training or instruction of any kind. Sketching and painting have always been just hobbies.
Russell Monegar, Reedsburg

Our sincere apologies. Here's to your good health and long life!

Thank you, Readers, for taking time to share your thoughts, insights and experiences on Jim Pruess' letter—*Whose deer was it?*—published in the March-April 1986 "Readers write" column. Your opinions and responses were so numerous and insightful, *Wisconsin Natural Resources* found them worthy of a separate story. It'll be printed in a future issue. Just a couple words of preview: According to you, true sportspersons are courteous hunters—and while most ethics in hunting are not regulated, responsible behavior is expected by landowners and other hunters. Again, thanks, and we hope you'll enjoy the upcoming story on your points of view, hunter to hunter.



White Tail Deer at High Noon.
By Artist Clarence Boyce Monegar

◄ On the inside front cover of the Wisconsin wildlife art special issue was a portrait of Chief Evergreentree by Indian Artist Russ Monegar that caught my attention. I have a pencil/charcoal sketch of a wolf drawn in the 1940s by Clarence Boyce Monegar, an Indian artist from Clark County. Is there a family connection between these two artists?
Carol Kaisler, Waukesha

Yes—the two artists are brothers. Clarence Boyce Monegar (1910-1969) worked primarily in watercolors. One of his paintings, "Ka-Ka-Gon Waters," hangs in the office of the Commissioner of Indian Affairs in Washington, D.C.

■Congratulations on an especially attractive layout for the recent issue that featured Wisconsin wildlife art.

I read with interest the story about Artist Virgil Beck. It's mentioned that "he paints in an unorthodox manner without an easel, holding the work on his lap as he makes each careful brush stroke." Glad to hear that I am not the only one using this technique—I have lap painted for the past 40 years.
Robert A. Scott, Hales Corners

■Since our artwork was among the sampling featured in *Wisconsin Natural Resources* my wife and I have received many letters with compliments and inquiries. I have accepted a couple of commissions for deer paintings, and she has sold an eagle bronze. The feature was a shot in the arm for the wildlife artist community in Wisconsin.
Bob Frankowiak, Milwaukee

■You haven't told quite all the story about "Hornet Housing." In a hard winter, such as 1985-86, I've seen crows tearing strips from the old nests and carrying them off. I suppose they eat the dead larvae inside.
Frankie Wilson, Madison

The crows may indeed be after dead brood, or perhaps an overwintering queen. However, since "strips" were torn from the nest, rather than chunks, the birds may have been taking bits of the papery envelope for nest building, which begins as early as March. Then again, they may just have been playing around as crows are wont to do.

■On the average, I do like *Wisconsin Natural Resources* magazine, but the March-April 1986 issue said very little. Anyway, thanks.
Jules A. Oravetz, Professional Engineer, Portage

Continued on next page

▲This unusual oak tree is near Sparta in Monroe County. What theory do you have on its development?
Al Hoff, Sparta

Perhaps as a seedling, the oak began growing atop a decaying old pine or hemlock stump. Its roots would have developed through the stump and into the soil. Then as the stump rotted away, the oak's early roots would have been left exposed giving the tree its bow-legged appearance.

■I am especially interested in trees and enjoyed the March-April 1986 special report: "Wisconsin's record trees." Are there more precise descriptions of the big trees' locations available? I would be interested in looking some of them up.
Gerald Ackeret, Dorchester

For the exact locations of specific record trees, contact Jerry Lapidakis at DNR's Bureau of Forestry, Box 7921, Madison, WI 53707. Many of these trees are in yards and on other private properties, in which cases the landowners must be notified for prior permission to visit the sites.

■Congratulations on an excellent champion tree supplement. It has made a significant, long term impact on the state's big tree program.

I particularly appreciate the professional editing and handling of my manuscripts.
R. Bruce Allison, Madison

■The report on Wisconsin's record trees is a wonderful special. I hope it helps to keep up interest in our possible champions. Walter certainly would have enjoyed promoting the new big tree society.
Trudi Scott, Madison

■In the March-April issue, I read about the need for big tree inspectors to verify state champions in the record tree program. I would like to volunteer for DNR training to measure trees and identify species in order to become a big tree inspector. I am interested in the program simply because I love trees. . .
Stewart J. Smith, Madison

Thanks to you and the more than 40 others who wrote asking to become big tree inspectors. A training session is planned for Saturday, July 26 at the Wausau School Forest.

For those still interested but who haven't gotten in touch yet, contact Jerry Lapidakis at DNR's Bureau of Forestry, Box 7921, Madison, WI 53707.

■In the March-April special report, the story "Big tree hunters" stated that Ted Pyrek came to our property "to measure one champion and ended up with two." Mr. Pyrek is quoted as saying, "When I went out to measure the poplar, I discovered the state record black willow."

Indeed, both of these trees are listed as Wisconsin records of their species, and T. Pyrek is listed as nominator for both. However, I think that the late Walter Scott should be given some credit somewhere for it was he, many years ago, who "discovered," measured and recorded the white poplar tree. And furthermore, it was my wife and I who suggested to Mr. Pyrek that he measure the black willow.
Fred Hanson, Fond du Lac

Thank you for bringing it to our attention that Walter Scott originally measured the champion white poplar in your yard. The register has been changed to document this fact. Also, you are now listed as co-nominator of the state record black willow tree.

■The caption under the osage orange picture in the "MacKenzie Center's Big Trees" article is incorrect. The osage orange is not native to Wisconsin. It is native to the United States, however, specifically eastern Texas and parts of Oklahoma.

Also, the list of MacKenzie's known champions has an error. The Black Hills spruce is a variety of the white spruce and should have been listed with native trees.
Robert Wallen, MacKenzie Environmental Center, Poynette

Unfortunately, our article reflected some of the discrepancies in methods of recording native and non-native champion trees in Wisconsin. DNR's native champion list includes all species native to the United States as a whole, but does not include varieties. The non-native list, kept by UW-Madison Horticulture Professor Ed Hasselkus, includes all species not native to the United States and also includes varieties. Therefore, the osage orange is on the Wisconsin list of native champions, and the Black Hills spruce is on the non-native list.

■My co-authored article, "The Cooper's hawk returns", was recently published in the March-April issue of *Wisconsin Natural Resources.* Regretably, some misinformation was printed.

The sentence that reads "The Cooper's hawk was a common nester in eastern North America in the early 1900s, but populations were greatly reduced by human persecution," should read "were *apparently* greatly reduced by human persecution."

The end of that same paragraph, as printed, reads, "More Coopers were shot than some legally hunted ducks during those years." My original stated, "Indeed, the Cooper's hawk had higher band return rates than 8 of 10 duck species hunted legally for the same years."

In the discussion on traditional nesting sites there is a typographical error in the sentence, "To determine this we trap and band adult hawks by setting a long high net near the nest tree and using a live owl as a decoy behind the nest." The last word should be "net," not "nest."

And finally, the photo caption on page 28 is incorrect. We do not use an owl to find nests; would you state as such.
Robert N. Rosenfield, UW-Stevens Point

Mr. Rosenfield also called the changes made in his manuscript "inexcusable," complained that they were made without his knowledge and that they were reviewed only by a "junior author." He threatened to boycott the magazine if such things continue.

The answer to all this is that editors have an obligation to change words in the interest of clarity, so long as accuracy is unimpaired—a principle by which this magazine has abided for 50 years.

In addition, one of the "junior authors" did say the presence of an owl can help locate nests.

As for the typographical error, nobody's perfect, especially proofreaders.

WISCONSIN
NATURAL RESOURCES

Angler's Almanac

Dept. of Natural Resources PUBL-FM-415 86

Prepared by Wendy Weisensel, Public Information, DNR

New 1986 fishing regulations

Three hooks or lines year-round; Lake Michigan bag limit for lake trout cut

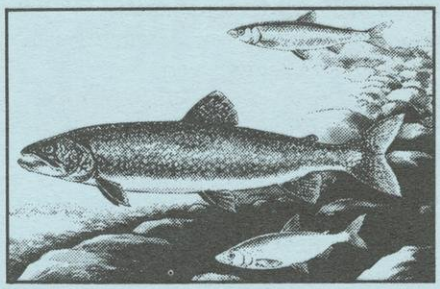
This year's Wisconsin fishing rules pamphlet, the "1986 Guide to Hook and Line Regulations" features a new look and several important changes. Using charts and tables to make it easier to find size, bag and season dates, the rules authorize year-round fishing with *up to three hooks, baits or lures* on *all* state *waters,* and cut the Lake Michigan limit on lake trout from three a day to two. Formerly the three hook and line rule applied, statewide, only to ice fishing.*

Other significant changes:

The size limit for trout from inland waters in the Southern Zone has been raised from six to nine inches. *The daily limit is three trout* from May 3 at 5 a.m. through September 30, except in eight counties with an early season. In these counties, the limit is two from January 1 to the first Saturday in May.**

In La Crosse and Vernon counties, the early trout season (January 1 to the first Saturday in May) has been cancelled.

In Douglas County, trout and salmon fishing on the Brule River is closed from November 16 through March 28.



In Sheboygan County, trout and salmon snagging is no longer allowed.

Rules for the Wisconsin-Michigan boundary waters have changed. Check page 24 of the regulations pamphlet for details.

There is no longer a daily bag limit for suckers and redhorse caught from inland waters.***

*Several *incorrect* references to this three-hook, bait or lure regulation are made in the pamphlet on pages 3, 19, and 22.

**These rules also apply to Trout Creek in Iowa County. Ignore the typographical error on page 16 of the pamphlet.

***Other pamphlet typographical mistakes: On page 3, only artificial flies may be used in McGee Lake, **Langlade** County (*not* Lincoln County). On page 13, under Walleye and Sauger, Moss Lake in Sawyer County should be **Moose** Lake, and **Chippewa Flowage** should be deleted (fishing on the Chippewa Flowage is closed from December 1 until the first Saturday of the following May). On page 20, under Douglas County, Brule River, fishing is prohibited from ½ hour after sunset to ½ hour before sunrise from October 1 *through* November 15 *and from March 29 through May 2.*

Careful release could save 250,000 inland trout

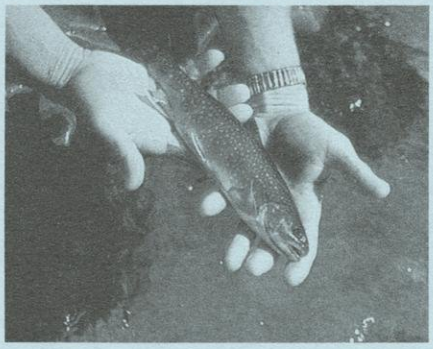
By Monica Nehm

The new nine-inch minimum size limit on trout caught in southern Wisconsin waters means anglers will be releasing more undersized fish.

"It's important to do this correctly, especially if they're caught on live bait," says Larry Claggett, DNR trout specialist.

"The regulations were enacted so that anglers could catch larger trout and have better fishing late in the season," he said. "We need people's cooperation or the regulations won't serve their purpose."

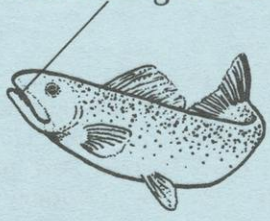
Claggett advises anglers to cut the leader rather than pull the hook out of deeply-hooked fish. A Wisconsin study shows that 65% more fish survive if the leader is cut and the hook left in the fish, while 25% die if



the hook is pulled out. The hook will rust and fall out in a relatively short time.

"We'd save 260,000 fish statewide if the leader were cut on deeply-hooked fish, and that's a conservative figure," Claggett says. "It would cost $100,000 to raise that many fish in hatcheries."

We Want You Hooked On Releasing Fish!



Today's released fish could be tomorrow's trophy!

Play a fish only long enough to land it

Use a net to land fish quickly and ease handling

Handle the fish gently; don't touch its gills or squeeze it hard

Hold the fish belly up when removing the hook

Cut the line when a fish is deeply hooked

Revive a fish by holding it upright until its gills move normally before releasing it.

Fish Wisconsin 2000

Jim Addis, director of DNR's Bureau of Fish Management says anglers are making new demands on Wisconsin fish management programs and ideas are in the works to satisfy them.

