Wisconsin natural resources. Vol. 3, No. 3 May-June 1979

Madison, Wisconsin: Wisconsin Department of Natural Resources, May-June 1979

Wisconsin
NATURAL RESOURCES

MAY - JUNE 1979 • VOLUME 3, NUMBER 3 $1.00

Pandora sphinx moth

From the William Sieker collection
Photo by Don Chandler

JOHN BAKER,
Entomologist,
Cambridge, WI

Beautiful bugs are more the rule in nature than the exception. This one, about the size of your index finger, looks as though some gifted artist had made it up. It is the larva of the pandora sphinx moth (Eumorpha pandorus), a member of a family that includes about 100 species in North America. This one has been collected in southern Wisconsin counties and ranges over most of the eastern US. It is sometimes green.

Most sphinx moth larvae are popularly called hornworms because of the distinctive horn at the end of their tails. Farmers and gardeners know the tomato and tobacco hornworms. Young pandora sphinx larvae have a horn on their tail, but like this one, lose it after the third molt. A shiny bump that looks like an eye develops in its place.

Sphinx moth larvae often instinctively lift the head and curl it back to look like a sphinx, hence the name. The pandora and many others can withdraw the first two segments of their body into the third as a startle reaction or defense mechanism. This creates a bulge and emphasizes the sphinx-like appearance.

Larvae pupate over winter and emerge as adults in late spring. Nearly all sphinx moths, including pandora are night fliers attracted to light. Another characteristic of the adult is a long proboscis, up to two inches, which is inserted into flowers to obtain nectar. Some hover like hummingbirds and are called hummingbird moths. Others are called hawkmoths because of their swooping flight.

Many are specific to certain plants. Various species need sweet potato vines, catalpa, tamarack, elm, birch ash, wild cherry or other particular vegetation. Pandora must have grape and Virginia creeper. The larvae are big enough to be noticed in late August and early September.

Photo by Phillip Kingsley, UW-Madison Entomology Research.

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May-June 1979/Volume 3, Number 3
Publication Number (USPS 346-250)

Wisconsin Natural Resources is an official bi-monthly publication of the Wisconsin Department of Natural Resources, 4610 University Avenue, Madison, Wisconsin 53705. The magazine is sustained through paid subscriptions. No tax or license monies are used.

Subscriptions rates are $4.50 per year, $8.00 for two years and $11.50 for three years. Single copies $1.00. Notification of address changes must include mailing label and new address. Allow six weeks. Send subscription information and requests to: Wisconsin Natural Resources, P.O. Box 7191, Madison, Wisconsin 53707.

Second-class postage paid at Madison, Wisconsin.

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Front Cover:

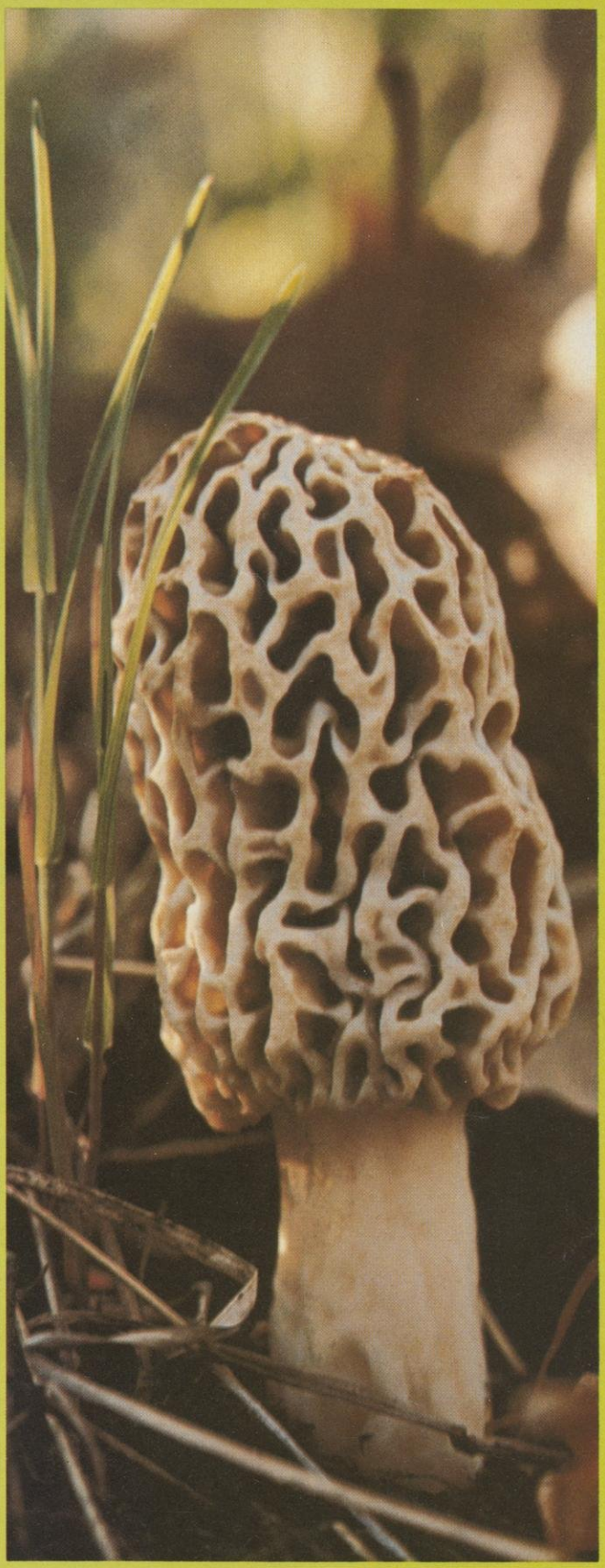
These 16-month-old coho salmon fingerlings weigh only one ounce and are about five inches long. Ready to be stocked in Lake Michigan in a couple of weeks they will lose the stripes and dots, called parr marks, and at the same time become imprinted with the chemical signature of their native water. Imprinting is the phenomena which draws coho back to the stocking site to spawn. When they return 16 months later they will be 28 inches long and weigh eight pounds or more. Unfortunately they will also be contaminated with toxic PCB. For a story about PCB and the Lake Michigan fishery, see page 13.

Photo by Don Chandler

Back Cover:

This fishing pier for the handicapped at Law Park on Madison's Lake Monona is located over a favorite fishing hole. Built by the Yahara Fisherman's Club with donated manpower and funds raised at their annual "percharee," the pier accommodates four wheel chair anglers and has a ramp for easy access.

Photo by Vern Minor.



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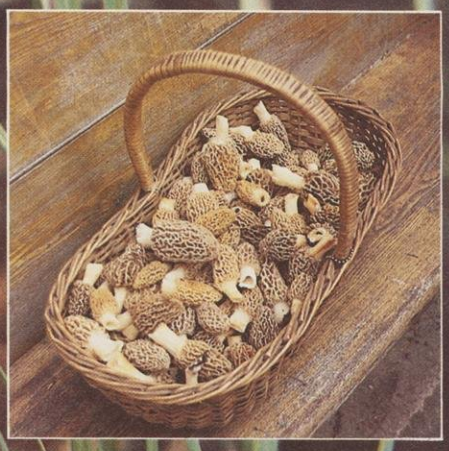
The morelist



JUSTIN ISHERWOOD, Farmer, Rt.1, Plover

When lilacs in the dooryard bloom. When planting is finally finished and the ambitious seed is in warming ground. When the plowshares are at last let cool and an ease comes over the township.

Then is a time when the farmer can come to know his woods again and see what the spring has brought.

There is a ritual of the woods that occurs from mid May to early June — a ritual of Sunday morning walks, hunting morel mushrooms. In this religion two sects exist, mushroomers and morel mushroomers. The difference is one of ability.

The mushroomer can cipher the form and texture that identify the eatable from the noneatable. In the world of mushrooms the distinction is sharp between palatable and poisonous, or if you prefer the hard edged words, between the living and the dead.

The mushroomer is a courageous sort. It is an act of wonder to watch one go to a patch of sylvan agaricus (which look like little white umbrellas with lace drip collars), pick a bushel basket full, take them home, throw them in a quick pressure cooker and can a winter supply.

The mushroom identification book has a picture of sylvan agaricus with the big word "edible" beneath it. Next to it is another picture of the flat capped agaricus (which also looks like a little white umbrella with a lace drip collar). Beneath is the word "poisonous."

The true mushroomer will scoff at that and say they aren't poisonous. "Ah well, they might make you a little sick but they're not poisonous." They might make a mushroomer a little sick, the rest of us normal mortals they would probably kill!

But mushrooming isn't all that bad and one of the reasons is the existence of the morel. That plant alone proves this is a loving universe. The morel is a delicacy for the multitude. If you can't tell the difference between a daisy and a rutabaga you can still distinguish a morel from the host of other mushrooms.

The morel looks like a pointed sponge three to five inches in height. A pitted conical head sits atop a creamy white stalk of half its total length. Color of the head varies from tan (light brown) to brown (dark tan) or grayish. At emergence they tend to have their darkest color, which fades in the few days of its existence to a gray almost white head.

For the morel mushroomer the picking spot is both secret and holy ground. It is too much to ask of a friend that he would tell the whereabouts of his morel ground. Perhaps it is too much to ask even of a marriage partner.