In a plan, two years in the making, that will go before the Natural Resources Board soon for action, **Addis cites new trends that show anglers want to participate more in decision making, want a level of management greater than managers can supply and are willing to volunteer time and money for important projects.** The trends also show an increase in leisure time leading to greater demand for fishing opportunities. In response to these trends, Addis is proposing:

- More reliance on volunteers to meet the demand for more management on more waters.
- Demonstration projects for specific waters and fisheries to show volunteers, by example, what can be done and how to do it.
- Increased management effort on inland, warmwater lakes and rivers to meet the growing demand for bass, northern pike, walleye and panfish.
- **A simpler format for fishing regulations to make it easier for anglers to find out about and understand the rules so that compliance remains high.**
- More closely meshed programs in fish and environmental management because protecting lakes from pollution and providing recreational fishing go together.

Addis points out that fishing is important to everyone in Wisconsin — both for its economic value ($700 million last year) and the leisure and recreation it offers to more than a million anglers annually. He urges everyone to **participate in the planning for fish management's encounter with the 21st century by sending suggestions to FISH WISCONSIN, DNR Bureau of Fish Management, Box 7921, Madison, WI 53707. Please include your name and address.**

State roadbuilders pledge erosion control

By Jeanne Sollen

Officials of the State Department's of Transportation and Natural Resources are working together to curb soil erosion at road construction sites.

In the past, streams and lakes have often suffered from an overload of sediment washed off road building sites during heavy rains. **But Harvey Shebesta, DOT District Director in Milwaukee, told his personnel they must see to it that road-building contracts intended to prevent erosion are enforced as required by state statutes.**

Mike Bozek, a DNR water quality biologist in Milwaukee, says that soil washed into streams and wetlands clouds water, which endangers fish and other aquatic organisms. Turbidity can raise water temperature and prevent plants from getting the sunlight they need to grow. Since aquatic plants produce oxygen, fewer plants mean less oxygen and less protective cover for fish. Cloudy water also hampers insect reproduction, so fish lose a food source. In addition, sediment smothers fish eggs and prevents them from hatching.

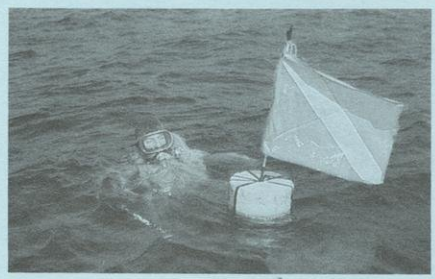
Erosion prevention techniques that highway builders will use include: • planting seed mixtures to grow tough mats of grass that hold soil; • spreading mulch; • bulldozing channels to divert rainwater to settling basins or more stable areas; • blocking or slowing water flow with hay bales; and • placing temporary filter fabric on erodible ground to hold soil until grass seed sprouts. DOT also tells roadbuilders to clear as little land as possible, and to clear in stages.

Boaters—watch for divers

DNR boating safety specialist Dale Morey warns boaters to be on the look-out for divers in all state waters and to give them a wide berth.

"Keep an eye open for diver's flags," Morey recommends. The flags consist of a rectangular piece of red plastic or cloth marked with a diagonal white stripe. Attached to floats, they mark where divers are located beneath the water's surface.

"It's illegal and dangerous to run your boat when divers are less than 100 feet away," Morey warns. "Propellers can easily cause injury or damage equipment, so steer clear."



When you see divers nearby, Morey recommends, turn off your boat motor and drift away. Don't fish, swim or water ski near them and never move or tamper with their flags.

WISCONSIN NATURAL RESOURCES

Angler's Almanac

Licenses needed to gather clams

A new law gives the Department of Natural Resources authority to regulate the commercial clam industry on the Mississippi River and other Wisconsin waters. The law allows the department to set seasons, close areas to clamming, specify equipment and harvest methods, require recordkeeping and reporting, and impose appropriate limits on sale and transport of mussels. **Buyers, pickers and helpers must purchase licenses with higher fees levied for nonresidents.**

The law passed because demand for clam shells for use in pearl culture is up and the number of commercial clammers on the Mississippi River between Minnesota's Twin Cities and Guttenberg, Iowa has greatly increased. Most clammers come to Wisconsin from southern states, where clam beds are depleted from overharvest and water pollution.

Clams need more protection, says Mike Talbot, DNR commercial fishing specialist, because they grow slowly and take a long time to become sexually mature. In addition, **an unidentified disease on the Mississippi has wiped out**

thousands of clams, and eroded farm soil or dredged sand and silt have smothered major beds.

"The number of mussel species on the Mississippi has declined by almost 50% since the 1960s," Talbot says.

The law sets fees for clam buyers at $300 for residents and $2,500 for nonresidents. Resident commercial clam shellers will pay $30 per year while non-residents pay $400. The new fees will help finance research to determine whether additional protection is needed for Wisconsin shellfish.

Hatchery fish killed to prevent disease from spreading

St. Croix Falls — About 540,000 brook trout fingerlings were destroyed at the St. Croix Falls Fish Hatchery in April to combat a disease outbreak. The fish were infected with a potentially serious bacterial disease called enteric redmouth, which is readily transmitted by contact between fish or through water. The three-inch fish would have been raised to larger sizes and stocked statewide this fall and the following spring. Brown trout raised in another part of the hatchery were not infected.

"We had to destroy the infected fish to prevent transmitting the disease to other hatcheries or into wild trout," said Larry Claggett, DNR trout specialist. Claggett said some of the loss will be made up by obtaining brook trout from other states and private hatcheries.

The source of the disease is a mystery, but people and other mammals are known to be hosts for the bacteria.

Rebuilt lamprey barrier now operating on Brule River

Brule — The rebuilt lamprey barrier on the Brule River in Douglas County started operating this year in time to stop the spring spawning run of lampreys. A design flaw in the original structure, built two years ago, had created swift currents that prevented many game fish from migrating upstream. To temporarily correct this, a large section of the four foot dam that spanned the river was removed.

The new design replaces the series of turbulent jumping pools fish had trouble swimming through with a system of gates, water control structures and a lamprey trap. Lamprey are caught in a special weir and periodically

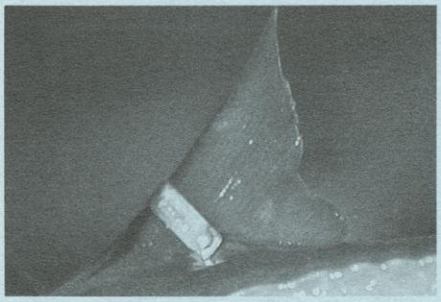
removed while gamefish like steelhead trout are able to continue upstream via special gates.

Lamprey kill between 40 and 80,000 pounds of lake trout annually in Lake Superior. **About 40% of the lamprey in Wisconsin's Lake Superior waters come from the Brule.**

You don't need a boat to fish

DNR plans to spend up to $300,000 a year in federal funds beginning in 1986 to acquire, develop and maintain fishing access sites for shoreline anglers. The money will pay for items like piers, easements for angler access on rivers, underwater structures near shore to attract fish, fishing platforms suitable for anglers casting from wheelchairs and other improvements. **Special attention will be given to facilities for the mobility impaired.**

National Fishing Week
June 2-8, 1986



Keep your eyes open for tagged fish

Anglers who return fish tags play an important role in making fishing better for everyone. To aid in research and management small, plastic or metal tags are often attached near the dorsal fin on the fish's back or in the lower corner of the jaw. Some plastic ones, especially in Great Lakes fish, are bright pink, yellow, or other colors. Microtags used on chinook salmon are embedded in the fish's nose.

Returned tags help fish managers track migration patterns, improve stocking techniques and learn more about fish growth and habits. The end result is improved sport fishing.

If you catch a tagged fish, send the tag to the address on the tag or to the nearest DNR office. Indicate where and when you caught the fish and the length and weight. Include your name and address to receive information about the fish you caught.

You needn't remove the tag from fish you return to the water. Just jot down the number, color and DNR address noted on the tag. Then let the fish go.

Microtags take a little more effort because they are small steel slivers very difficult to see. First, look over any chinook salmon you've caught to see if it's missing an adipose fin, a tiny fin located on the back just in front of the tail. Salmon that carry a microtag will be missing this fin. To return the microtag, remove the salmon's head and take it to a participating bait shop or DNR office along the Lake Michigan shoreline. Record where and when you caught the fish and its length and weight. **A $3 reward plus a free salmon fishing lure is given for the return of each microtag.**

Charter boat fishing boom on Wisconsin's Lake Michigan

The number of licenses issued to charter boat captains on Lake Michigan has tripled since 1979 and now totals 524, according to Mike Hansen, Great Lakes sport fishing specialist for DNR.

"The real growth has come from anglers traveling to Lake Michigan from other Midwestern states," Hansen says.

About 47,000 out-of-state residents plied the big lake's salmon-laden waters from charter boats last year — a 10-fold increase over the last decade. In 1985, nonresidents made up 68% and residents 32% of the clientele, the reverse of figures compiled in 1978.

Chinook (king) salmon made up 50% of the charter boat catch last year. Lake trout ranked second, providing 23% and coho third at 18%. **The total trout and salmon catch by charter boats jumped from 20,000 a decade ago to a record 117,000 in 1984. Last year it was**

113,000 fish. Anglers fishing from piers, tributaries and boats, including charter boats, catch a total of about 600,000 trout and salmon a year.

July and August are the most popular charter boating months. Anglers pay between $100 and $200 for a four-to-six hour trip. Usually groups of five people split the cost. Wisconsin charter boat captains collect between $2.5 and $3-million in fees annually.

Donations pay for managing fish

Fishing clubs, communities, individuals and corporations donate up to $50,000 a year for Wisconsin fish management programs, according to Ron Poff, DNR inland fisheries chief.

"Many gifts we receive don't always involve money," Poff says.

For instance, it's not uncommon for a farmer to haul stone free for riprapping trout streams. A central Wisconsin man built and installed boxes that hold creel census forms. The Sheboygan Area Great Lakes Sport Fishermen provided $3,400 worth of materials and labor for a roof over raceways at Kettle Moraine Springs hatchery.

Donated cash is used for a variety of projects. A lake improvement association paid 95 cents a mile to haul crappies from one lake to another. The Wisconsin Valley Improvement Corporation spent $34,830 on radio transmitters, reward tags, pamphlets, flowage maps, and dredging and stocking at Spirit Flowage. Wisconsin Power and Light donated up to $5,000 annually for several years to fund a popular hybrid striped bass project at its Columbia Generating Station near Portage.

In 1983 Lake Delton gave $15,000 for five years of fish stocking at the lake. Sturgeon for Tomorrow donated about $2,000 in 1984 for lake sturgeon work, and this year the Wisconsin Council of Sport Fishing Organizations held a raffle to finance habitat projects. Numerous musky clubs have donated money for research projects and hatchery equipment.

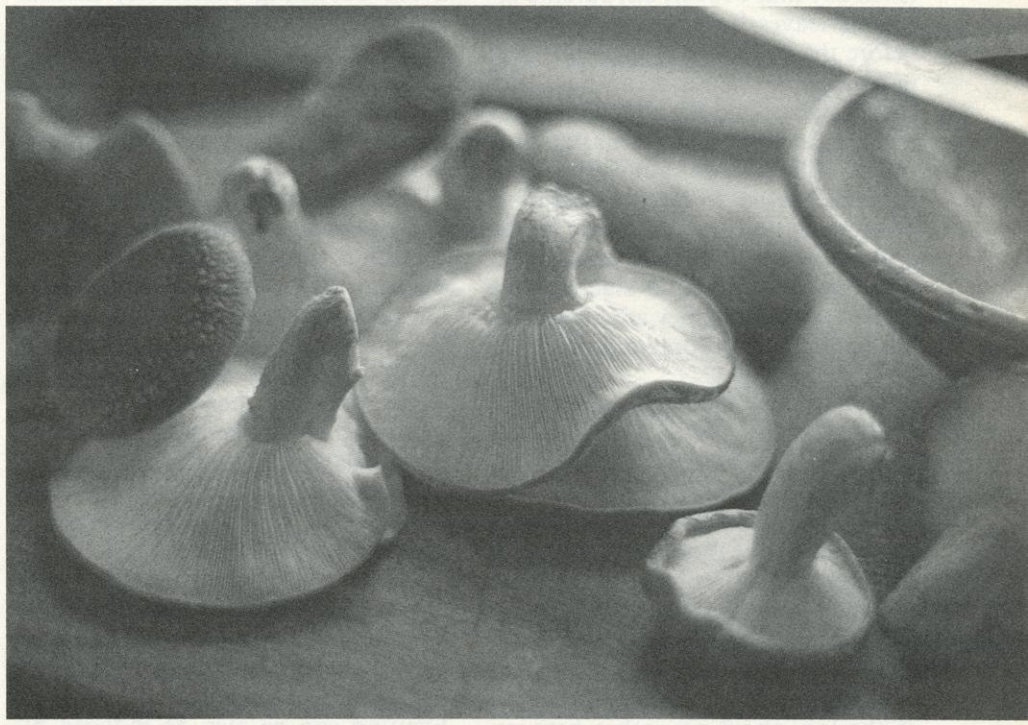
"The money, time and materials people and groups donate improve the state's fishery for everybody," Poff said.