Some local farmers have been seen heading into the woods on a fine clear Sunday morning while wife and kids dressed for church, with the excuse of mending fence, a frying pan slung over the shoulder, a small pat of butter in the jacket pocket and a couple matches.

There is a theological theory that the forbidden fruit in the garden was in fact morel mushrooms, that the maker wanted to save the flavor (and knowledge) for himself, herself or itself.

The place to hunt that musty tidbit is in old woods. There are those who say to look for ash trees and there you will find the best morel ground. There are those who say go among the old dead elms.

Some say don't look at all if it hasn't rained recently, that dry ground and mushrooms don't go together. There is plenty of evidence that few can be morelists when it really gets hot.

Others go into the hills to find the deserted homestead with an old apple orchard out back. Still others look only beneath balsam fir and others hunt in mature oak woods.

The true morelist will find them almost anywhere, making the best of a nearby world.

Morels are never abundant and thus difficult to share. Like too many good things, they don't respond well to cultivation. You can't just throw the seed in the ground and wait then for an easy harvest like prayers thrown at a vending machine deity. You have to go on the search yourself and find the knowledge and delight of the woods.

There is an ethic involved. You should ask whose woods these are. Not many do that anymore (if they ever did) — come to the door, hat in hand and ask in mild voice if it is OK.

Not many come on that hot Saturday afternoon to help pack away the last of the hay in the hot, thin aired mow and sit afterwards talking easy on the porch with a cold beer before milking time. If so there would be fewer of those big yellow signs with black letters saying "NO TRESPASSING." At least they would know it wasn't meant for them!

One more thing, the morelist doesn't pick them all. Some are left if not for others then out of humility — that we would not be like an ancient king who shot arrows at the sun in an attempt to kill it. There is an Iroquois tale which says that king was the father of the white race.

Enough of this, go find morels for yourself. If you don't find any you will no doubt visit their green neighbors and that is reward enough in spring. □

Left: Morchella esculenta Photo by Michael Cain
Bottom: Photo courtesy of Dr. Martyn Dibben, Milwaukee Public Museum

An innocence of prairie*

Some of Wisconsin's pioneers who loved the land made mistakes and knew it. This excerpt from the book by our famed folklore scholar and author treats them with compassion. Other chapters about trees and children, age and faith are full of fine perceptions.

ROBERT E. GARD

Who were they who came to the Wisconsin land, heroes in their imaginations, crusaders against a primitive innocence of grass and trees.

They broke open the primitive prairie with oxen and an iron plow. They were the iron-ringers shouting: Iron on iron! Rock on rock! Iron on iron! Rock on rock! They cried: Here it is! This land, this valley, this hill, this link of woods is ours! And they named the prairies for far places: Empire and Arlington; for star and sun; for Indian legends; for women; for a joyous heart, or a human dream.

There was innocence in their joy. They thrust deeply into the warm, virgin womb of earth, planting, planting more and more. And with joy and with fury they tore open the primitive sod with oxen and an iron plow; they, the iron-ringers. Their shares laid over the ribbon of severed roots, and turned under the yellow sunflower, buttercup, lobelia, the blue lead plant. Laid under the ribbons were the aster, the indigo and the star grasses.

And they chanted their hymns of religion and of work, and work was often their religion, a glorious effort of despoilation and innocence. Above the severed prairie grew the grains; the trees uprooted burned through the nights; the wild land became transformed and wild waterbirds nested no longer on prairie wetlands. The pigeon flocks that once obscured the sun were there no longer, and a victory over an innocence had been won, an elemental conflict resolved.

Innocence is of many times, and of many things.

They had no sense of violation, for home and family are concepts of the innocent. They had joy in the clear waters flowing through time; in valley springs and hillside brooks. They discovered the crystal flood rushing from old springs, through white sand basins and amid crisp watercress. The water was violated only by the bend and thirst of those who revered pure, cold water; yet the waters stopped their innocent flow.

*From the book *An Innocence of Prairie* by Robert E. Gard, $10.95, American Printing and Publishing, Inc., 2909 Syene Rd., Madison, WI 53713.

We, who now look backward, see clearly the beginning of the violation; when the grand passage of the ducks was no longer; when the Whooping Crane was not seen; when the Bald Eagles flew less and less, and the rivers grew dark with slime, and a cruel darkness began in the brain of man. We see an irony that the innocent violated the innocence.

There was one who knew, when he was old, that the innocence of the primitive had ended; that he had despoiled what there was of the wildness he cherished. What, he wondered, would then become of his son? What bequest had he to leave of the wild prairie, and the memory of the way it was?