JOSEPH H. KRAWCZYK and MARY ELLEN KOZAK, Peshtigo, Field and Forest Products, Inc.

shiitake

The sound of a new industry is buzzing through the woodlands of Wisconsin. Listen! You may hear the whir of a drill bit making holes in oak logs, followed by the persistent tap-tap of a hammer driving wooden dowel spawn into the holes. These are the sounds mushroom-growing enthusiasts make when seeding the spawn of the valuable Shiitake (Shee-ta-kay) mushroom—an edible delight whose robust flavor and unique texture have made it an almost instant culinary hit.

Wisconsin gourmet cook Ann Kozak has high praise for Shiitake. "When you eat a Shiitake you know you are eating a mushroom. It is versatile. The texture, depending on preparation, can range from tender to chewy. Because of its firmness, it can be sliced easily and will hold its form, making beautiful visual additions to many dishes. A fresh Shiitake keeps extremely well. I have refrigerated them up to two weeks with no noticeable change in shape, color or fragrance."



Harvested Shiitake mushrooms await preparation.

All photos courtesy of Field and Forest Products, Inc.

Shiitake is native to Japan where it is grown on a commercial scale in a cottage industry that employs more than 200,000 people. Dried Shiitake is Japan's number one agricultural export valued at over $1-billion annually.

Because of its income potential and compatability with woodland management, Shiitake has already taken a firm hold in Wisconsin. It is preferably cultivated on small diameter hardwood logs, usually oak, but can also be grown on maple, hornbeam, aspen, birch and many other species. Because of the large amount of underutilized, small diameter hardwood logs in Wisconsin forests, Shiitake cultivation can readily be coordinated with logging operations or timber stand improvement.

The mushroom can be cultivated outdoors in all areas of the state provided the grower has access to disease-free, small diameter hardwoods and is willing to invest in a relatively low capital, highly labor-intensive effort. There is a choice of many Shiitake strains which have been shown to produce abundantly in both the northern and southern parts of the state.

Until recently, use of Shiitake in the United States was limited to gourmet cookery and oriental cuisine where the mushroom is also known as the "Japanese forest," or "black" mushroom. However, with unfolding knowledge of new and improved methods of cultivation in the United States, Shiitake may soon become a popular item on many produce counters where the fresh mushroom has been seen retailing for anywhere from $4.00 to $24.00 per pound.

Methods used by Wisconsin growers in cultivating Shiitake are those adapted from the Japanese. Many excellent how-to books and pamphlets go into detail on the process for both the novice and experienced grower. Basic steps are as follows:

During the winter, growers decide how many logs are to be inoculated the following spring. This determines the amount of spawn needed, which is then calculated. Spawn is the vegetative root of the mushroom and is grown by suppliers on sawdust or on wooden dowel plugs. About 7,000 plugs are needed per cord of wood. A cord contains approximately 200 to 250 logs, four inches in diameter by four feet long. Depending on diameter, each log requires anywhere from 20 to 40 spawn plugs. When the amount needed is determined, it should be ordered about eight weeks prior to inoculation to give the producer adequate time.

Growing the gourmet black mushroom of the Japanese forest in Wisconsin will bring in more dollars and aid in timber management.

Logs selected should be hardwood, preferably oak, alive, healthy and free of obvious colonization by other fungi or insects. The bark should be coarse and the diameter of the eventual log should range from three to eight inches. Traditionally logs for Shiitake are one meter in length, however, size may range from two to four feet depending on how strong your back is!

Trees for making the logs can be felled any time of year, but autumn after the leaves have fallen, or spring before the buds break, are best. During this period, sapwood nutrient content is highest and the abundant sugar give the fungus a head start after inoculation. Shiitake will not colonize living wood tissue, so the cut trees must age for two to six weeks to let all the cells die. Felled trees are usually cut into meter lengths and stacked in a shaded area where they are allowed to dry until moisture content drops to 30 or 40% by weight.

In southern Wisconsin, growers inoculate logs by early to mid-April—by late April in northern Wisconsin. Inoculation is the most time-consuming part of the cultivation process. It takes a team of about three people to do it efficiently. Main tools are a drill and drill bit equipped with a stop collar, a hammer, suitable wax and a wax applicator.

Holes are drilled in rows the length of the log, about six inches between holes and two inches between rows. They should be a little deeper than the length of the spawn plug to create an incubation chamber for the fungus. A spawn plug is placed into each hole and tapped in with a hammer until the top of the plug is flush with the surface of the log. It is then sealed with wax to prevent moisture loss. Log ends should also be waxed. Best system is to have one person drilling while the others pound spawn dowels into the holes and apply wax.

Once logs are inoculated, they go to the "laying yard." This is a waiting game and requires patience. To fruit, the fungus must first totally colonize the log and the laying yard provides optimal conditions for this to happen. Finding one with the proper characteristics can spell the difference between success or failure in commercial Shiitake cultivation. A good laying yard not only provides optimal conditions to promote growth of the Shiitake, it also helps in avoiding infestation by weed fungi which compete for the log's nutrients. Temperatures should range between 50 and 84 degrees Fahrenheit and relative humidity between 80 and 85%. Usually these conditions can be met beneath the canopy in pine or hardwood forests. On drier sites, such as a pine forest, the logs should be stacked horizontally, close to the ground and spaced about four inches apart. This should prevent excessive air circulation between logs and enable them to be rained upon yet avoid becoming excessively humid. On more humid sites, such as beneath the canopy of a beach-maple forest, logs are stacked in an upright position with about eight inches between each one. This allows for proper air circulation.

The environment of a laying yard is likely to change during the season, so condition of the logs must be watched diligently. If several weeks elapse without rain, logs should be layered closer together and closer to the ground. If rainfall is above normal for many weeks, the stack should be opened up or layered further apart to allow more air circulation. In winter, logs should be low to take advantage of the insulating effect of snow and to avoid heavy, cold winds.

After incubation is complete, the logs are ready to fruit. Fruiting occurs naturally in spring and fall when temperatures hover around 50 degrees Fahrenheit and rainfall is adequate. Fruiting can be also be induced by soaking the logs in cold water for about 72 hours to a moisture of 50% by weight. Any container of suitable size may be used for soaking, such as a livestock tank, old bathtub, or of course, a pond. This will enhance yields. A good yield is considered to be between 10 and 30% of the weight of the log over a five year period. This means, on average, a 20 pound log will produce one pound of mushrooms per year, or four pounds over the entire fruiting cycle.

After soaking, logs are restacked in an A-frame configuration and covered with moistened burlap until mushroom "pinheads" (immature mushrooms) appear. At this time the burlap is removed and the mushrooms are allowed to develop to the desired size.

Shiitake are harvested before the cap opens fully. They can be cut with a knife or pulled from the log with a quick, twisting motion. The mushrooms are then refrigerated as quickly as possible because for every hour left at room temperature, they forfeit one day of shelf life. Refrigerated mushrooms keep well for about two weeks.

Marketing is a critical step in successful promotion of this new food. Aware of this fact, producers have formed an association called SHIIGAW, Shiitake Growers Association of Wisconsin. Its purpose is to provide current technical information on cultivation and help growers market their crop. Organized in September 1985 with 96 charter members, enrollment now stands at 116.

Keeping track of log production is a key element in the association's function. A production record sheet is made available to growers who list the date of inoculation, Shiitake strains and wood type used and the number of logs inoculated. Results of this data collection show that in the spring of 1985 approximately 13,000 logs were inoculated in Wisconsin. The number is expected to double this year.

Right now, those involved with the cultivation of Shiitake in Wisconsin are pioneers in a new industry. Experience and experimentation should result in more efficient and extensive production. Eventually, these mushrooms will increase the value of the state's timber resource and at the same time provide a lucrative food crop. In the meantime, try a sample. They're delicious!

Chicken and Rice with Mushrooms RECIPE

To serve 4

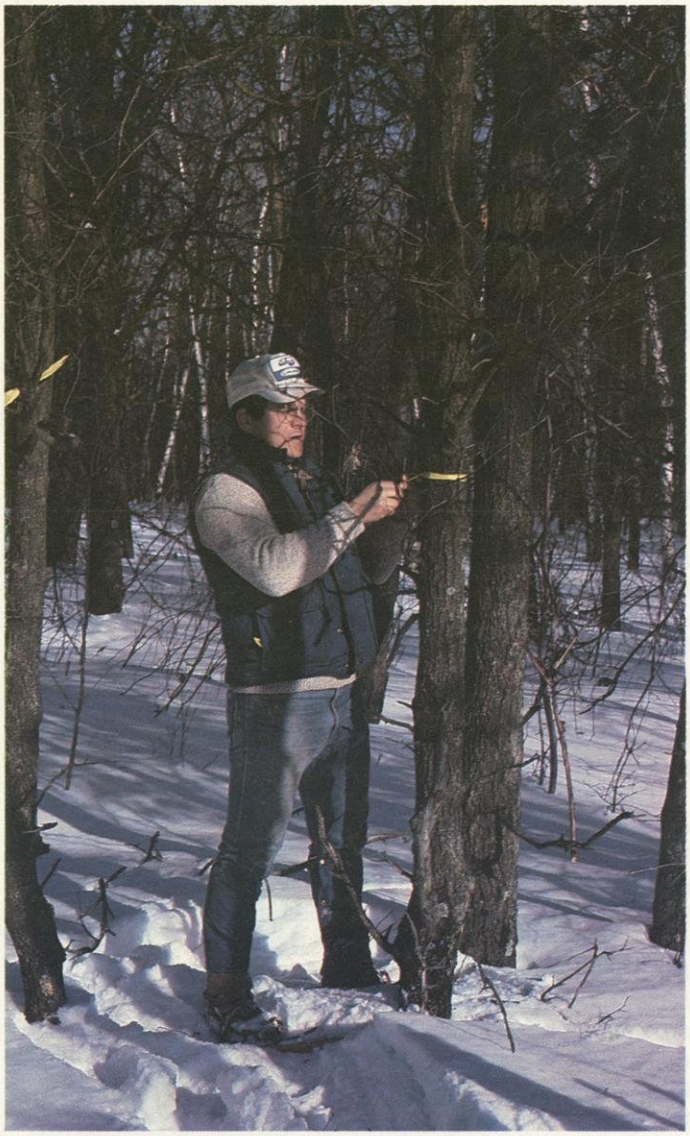
1 whole chicken breast (about ½ pound), skinned and boned
4 medium sized dried shiitake (soaked several hours in warm water to reconstitute, hard center cores removed)
1½ cups white Japanese rice, or substitute 1½ cups unconverted long grain rice, washed and soaked in water to cover for three hours
4 cups "niban dashi," or substitute 4 cups chicken broth, fresh or canned
4 teaspoons "mirin" (sweet sake), or substitute 1 tablespoon pale dry sherry
1 teaspoon salt
MSG (optional)
1 teaspoon soy sauce
2 ounces (about 4") burdock, washed and slivered (optional)
1 tablespoon finely chopped parsley

Cut chicken into shreds approximately 1" by 1/8". Shred mushrooms thinly. Drain rice and combine with chicken broth, sherry, salt, optional MSG and soy sauce in a 3 to 4 quart pot. Add burdock, shiitake, then chicken. Bring to boil over high heat, stir once or twice and cover tightly. Reduce heat to moderate and cook 3 minutes, lower heat again and simmer about 4 more minutes. Turn off heat and let rest covered for 2 minutes before serving.

To serve, divide equally among 4 bowls and garnish each with a sprinkle of chopped parsley.

Variation: shredded uncooked shrimp, clams, or lobster may be substituted for chicken.

—Ann Kozak



Trees removed from overstocked stands make ideal Shiitake logs.

A log's first flush of mushrooms.

Shiitake inoculation bee. Friends and neighbors drill the hundreds of holes, pound in the wooden dowel spawn and apply wax in the most tedious part of the production process.

Don Blegen, Instructor, biology, English and photography, Elmwood High School

Are snakes the pits?

Snakes make some people shake, shudder and commit repticide. Others say "live and let live." Where do you stand?

"Snake!" Just the uttered word (let alone the real thing!) can give some people chills. No other creature, not even the bat, the rat or the spider, inspires so much panic. Or fascination.

If you're one who shudders at the sight of a snake, read on. This article is pro-reptile, meant to demonstrate they are not the creepy-crawly horrors you believe in, but just critters like the rest of us, and extremely interesting ones at that. Ignorance, superstition and misinformation have sometimes hidden the fact that most are harmless and some extremely beneficial. They never deserve summary execution.

Poisonous snakes exist in Wisconsin, but are comparitively rare. Most Wisconsinites have never seen one and never will. The overwhelming majority of our snakes are completely harmless. It is a wise thing to fear a dangerous snake and give it the respect any dangerous animal deserves. To fear a harmless snake is quite another matter and to kill one because some snakes are dangerous is even worse—although it happens all the time.

Why does a harmless snake send so many otherwise sensible people into a full-blown, fight-or-flight, adrenalin-charged reaction? Why do so many otherwise well-informed people kill any snake on sight, using automobiles, rocks, tree-limbs, hoes, shovels, shotguns, tractors, dynamite or whatever comes to hand? Do snakes really represent as great a danger as this behavior would suggest?

Statistically, our poisonous snakes are less of a threat to the average person than automobiles, motorboats, chain saws, bicycles, honeybees, rare pork, or penicillin—all of which have caused the deaths of many Wisconsinites over the years. And harmless snakes, by definition are no threat at all.

So why the fear-and-kill reaction? Best explanation is that it is probably cultural, passed from parent to child in the earliest, most impressionable years. People who fear dogs pass it on to their children. The same with snakes, and the children never question why they fear snakes, they just do. A lot.

Another cause is misinformation. A great deal of what many people believe about snakes is simply untrue—and downright scary. Because they have no factual foundation for skepticism, they may swallow some real "whoppers."

Many believe that snakes are wet and slimy. They're not. They're dry and feel much like certain kinds of soft plastic. Some believe certain snakes have venomous stingers at the end of their tails. Others think snakes have eerie, hypnotic powers—or that a snake's forked tongue can puncture skin and is frequently venomous. They believe that dead trees on hillsides are victims of snake venom—that pilot blacksnakes (black rat snakes) guide poisonous snakes to safety from enemies—that puff adders are as deadly as cobras—that milk snakes steal milk from dairy cattle—and that copperheads and water moccasins infest Wisconsin. All this is nonsense, but devoutly believed by a surprising number of people.

There was an apocryphal horror story making the rounds a few years ago that illustrates what I'm getting at: A teenaged girl was swimming in Lake Pepin. She was not a good swimmer, got in a little trouble, and swallowed some water. With the water, the story goes, she accidentally swallowed a rattlesnake egg. Back on the beach, the warmth of her body was enough to cause the egg to hatch. The baby rattler repeatedly bit her in the stomach lining, causing excruciating pain. She was rushed to a hospital and operated on to remove the snake. In some versions, she nearly died. In others, she did die. A real horror story, and supposedly true. Lots of people believed it. There are rattlesnakes around Lake Pepin. But it never happened. It's a whopper. How can I be so sure? Because rattlesnakes don't lay eggs. They give birth to their young alive. Some might say the moral of the story is valid anyway: "Don't drink Lake Pepin water; God knows what might be in it!"

Don't be taken in by the most blatant falsehood of all, that there are swarms of dangerous snakes out there, coiled in ambush and eagerly anticipating sinking their fangs into human flesh.

It just ain't so. Snakes are afraid of people. They will retreat if given half a chance. They will bite only if stepped on, handled or cornered. The bite of all but two species of Wisconsin snakes is completely harmless and should be treated like any other minor break in the skin. If you don't handle or hunt snakes and if you watch where you're walking, your chances of ever getting bitten by a snake are close to zero. Harmless snakes outnumber poisonous snakes in this state by at least 300 to one.

Wisconsin's only dangerous snakes are the massasauga and the timber rattler. Actually, both are rattlesnakes. The massasauga is so rare it is on the endangered species list. While both are potentially capable of killing an adult human being, the fact that Wisconsin has been spared indicates several things: some venomous bites are "dry," that is, no venom is injected; most bites are on the extremities, giving the victim a maximum chance for survival; also, most of our

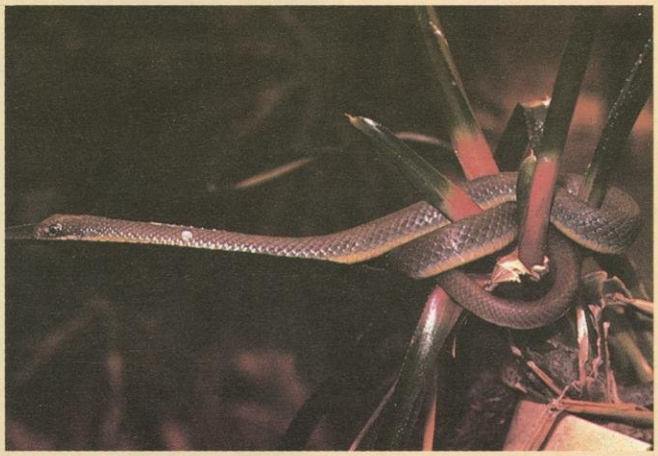


Photo by author

Black rat snake

also called pilot black snake

Elaphe obsolete

Size: 60 to 100 inches

Diet: Mostly rodents, some small birds

Reproduction: Lays six to 22 eggs in rotting wood during the last half of July. Hatchlings emerge in about 60 days.

This large and handsome constrictor is found in southern Wisconsin. Recognized by its glossy black color and white chin, it is a good climber and usually hunts at night. It has a spiny tail tip that it "buzzes" when angry. The name comes from a folk belief that when danger threatens, these snakes lead venomous species to safety. Their range coincides with that of copperheads (none in Wisconsin) and rattlesnakes, and all three often feed and den in the same areas. When an enemy approaches, they head for a place to hide. The black rat snake is much swifter than the other two and inevitably gets to safety first. It's not "piloting" the others; it's just faster.

Photo by Ron Rich

Smooth green snake

Opheodrys vernalis

Size: 15 to 26 inches

Diet: Insect larvae such as cutworms and caterpillars, snails, spiders, and salamanders.

Reproduction: 3-12 eggs laid late June to mid-September; hatch from early August to early October.

Seems to like low-lying, boggy, grass or shrubby areas. A fairly good climber, it is a very shy, secretive snake. Its color camouflages it very effectively. Ranges over the entire state.

DNR photo

Hognosed snake

also called puff adder, blow snake

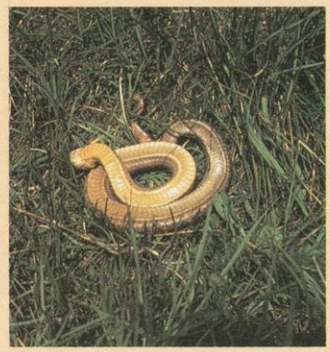
Heteredon platyrhinos

Size: 24 to 40 inches

Diet: Mainly toads, some frogs

Reproduction: Lays 5-40 eggs in June or July in sand or soil, rotten logs, or hollow stumps

Color is highly variable, from reddish brown to gray or black. Can be recognized by its stout body and turned up nose. This snake terrorizes, despite that fact that it is completely harmless. When confronted, its head flattens and becomes a triangular, pit-viper shape. The body also flattens to mimic the stout-bodied poisonous snake. It hisses ferociously, coils and strikes out repeatedly even though the intruder may be hopelessly beyond range. It's all a sham. Put a hand out and it will strike with closed mouth, then play dead, rolling over on its back, lolling its tongue out and growing limp. Turned right side up, it promptly turns over on its back again. The hognose ceases this behavior with repeated handling.



Hognose playing dead.
Photo by Ruth Hine

Milk snake

Lampropeltis doliata triangulum

Size: 24 to 48 inches

Diet: Mainly toads, some frogs
Rodents, young birds, other snakes including small rattlers

A constrictor, and the only member of the king snake family found in Wisconsin. Our only gray snake with chestnut brown spots. Rare in northeastern Wisconsin, it is fairly common in the rest of the state—but declining. Often killed and labeled "copperhead." There are no copperheads in Wisconsin. "Buzzes" its tail when angry. Adapts to a wide variety of environments. A good climber and excellent swimmer. Frequently found in and around farm buildings where they prey on mice and rats. This probably gave rise to the myth that they climb cows' legs and suck milk from the teats.

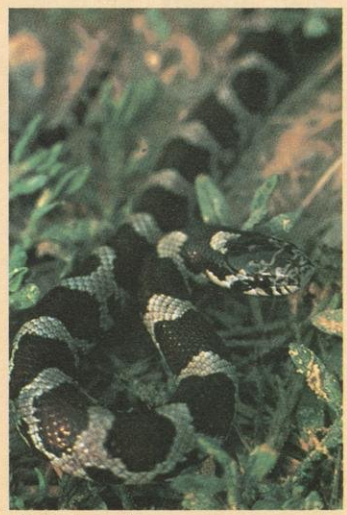


Photo by author

Photo by Dan Nedrelo

Ringneck snake

Diadophus punctatus

Size: About 12 inches

Diet: Earthworms, salamanders, smaller snakes, insects.

Reproduction: Egg-layers, but may verge on being live-bearers.

A very beautiful snake, with a lustrous sheen to its scales. Has a bright yellow to salmon-red belly with a bright yellow ring around its neck. This is a very secretive snake and not often seen, even in areas where common. Usually found accidentally beneath the bark of dead trees or under flat rocks. A burrower. Often behaves peculiarly when threatened. Will bury its head and display its brightly colored belly. Probably ranges over the whole state.

A great deal of what many people believe about snakes is simply untrue—and downright scary.

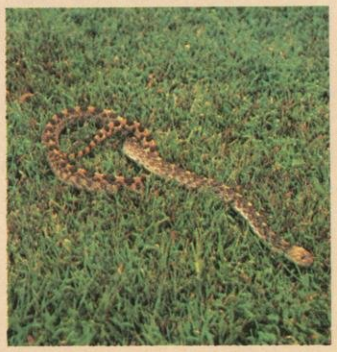


Photo by Mike Weil

Bull snake

Pituophis catenifer

Size: 38 to 100 inches

Diet: Rodents, occasional birds

Reproduction: Lays 3-24 eggs in sandy soil beneath large rocks or logs, June to August; hatch late August to early October.

At home in many kinds of terrain and environments. Widely distributed across the state, but decreasing in numbers. This constrictor is very beneficial because of its rodent diet. One five-footer was found to contain 35 small mice. When confronted, it may stand its ground, hissing loudly, "buzzing" its tail, and striking out from a coiled position. It's not bluffing; it will bite. The bite is not dangerous, but can draw blood. Frequently mistaken for a venomous snake, it is often just killed on general principles.

The pine snake is a close relative of the bull snake, and although it is not supposed to be there, the author has collected one near River Falls. There is much controversy about this snake among experts. Some say the gopher, bull and pine snakes are all color versions of the same species-in the same way as red and gray versions of the ruffed grouse and screech owl. Others say they are separate species. Whether the one at River Falls was a native, an escapee from a snake show or a pet that was released into the wild is unknown. Habits, size, reproduction, and diet of the pine snake are identical to the bullsnake, but the color is a striking brown and black on white. According to the author's references, the nearest pine snake should be in northern Tennessee, but they could be wrong.

DeKay's snake and redbellied snake

also called the little brown snakes

Storeria dekayi and Storeria occipito-maculata

Size: 10 to 14 inches

Diet: Slugs, snails, earthworms, insects, spiders

Reproduction: 1-25 living young born from early July to late September

These two species are closely related, have similar appearances, and feed upon the same prey. They are common snakes, but secretive and feed mostly at night. Both are found statewide, even in our large cities, although DeKay's is more abundant than the redbellied. Along with the garter snake, these snakes have maintained their populations better than many others. They are most frequently found fairly close to water, often under flat rocks, logs, and similar places. They also burrow. Their primary food is the slug, a serious garden pest. Will usually not attempt to bite, but if they do, their mouths and teeth are too small to break the skin.

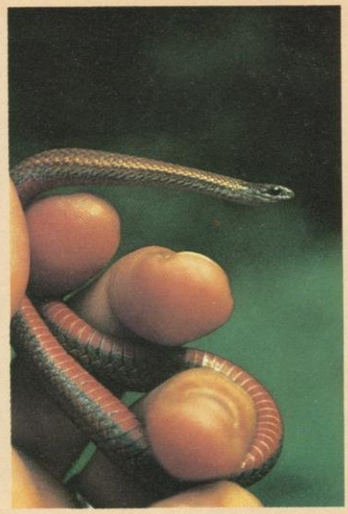


Photo by author

Photo by author

Garter snakes

also called grass snakes, ribbon snakes

Genus Thamnophis

Size: 18 to 40 inches

Diet: Earthworms, frogs, fish, mice, young birds, insects, and spiders

Reproduction: 4-70 live young, born from June to September

Our most common snake. Easily recognized by lengthwise black and yellow stripes. By far the most widely distributed snake in North America. There are four species in Wisconsin: the common garter (Thamnophis sirtalis) found statewide; Butler's garter (Thamnophis butleri), which lives in southeastern Wisconsin; the western ribbon snake (Thamnophis sauritus), a southern Wisconsin snake; and the plains garter (Thamnophis radix), also of southern Wisconsin. This is the first snake to appear in spring, and the last to go into hibernation in fall. Like most snakes, they mate soon after leaving the dens in spring, sometimes as early as March before all the snow is gone. Still abundant, probably because they are so prolific, they tame quickly with handling, but bite at first and exude a foul-smelling secretion from the anal gland.

rattlers are small compared to the giants down South and the smaller the snake, the less venom. Rattlers are generally people-shy, and avoid confrontation whenever possible. Besides, there just aren't that many around.

The timber rattler is found along the Mississippi River from the southern border near Prairie du Chien up to Prescott. A few scattered populations live in the lower third of the state. The massasauga, or swamp rattler is also found along the Mississippi and in some of the central sand counties. There are a few scattered populations in the southern portion of the state. Neither could be called abundant even within their ranges, especially the massasauga. In the northern two thirds of the state, away from the Mississippi, chances of encountering either species are practically nonexistent.

What about water moccasins and copperheads? Very simply, there aren't any in Wisconsin, period. Except maybe in zoos. Southern Illinois is as close as their range approaches. But every year in Wisconsin, thousands of large snakes are mistaken for copperheads and water moccasins and slaughtered.

The common water snake is the one that gets nailed as a water moccasin. Milk, fox and bullsnakes get mistaken for copperheads. These last three are among our most valuable species. All are nonpoisonous. It's a matter of mistaken identity. Pure and simple.

Pseudo rattlers make nearly everybody run scared. A number of snakes have sharp, horny tailtips. When angry, the coiled tailtips vibrate so rapidly they become blurred. If this happens in dry grass or leaves, the resulting "buzz" can be very convincing. Fox snakes, bullsnakes, milk snakes, and black rat snakes all do this. So does the water snake, although its tail doesn't have a spiny tip. If the bluff works and the person is frightened away, an erroneous "rattlesnake" sighting gets reported. If the masquerade backfires and the snake is killed, the slayer hunts in vain for the rattles, then assumes they got lost in the grass or leaves. And the story spreads that so-and-so killed a rattler in such-and-such a place.

There are a couple of other "dangerous" snakes you should know about. One is the hoop snake. It is reputed to have a sharp, spiny stinger on the end of its tail that contains a virulent poison. It forms itself into a hoop, rolls downhill at its prey and drives the stinger home with fatal results. Sometimes, when things are slow, it is said to practice on trees. This snake should be classified with the hodag, the jackalope, the sidehill gouger and other mythical beasts.

The other "dangerous" snake really exists, but isn't dangerous at all. The puff adder or blow snake has a fearsome reputation in some circles. But when you come down to it, it's only the harmless hognosed snake, a master of bluff and masquerade. If you have the slightest fear of snakes, the hognose will scare the daylights out of you. It looks poisonous. It acts poisonous. It puts on such a demonstration of sheer viciousness that it is easy to see how it got its reputation. If all this hissing, striking and apparent meanness fails, however, it falls back on its last resort. It plays dead. The hognose is about as dangerous as a cottontail rabbit.

Some of the fear, no doubt is prompted by certain remarkable physical adaptations of reptiles, which makes them absolutely unique among the vertebrates. These adaptations give them abilities that are amazing, almost magical or supernatural. What we do not understand, we often fear.

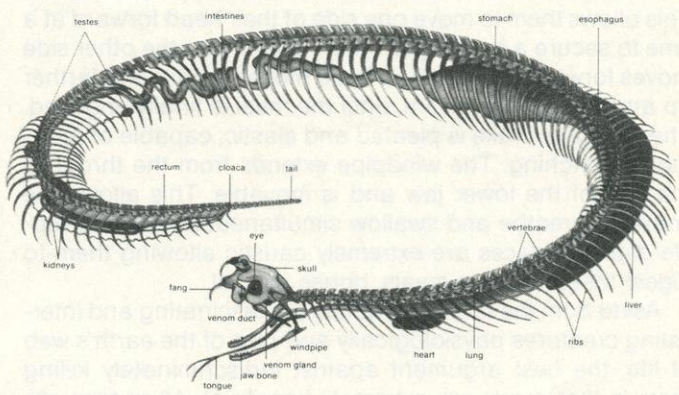
It is impossible to stare down a snake. Somewhere back in the days of the Evil Eye, the powers of hypnosis were attributed to snakes. This, too, is nonsense, but it's disconcerting to have a creature stare back at you with such a steady, unblinking gaze. Snakes don't blink because they have no eyelids. A snake's eyes are protected by two transparent, waterproof scales that make blinking to moisten the eyes unnecessary. And, to some, any animal that sleeps with its eyes open must be in league with the devil.

Snakes have no external ears. They are deaf to most air-conducted sound, but very sensitive to ground vibration. Since they can "feel" approaching footsteps, most snakes disappear before you get to them. Vibrations by heavy equipment can upset every snake around. Seeking escape from the unsettling vibrations, they are often seen all over the place right after bulldozers and earthmovers begin operation.

Snakes smell with their tongues. A snake's forked tongue is not the sharp, puncturing weapon some believe it to be. Rather, it is a very delicate, very scent-sensitive organ whose touch is light as a feather—almost undetectable on the skin. They use it to trail prey and detect enemies. The more nervous a snake becomes, the more frequently it flicks its tongue. Along with its eyes and its sensitivity to vibration, a snake's tongue tells it what it needs to know to survive.

A snake's unnatural flexibility makes it easily able to form its body into a knot if it so desires. While human beings have 28 vertebrae, snakes may have as many as 400, mostly with pairs of ribs attached to each one. There may be as many as 24 muscles connecting one vertebra to the next, each rib to the next and each rib to a transverse belly scale called a "scute." Scutes are arranged like shingles pointing toward the tail.It is this vertebra-rib-muscle-scute arrangement that makes possible the snake's most magical talent: moving without limbs.

Most people see snakes moving in their panic mode—an S-shaped wriggling. But an undisturbed snake can, and often does, move in a straight line, even uphill. It is a slow, silent movement, ideal for stalking prey. It is not hard to understand how this legless movement could inspire awe and perhaps fear. It defies common sense.



Snake skeletons consist of a skull, with loosely attached jaw bones and many vertebrae with ribs. Some species have as many as 400. A snake's long, thin internal organs are well adapted to its slender body. The digestive system includes a thin esophagus and an expandable stomach with a large capacity. Most snakes have but one functional lung.

There is, however, a reasonable explanation. Each rib-scute set can be moved independently of the others. A snake's muscle control is phenomenal, putting any belly dancer to shame. Some sets are lifted and moved forward while others are pressed down and back. The edges of the scutes in contact with the ground catch against the slightest surface irregularities. When the scutes have traversed as far as they can, they are lifted and another set pressed down and back. The rougher the surface, the easier it is for the snake to grip with its scutes. This ability, along with remarkable body flexibility, allows a snake to traverse the roughest terrain and the densest vegetation with ease.

A great many of the snake's physical adaptations have to do with killing or eating prey. Most notorious are the reptiles that kill with venom. Wisconsin's timber rattlers and massasaugas are in this group. Their poison is injected through two specialized teeth, hollow fangs that work exactly like hypodermic needles. Constrictors use a different system. They grab their victim, usually a rodent, by biting it. Constrictors have no fangs, but they do have about 200 small, needle-sharp, backward-slanting teeth. These get a purchase on the prey. Then, in a movement so fast it is difficult for the eye to follow, the snake wraps itself around the victim and squeezes. The force exerted is considerable. It does not crush, but rather constricts the prey's breathing, tightening with each exhalation until death by suffocation occurs. Milk snakes, fox snakes, bull snakes, and black rat snakes are among the Wisconsin constrictors.

A third group might be called "live-swallowers" and make up the majority of snakes. Wisconsin's hognosed, smooth green, garter, common water, redbellied, DeKay's and ringnecked snakes are all in this group. They simply grab their prey with their teeth and gulp it down alive.

Snakes in all three groups swallow prodigious meals. None have chewing teeth and all must therefore swallow their prey whole. The prey's diameter is often much greater than the snake's head. A milk snake swallowing a rat would be roughly comparable to you swallowing a 39-pound suckling pig—whole. It defies belief. Nevertheless, they do it all the time. Several adaptations enable them to perform this gastronomic miracle.

First, snakes can dislocate either side of their jaws at will. This allows them to move one side of their head forward at a time to secure a better grip on the prey. Then the other side moves forward. The reptile's head moves farther and farther up and around the victim, until the meal is finally engulfed. The skin of a snake is pleated and elastic, capable of enormous stretching. The windpipe extends from the throat to the end of the lower jaw and is movable. This allows the snake to breathe and swallow simultaneously. Finally, reptile digestive juices are extremely caustic allowing them to digest these massive meals, bones and all.

Aside from the fact that snakes are fascinating and interesting creatures physiologically and part of the earth's web of life, the best argument against indiscriminately killing them is that many are extremely beneficial. All snakes are part of the natural balance, but some are important allies.

A case in point involves rodents—mice, gophers, and especially rats, which cause millions of dollars damage in Wisconsin every year. Extremely abundant, despite all-out efforts to eradicate them, rodents can carry dangerous diseases including rabies and bubonic plague. Certain Wisconsin reptiles feed almost exclusively on rodents, especially milk snakes, fox snakes, bull snakes, and black rat snakes. It's a shame that they're often senselessly slaughtered when they do us so much good.

I once put two large fox snakes into rat burrows beneath a rat-infested corn crib. I sat down with my dog and gun, hoping to pick off a rat or two that might decide to leave the premises. I was not prepared for what happened. Within two minutes, dozens and dozens of rats were exiting every available hole in blind panic. They fled in terror, running out into the surrounding grass, into the cornfield, and even out into the open. I shot a couple, the dog got a couple, and the snakes probably got a couple. But there were so many we were overwhelmed. Those rats wanted to be someplace else. The snakes went right down into their refuge, and the rats left. That's a kind of rodent control no cat can provide. Yet many farmers keep cats to control rodents and kill any snake on sight.

> Some of the fear, no doubt is prompted by certain remarkable physical adaptations of reptiles, which makes them absolutely unique among the vertebrates.

The late Raymond Ditmars, in his Reptiles of North America, tells of an incident that illustrates this anti-snake prejudice. He had been called to a farm to identify a snake a farmer had killed in the barn. It was a milk snake. Ditmars dissected the stomach of the snake, disclosing five young rats. He showed this to the farmer, thinking it might enlighten him. The man looked at the snake, the rats, and then at Ditmars. "A snake is a snake," he said and walked away.

It should please the snake-haters that we are losing our snakes. Numbers are declining all across the state, probably across the country. This is especially true of the large, beneficial species. There are several reasons and there isn't much that can be done about most of them.

Loss of habitat is affecting all wildlife, including snakes, and is a major factor. Also, many necessary farming operations are deadly to snakes. Plowing, cultivating, and haying kill thousands. Highways are linear slaughterhouses. Not only because snakes are run down crossing them, but also because snakes will deliberately seek out pavement on cool mornings or after dark, soaking up the stored heat. All these are the price of progress, and not much can be done about them.

But there is something that can be done about the deliberate killing of any snake on sight. That's something each of us has control over. Learn your snakes. There aren't that many. In the unlikely event that you encounter a venomous snake, stay out of its way. If it's taken up housekeeping near where people live, keep your distance and phone the Bureau of Endangered Resources at DNR, 608-266-7012. They'll help you handle the problem. If the snake you've encountered is harmless, leave it alone. It's no more dangerous to you than a hawk an owl or an eagle and just as much a part of the natural scheme of things. It wasn't too many years ago that we blasted hawks and owls as "varmints," but we've learned enough to take a dim view of that these days. It's time we realized that the killing of most snakes is as senseless and counterproductive as the killing of birds of prey, and for much the same reasons.

Photo by Mike Mossman

Northern water snake

Natrix sipedon sipedon

Size: 24 to 48 inches

Diet: Fish, frogs, crayfish, occasional mice

Reproduction: 9-40 living young, born August-October

Nearly always found in or near water. Excellent swimmer, both on the surface and underwater. Can hold its breath for many minutes. Easily catches small fish and crayfish underwater. Often sunbathes on vegetation overhanging water, and drops off when danger approaches. Frequently mistaken for the water moccasin (there are no moccasins in Wisconsin) and killed. This is a very feisty snake and may not retreat. It hisses loudly, "buzzes" its tail, and will strike repeatedly. Bite is painful but harmless. Found statewide, especially in marshy areas and along large rivers.

Photo by author

Massasauga
also called swamp rattler

Sistrurus catenatus

Size: 20 to 40 inches

Diet: Rodents, frogs, fish, toads, small birds

Reproduction: 5-15 living young, born July to September

A venomous snake, the massasauga seems to occupy a taxonomical and ecological niche between moccasins and copperheads and the true rattlesnakes. Unlike some other species, they feed heavily on coldblooded prey. This snake likes watery, damp situations and is usually found in lowlying areas near marshes, swamps, lakes and backwaters. Color is highly variable, ranging from reddish brown to black. So rare they are on the Wisconsin endangered species list, they are found in scattered locations along the Mississippi River and a few of its tributaries as far north as Durand and in some of the central sand counties.

The more nervous a snake becomes, the more frequently it flicks its tongue.

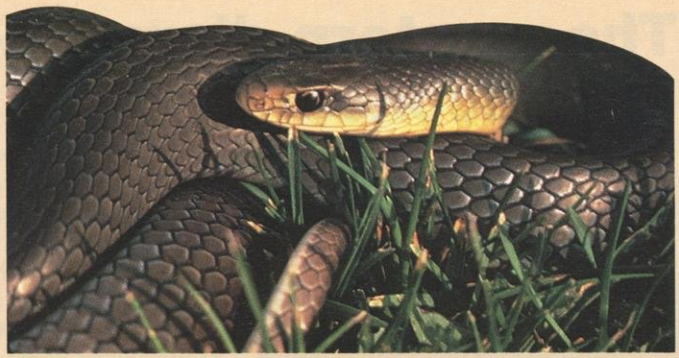


Photo by Dan Nedrelo

Blue racer
also called blacksnake

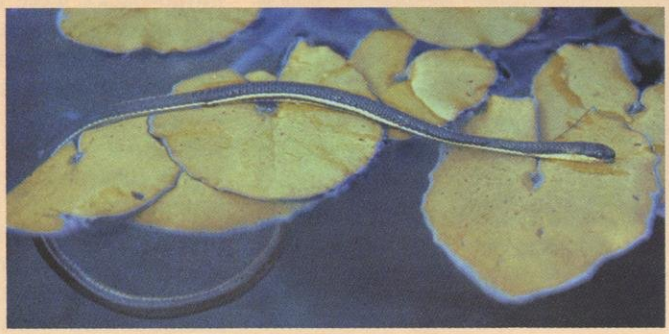
Coluber constrictor

Size: 48 to 75 inches

Diet: Mice, frogs, small birds, insects, smaller snakes

Reproduction: Lays 3-40 eggs from June to July in soil or rotting wood, eggs hatch from late July to mid-September.

A large, fast, agile snake. Could easily be confused with the black rat snake, but is more slender. Also, despite the scientific name, it is not a constrictor but a live-swallower. Like many of our large and beneficial snakes, it may defend itself if it feels cornered. The bite is harmless.



DNR photo

Queen snake

Natrix septemvittata

Size: 25 to 35 inches

Diet: Crayfish, fish, frogs, salamanders

This is a water snake, closely related to the common water snake. The queen snake is very rare in Wisconsin, found only in the extreme southeast corner of the state. Feeds mainly on crayfish.

Fox snake

Elaphe vulpina

Size: 48 to 66 inches

Diet: Rodents, some small birds

Reproduction: Lays 7-29 eggs from June to August, eggs hatch August to early October.

A beneficial constrictor, feeds primarily on rodents. Frequently misidentified as a milk snake, bullsnake, copperhead or even rattler. "Buzzes" its tail when angry. It gets its name from the anal secretion it gives off when first handled, which is supposed to smell like fox urine. Found statewide.

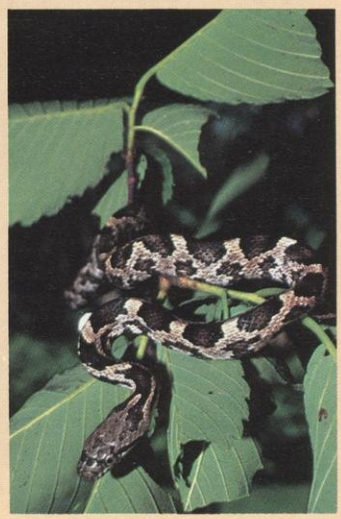
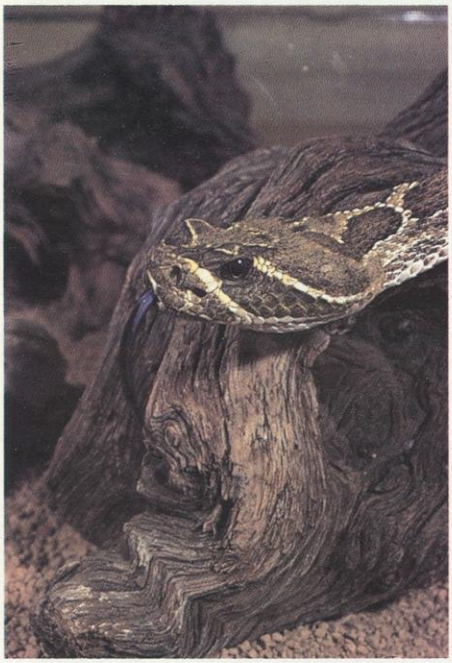


Photo by Greg Scott

The western diamond-back rattler in Wisconsin

Edward M. Judge,
Naturalist,
Barneveld



Western diamondback rattler. Photo courtesy of Texas Parks & Wildlife Dept.

The year 1928 was an exciting one for Wisconsin herpetologists. They had learned of an encounter near Viroqua between a road crew workman, who probably did not like snakes, and a reputedly ornery reptile that was about 1,000 miles away from its purported home range.

While the encounter soon proved fatal for the snake, the creature's misfortune was a stroke of luck and a puzzle for those who keep track of the state's coffer of native species. Wisconsin could now add a new reptile to its list of natives: the western diamond-back rattlesnake. Or could it?

For many years prior to this incident, there had been rumors that isolated populations of western diamond-backs were occupying certain ridgetops in the state's unglaciated region. Reliable sources familiar with Wisconsin reptiles periodically reported such rumors to T. E. B. Pope, the Milwaukee Public Museum's highly regarded curator of zoology.

One such source was W. Ray Spellum, whom Pope described in the 1928 Milwaukee Museum Yearbook as "an enthusiastic collector of reptiles, and excellent field observer and generous contributor of specimens to this museum." Spellum and Charles Brown, then director of the state's historical museum, contended that snake hunters of the western counties were occasionally presenting western diamond-backs for bounty payments. The bounties were being paid for the relatively common banded rattlesnakes (now better known as timber rattlers). The rare diamond-backs were simply being mixed in with the more abundant rattler species, and after the bounty was paid the evidence, which was often just the tail section, was discarded. One day Spellum came across a construction foreman walking into a Viroqua government office to collect bounty on a somewhat crushed body of the western diamond-back that ended up becoming the Milwaukee Museum's specimen #2293.

It should be noted that until this time the closest most Wisconsinites ever came to a western diamond-back was on the movie screen.This was the snake that menacingly coiled at the feet of fictional cowboy heroes. Called the "second most formidable serpent in North America," it is extremely common in south Texas and northern Mexico westward to California. Its northernmost range is supposed to be lower Arkansas, not Wisconsin.

However, against all geographical odds, three more western diamond-backs, including a young one, were found in the state three months after Spellum's initial discovery. These snakes were killed on Hogback Hill, seven miles south of Viroqua. Not long after these killings, to further add to the authenticity of the reptile's Wisconsin existence, the Milwaukee Museum received an official packet of affidavits from six Vernon County residents who had in previous months observed western diamond-backs both dead and alive.

Any suspicion that these claims were merely made under popular hysteria could easily be dispelled by research notes written six years earlier by Huron Smith, the Milwaukee Museum's botany curator. These notes mention that Smith, and research assistant Tenus Tuttrup, came across a six-foot long western diamond-back in July of 1922 on Monument Rock, less

Photo by Scott Thiel

Timber rattler

Crotalus horridus

Size: 30 to 60 inches

Diet: Rodents and small birds

Reproduction: Bears to 3-18 living young, August to October

Venomous. The timber rattler comes in a variety of colors, usually golden yellow with black or brown bands, but is sometimes almost completely black. Very shy for a rattler. Feeds almost exclusively on warmblooded prey, especially rodents. Is able to home in on warmblooded prey even in complete darkness, using heat-sensitive pits located between each eye and nostril. Found along the Mississippi River as far north as Pierce County and in several scattered locations across the southern fourth of the state.

than a mile from Hogback Hill.

"Mr. Smith says that this specimen of snake was only about 15 feet distant from him at the time of observation and that he plainly saw the prominent white stripes on the side of the snake's head that distinguishes this species at sight from the common banded rattlesnake," wrote Pope.

Pope emphasized that since this sighting was made six years earlier it confirmed "the assertion that his serpent had become established in this state and for a longer period of time than perhaps we realized."

What immediately surfaced was a theory that the species was expanding its northward range by moving up the Mississippi Valley, as were two other somewhat exotic southern creatures, the cardinal and the opossum. But there was one grand flaw in the theory: the western diamond-back could not be found in the lands downstream from Wisconsin, neither Iowa nor Illinois. L.M. Klauber, a rattlesnake expert from San Diego, was also skeptical of the theory.

"I cannot but believe that the introduction of these snakes into Wisconsin must have been accidental rather than a natural extension of the range," wrote Klauber.

Amazingly, just when the range extension theory was almost completely shattered, along came a new rumor that there was another diamond-back population in the region, and this group was not to the south, but rather to the north! This story about another population also came from botanist Smith, who had been doing field work in Wood County. Smith's notes contain the following paragraph:

"During the latter part of August 1928, I heard a rumor of the appearance of the Diamond-back Rattler from some Winnebago Indian friends of mine who were also informants in my field work done among them that summer. It came about through a trip when I took George Monegar, a chief and medicine man and his wife, over to collect a few remedies that did not grow near their home. We went to Nekoosa and south of there to some sand hills. Among these remedies was one for a certain kind of rattlesnake, which they called the 'King of the Rattlesnakes' and which was different from the usual small kind said to infest Rabbit Hill in northern Adams County. They told me that this kind was found around Babcock Creek, in the vicinity of Babcock, in the southwestern part of Wood County. I was often around Babcock but did not get to see the snakes. Further confirmation was given to the presence of this snake by Ray White and Fred Mallory, both Winnebago Indians. Their opinion was that the snakes were not common and had come in possibly eight years ago."

Adding a coincidental twist was another bit of pertinent information that became known at about the same time as Smith's writing. This newer data came from University of Michigan zoologist L. C. Stuart.

"It seems that a number of years ago several (western diamond-back) specimens escaped from a circus in the vicinity of Pittsville in Wood County," said Stuart in a letter to Pope. "It is still rumored that a colony of them have become established along a creek (Babcock Creek, I believe) a few miles to the west."

This report seemed to pacify everyone. Said rattlesnake expert Klauber about the diamond-back in Wisconsin, "I think the explanation that the nucleus of this colony escaped from a circus is quite probably correct."

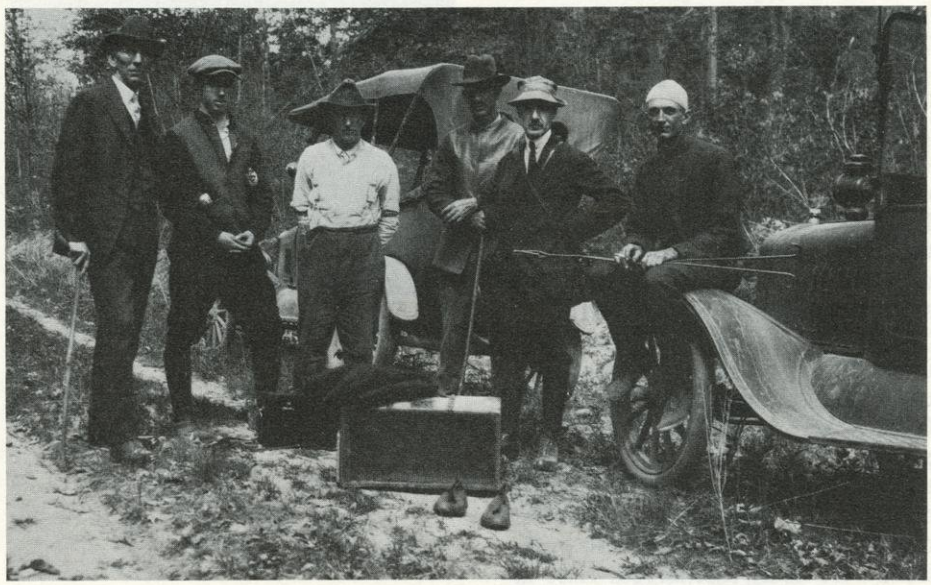
Pope, who masterminded the investigation, concluded: "Thus it appears that, if the escape of the snakes from a circus near Pittsville be confirmed, some members of the Babcock Creek colony must have found their way to Vernon County."

Whether such confirmation was ever made remains unknown because soon after Pope issued his opinion, the reports, theories, written literature and initial enthusiasm about Wisconsin's diamond-backs faded. What remains imprinted, however, is the fact that this snake, which often makes its home in surroundings that become so harshly hot it must prowl only at night, was now known to readily adapt to a climate as harshly cold as Wisconsin's.

As Raymond Ditmars, one of this century's prominent herpetologists, wrote in his 1931 classic *Snakes Of the World:* "At any rate, the species has become established, young have been born and have since grown and bred, and spread for many miles along the shattered cliffs, indicating adaptation to endure the long and severe winters of Wisconsin."

Whether the reptile could endure the depredations of human beings remains questionable, along with its present status in the state. "I have no qualms about saying outright that the animal does not exist in Wisconsin," says present-day zoologist Bob Henderson of the Milwaukee Public Museum.

But of course, because of the history, there does remain a certain doubt. Perhaps at this moment a few western diamond-back rattlesnakes are sunning themselves on a rock ledge somewhere in Wood or Vernon counties. But probably not.



A 1923 photo of T. E. B. Pope and his party near Merrimac during the search for a Wisconsin western diamond back rattlesnake. Pope was Curator of Zoology at the Milwaukee Public Museum. He is second from the right, wearing a tie and snakebite-proof leggings. The man on the fender holds a pair of tongs used for handling snakes safely. Photo courtesy of the Milwaukee Public Museum

Lloyd L. Chambers III, Director of Governmental Affairs and Economic Analysis, Nekoosa Papers

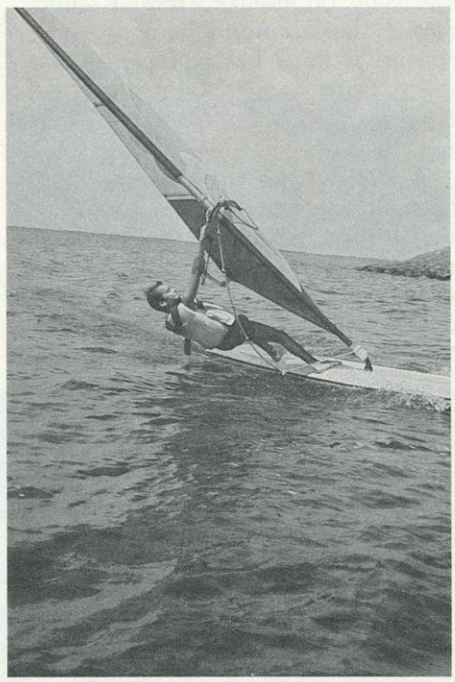
Cleanup makes paper mill rivers fishy

Like many Wisconsin residents, I grew up in small-town Wisconsin enjoying the fields and forests, the lakes and streams, and developing a true appreciation for the enjoyment provided by these wonderful natural resources. With my boyhood home located a few hundred yards from the picturesque Wisconsin River, I was sometimes frustrated by the obvious evidence of pollution that made this otherwise beautiful stream a no-man's land. I have vivid memories of catching a 31-inch northern in the river, delivering it to my mother and informing her that I had caught it in Nepco Lake, now a scenic, pollution-free body of water a few miles south of town. Suspicions were aroused when strange odors were detected as the fish sizzled in the frying pan. The charade was quickly revealed when the family recognized the fish as unpalatable. From that day on, I was keenly aware of the impact that pollution had had on the Wisconsin River.

A generation later, my own children are pulling fish from the Wisconsin River and consuming them without hesitation. The spring walleye run has provided us with some of the best fish dinners we ever consumed and our other recreational enjoyment of the stream has also been abundant.

The dramatic change in water quality on the Wisconsin is the direct result of Congressional Amendments to the Clean Water Act which was originally passed in 1948. This act was intended to control water pollution by basing cleanup requirements on the desired uses of the streams into which pollutants were being discharged. Uses included drinking water, body contact recreation, fishing, navigation, and others. Accordingly, state water pollution control agencies applied water quality standards to each stream or portion of stream where standards were not being met and sought to determine the responsible parties. This strategy proved ineffective due to a number of political, technical, and legal weaknesses. Stream uses were designated to protect or attract industry; there was inadequate information on the cause and effect links between discharges and water quality; inadequate consideration was given to the health of aquatic ecosystems; and, there were problems of equity between old and new pollution sources. Recognizing these deficiencies, Congress passed amendments to the Clean Water Act in 1972 which provided for a sweeping revision of concepts and philosophies embodied in the original law. A permit system was established which provided the first major enforcement procedure against polluters. Nationally-uniform industrial effluent limitations were imposed as were effluent limitations on municipal dischargers.

Million dollar investments have brought improved water quality that make modern times better than old memories.



Windsurfing on Lake Petenwell.
Photo by Lloyd Chambers

Prior to the 1972 amendments, individual companies in any industry would have been unable to remain competitive if they unilaterally installed costly pollution control equipment. The new law provided an umbrella by forcing all competitors to absorb the costs of such facilities. It also stimulated the appropriation of millions of dollars in state tax money under Wisconsin's Outdoor Resources Act Program to help local units of government pay for municipal pollution control and forced the reluctant communities to levy taxes for that purpose. We can thank Congress for mandating national pollution controls and the Department of Natural Resources for pushing them at the state level. These actions have provided all of us with a better environment in which to live.

The waste water stream generated by paper mills is composed largely of insoluble fiber, clays, and the soluble organic substances released from wood in the pulp and papermaking process. The soluble organics create an oxygen demand in the process of decomposing. The term biological oxygen demand, or BOD, is the scientifically-accepted term for this form of pollution. In the process of making wood pulp, wood chips are cooked under intense heat and pressure to dissolve the lignins or organic binders which hold the wood fiber together. The product of the cooking process is a dark syrupy liquid called black liquor. Historically, sulphate pulp mills have been designed to recover the cooking chemicals by burning the black liquor in what are known as recovery boilers. Economics of the sulphite pulping process, however, did not justify recovery with the result that spent sulphite liquor was dumped directly into the river. In addition, leaks, spills and rinse water produced in both the sulphate and sulphite processes found their way into the rivers. The obvious evidence of pollution showed up in the form of foam and foul odors. Perhaps the most unsightly pollutant was the wood fiber that escaped the pulp and papermaking process and clung to weeds and snags along the shorelines. Upon entering the river, these pollutants began to decompose, robbing the water of life-giving oxygen and greatly reducing the aquatic community of fish, amphibians, and other oxygen-dependent life forms. All that is now changed as industrial and municipal polluters have invested large sums of money to treat their waste products and render them harmless.

The Wisconsin Paper Council estimates that more than $450-million has been invested in pollution abatement equipment by papermakers since the mid-1970s. The cost to operate this equipment is over $100-million annually or about $26 per ton of paper produced.

A showcase example of a modern, effective paper mill effluent treatment system is the facility operated by Nekoosa Papers on the east bank of the Wisconsin River between their two mills in the City of Nekoosa and the Village of Port Edwards. This facility, shown in the color photo on the last page was constructed at a cost of $30-million and has been in use since 1977. The system has several elements, each

DNR report shows marked improvement in water quality.

DNR's 1986 Wisconsin Water Quality Report to Congress says that of 800 miles of stream that were degraded by point sources in 1972, 676 miles are now "markedly improved." The report goes on to say that "The most dramatic improvements occurred in the Fox and Wisconsin Rivers where pulp and paper mill and municipal wastewater treatment discharges were significantly reduced."

Records for 1985 show that anywhere from 92 to 96 percent of all state treatment plants were in compliance with their effluent limit requirements. Since 1972, according to the report, about $744-million in federal money and $490-million in state dollars have been used, statewide, to construct municipal wastewater treatment facilities.

The report says this of the Lower Fox River:

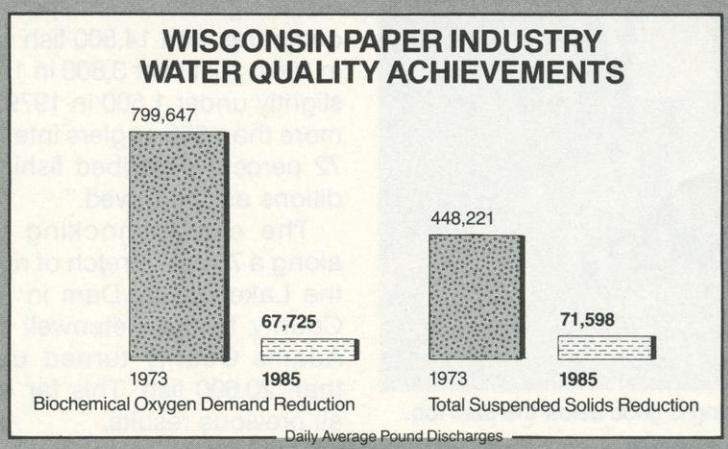
"The 40 mile stretch of the Lower Fox River from Lake Winnebago to Green Bay has one of the heaviest concentrations of point source dischargers for its length in the country. Six municipal wastewater treatment facilities and 15 pulp and paper mills are located along this reach. Since the 1800s, the combination of nearby sources of pulpwood and available hydropower has attracted a number of paper mills. Their development has taken a heavy toll of the river in terms of degrading water quality, which has gone largely unchecked until recently. Municipal loadings have also been significant, accounting for about 12 percent of the total loadings. In 1973, the average daily five day biochemical oxygen demand (BOD) loading from industrial and municipal point sources exceeded 218,000 pounds per day, the equivalent of untreated waste from a population of 1.3-million.

"Today, the Lower Fox is able to support game fish and the sludge beds and mats of paper waste that were common sights have disappeared. Controls implemented by the paper mills and publicly owned treatment works have been responsibile for the cleanup and the river is meeting Wisconsin's standard of five parts per million (ppm) of dissolved oxygen (DO)."

With reference to the Wisconsin River, the DNR Water Quality Report to Congress has this to say:

"Water quality conditions on the Wisconsin River have closely paralleled those on the Lower Fox. The Wisconsin River from Rhinelander to the Petenwell Flowage (170 miles) is one of the hardest working rivers in the world with 29 major industrial and municipal dischargers. As was the case with the Lower Fox, this stretch of the Wisconsin River was grossly polluted in the early 1970's and DO levels in certain reaches were commonly below one ppm during the summer. Extensive fish kills occurred and, while some game fish were caught, they were unpalatable due to taste and odor problems.

"Between 1973 and 1983, the waste load allocation process resulted in a reduction of more than 90 percent in the amount of BOD being discharged by pulp and paper mills and municipalities along the river. There were marked increases in DO levels.... The entire river now meets full fish and aquatic life standards."



designed to perform a specific function in the process of converting mill effluent to products which can be disposed of without negative impacts on the environment.

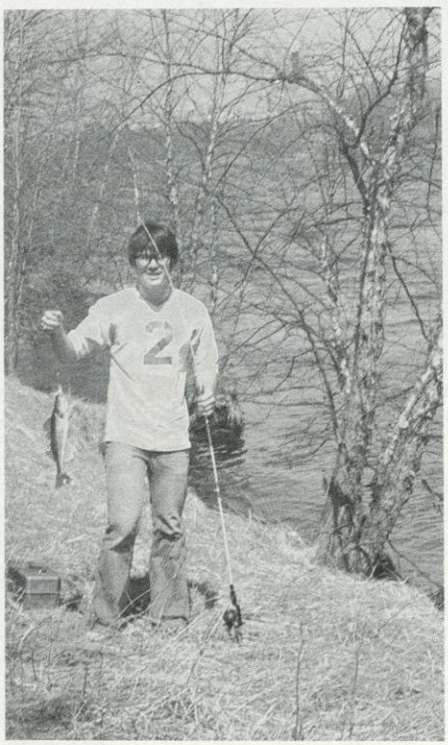
In the right center of the photograph are two side-by-side circular devices of differing size. These devices are called primary clarifiers and are the point at which the mill effluent enters the treatment system. One clarifier handles waste from the Nekoosa mill, the other from the Port Edwards mill. A clarifier is essentially a settling tank wherein the solids are removed at the bottom and liquids at the perimeter on the surface in a fashion similar to an overflow sump commonly found in swimming pools. A very slowly rotating "rake" moves around the bottom of the clarifier, pushing the solids to the center where they are withdrawn. The superstructure supporting these rakes can be seen in each of the clarifiers.

With over 80 percent of the solids removed in the primary clarifiers, the remaining liquid is discharged into lagoons which appear as two large rectangles, the most dominant feature in the photograph. Originally, these lagoons were intended to provide additional retention time causing further settling of the suspended solids. Installation of several downstream elements of the treatment system, which are considered "secondary" treatment, obviated the need for this additional settling capacity. Today the lagoons' primary function is to stabilize the system by avoiding surges of effluent with unusually high concentrations of BOD. This buffering effect is very important to the secondary treatment system as this system depends on a thriving colony of microorganisms to function effectively. Above the lagoon on the left is a white rectangular structure called a reactor in which biological decomposition takes place. Naturally occurring bacteria decompose or literally eat the wood sugars that constitute BOD. .The microorganisms, popularly called "bugs," thrive in an oxygen-enriched environment. By providing pure oxygen to the system, the physical size of the reactor can be reduced. An oxygen-generating plant is part of the facility and is visible as several white cylindrical structures appearing immediately to the right of the lagoons. Oxygen is manufactured on site by liquifying air and boiling off the more volatile nitrogen.

In the process of biological decomposition, additional solids are produced requiring further settling and extraction. This is accomplished in the three clarifiers located at the top center of the photograph. The material that settles to the bottom of these clarifiers contains only 1% solids and is extremely light and fluffy, making it hard to settle out. It is pumped to two gravity thickeners that look like clarifiers located next to the oxygen plant where additional retention time further removes solids. These solids, together with those from the primary clarifiers, are combined in the building standing next to the primary clarifiers and further dewatered on large horizontal rotating drums using a vacuum process. The solids, which are now called sludge, are removed from the system and trucked to a landfill, visible in the upper left-hand corner. The sludge is deposited in beds approximately eight feet thick and covered with a one foot layer of sand, which in turn is followed by successive layers.

The water extracted from the three secondary clarifiers and the two gravity thickeners, having had almost all of the BOD and dissolved and suspended solids removed, is pumped to a foam retention pond on the bank of the Wisconsin River. This pond appears as an oval basin in the left foreground. Water is extracted from the bottom of the pond and flows into the Wisconsin River through a submerged pipe extending approximately half way across the river. The water thus discharged more than meets all the rigorous specifications regarding biological oxygen demand, suspended solids, and pH established by the EPA and DNR. In fact, BOD discharges actually average less than one-fifth and suspended solids less than one-third of the amounts required by law.

Anyone living near the Wisconsin River today or enjoying this beautiful river knows how effective the industrial and municipal treatment systems have been in improving water quality. In addition to fishing, which attracts the greatest number of recreationists, there is growing use of the river by swimmers, water-skiers, sailors, and more recently, wind surfers. These activities have been further enhanced by the sponsorship of a marina on the shores of Petenwell Lake by Consolidated Papers. The river now supports a significant muskie population, which to my chagrin produced a muskie, caught by my son, larger than the 31-inch northern that I caught back in 1956. Biggest difference was that this fish was eminently edible and, for me, symbolic of the entire change from polluted stream to clean river.



Bank fishing is good below the dam too.
Photo by Don Krohn

More fish, happy anglers

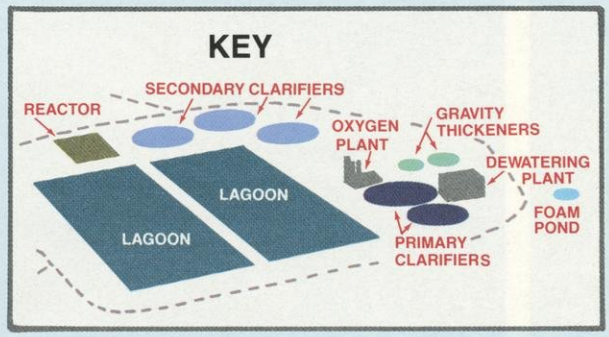
Both electroshocking and creel surveys by Consolidated Papers and Nekoosa Papers along the Wisconsin River show increased numbers of fish to be present and more satisfied anglers.

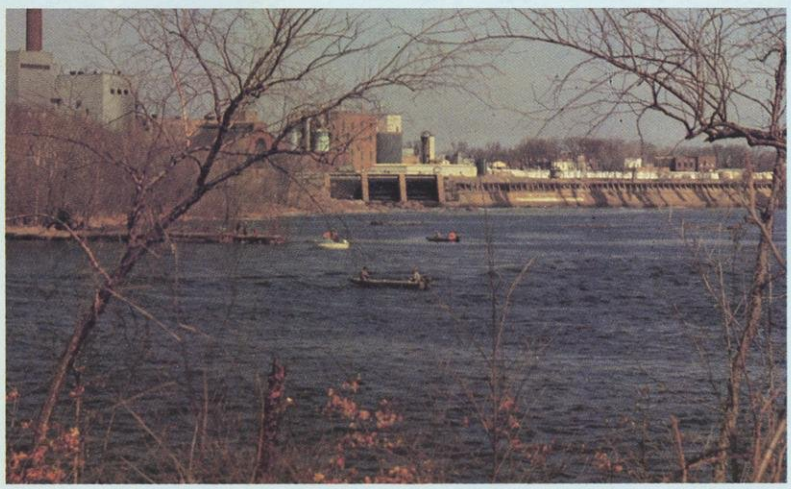
The most recent creel survey recorded more than 33,000 fish representing 38 different species. This compares with 14,500 fish counted in 1981. Just over 3,800 in 1980 and slightly under 1,600 in 1979. Of the more than 600 anglers interviewed, 72 percent described fishing conditions as "improved."

The electroshocking survey, along a 70 mile stretch of river from the Lake DuBay Dam in Portage County to the Petenwell Dam in Adams County turned up more than 20,600 fish. This far exceeds all previous results.

Nekoosa's $30-million effluent treatment system on the Wisconsin River between Port Edwards and Nekoosa. Photo by Tom Kujawski

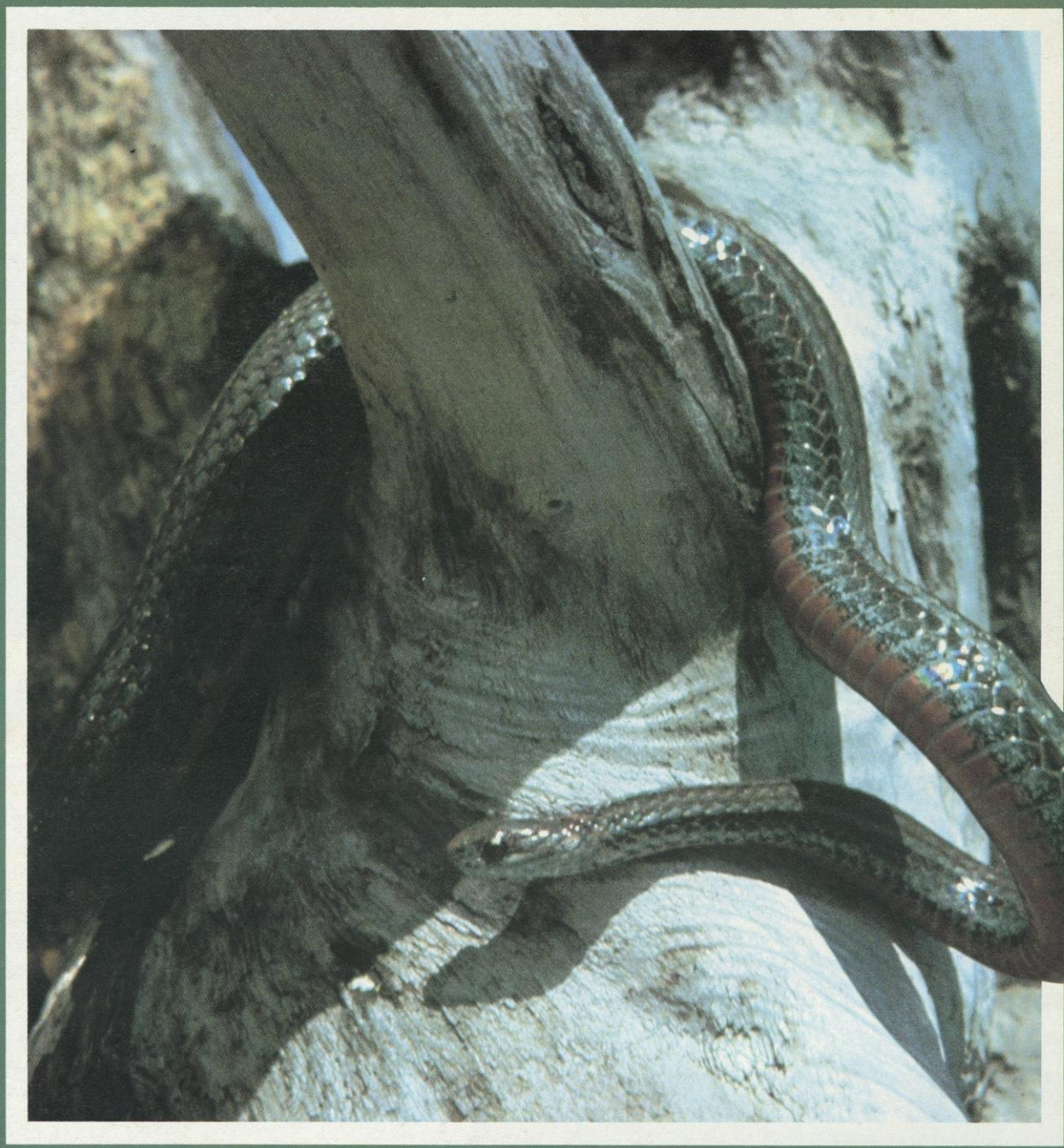
A day's accumulation of sludge ready for the landfill. Photo by Jeff Fox





Spring walleye run below the Nekoosa dam. Photo by Don Krohn

Back cover: Red-bellied snake.
Photo by Tony Geiger



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