As he knew, finally, what it was that had been left for him, the son spoke:

My father sang the song of pioneers
And broke the sod; he made the prairie bloom.
But I who came to manhood in a different way,
Found little left of grass and less of way.
My father dreamt of victory over roots;
Saw cities limned against a prairie sky;
Saw derricks pumping wealth and homesteads rife,
Saw every man a king: a god of life.
But I — what was there left for me?
When pioneers had sapped the soil of its juice
And given all the glory of their strength
To occupations that to them alone had use.

For I, yes I, a singer also bold and free
Was eager to pit my strength against the earth,
To sense my destiny and girth,
And set my course against a prairie sea.
One morning when I'd turned just seventeen
My father led me through a field of tasseled corn,
"There yonder lies one acre of the virgin sod,"
he said.
"It will never be turned; wild grass must stand
Tall to the shoulder, hiding beast and man."
Strong roots in fertile soil to the breast
Of earth and season pressed and pressed.
For this to him the symbol of the past
More real than hungers of my restless heart
To know what lay for me beyond an acre's edge,
And of a mystery where no broken earth had part.
"I walked out from Ohio, boy, was seventeen
Like you,"
he said,
"Your age.
More sense,
More will and drive, ambition.
Something keen,
A wringing knowledge that I must succeed.
And look, of all that was, this acre only left.
I conquered all.
I am what I set out to be.
All this, our hope, our will.
We conquered fear.
We won.
And you —
What, boy, of you?"
Yes, what of me, poor singer with no song,
No song of wild grass to tell my dream;
And where to go and what to seem.
You had all the grass, father.
What indeed, of me?
He said:
"We own a nation open, wide and free.

Walk out as I did. Seek the prairie sea;
We opened all the doors for you and yours,
Find the new prairie and come home to me."

The answer, father, when the grass is sped,
The cities builded and the spirit dead. . .
No great wide sky, no wagons rolling slow,
No yoke of oxen, no stalwart man with hoe?
No clear, pure stream that man has not defiled,
No unpolluted air, no unsuspected star,
No moon, unthreatened, to hang above a glade?
You've left me only doubt, and I'm afraid.

Away from the acre walking as he walked,
I searched the west in frantic vain;
I set my face for prairie rain
But tasted gall and sensed a nation's pain.
I heard the warplanes in the skies
Read the tall headlines blazing blood;
I saw the streets filled with a violent mob
And heard that man had murdered God.

Is this the heritage you left: despair and fear,
For which to struggle and to sing our song?
To find our own black soil deep and strong
Discover words we dare to hear?

Oh, father, father, I came home to you,
To tell and ask and seek what you might say.
I found the acre but a broken gash
And one lone crooked tombstone under which you lay.

Birds' eggs

The size, shape and color of a bird's egg make it a thing of beauty, but beyond beauty is strength and function. All have their reasons.

THOMAS C. ERDMAN, Assistant Curator, Richter Collection, UW-Green Bay

The eggs of birds have appealed to mankind since creation. They are an important food source. The first people relied on colonial nesters such as gulls, to supply quantities of eggs much in the way *Gallus domesticus,* the chicken, supplies us today. Traditionally, for example, Indians along Green Bay gathered each summer on the Gull Islands north of the Door Peninsula for an annual egg feast. They traveled to the islands in their canoes and mackinaws and sometimes remained several weeks feasting and dancing until gull eggs held no further charm. By the late 1800's, Indians along with commercial fishermen were gathering island eggs for markets in Escanaba and other towns where the going rate was as much as 25¢ a dozen. Gull Island eggs were also used to manufacture "eggine" or egg albumen. Such enterprises became less profitable as the region became more settled and occupations switched from logging to farming.

Bird eggs were taken for other purposes than food. Their great beauty and interesting shapes appealed to the collector. Egg collecting was considered a gentlemen's hobby at the turn of the century. After the eggs were collected and the contents carefully removed with blow pipes through a single small hole, the remaining shell was cleaned, labeled and preserved. Private collections were common and egg sets (clutches) were exchanged nationally and internationally much in the same way we exchange stamps and coins today. Oology, that branch of ornithology specializing in the study of eggs was a very popular science at this time. Scientific collectors, however, realized that eggs were of value for more than just beauty or rarity. They were very important in describing new species and subspecies of birds and in establishing taxonomic relationships.

Killdeer
Photo courtesy of the Milwaukee Public Museum

Eggs, or rather their shells, are easiest to preserve when collected just after the entire clutch is laid and before incubation by the female. Collectors, therefore, were required to spend a great deal of time studying nesting habits and recording life histories of birds they worked with. The hobby's widespread practice helped document breeding ranges and nesting phenology for most species. Nearly all of our leading early ornithologists and naturalists were involved in egg collecting at some point in their careers. Egg collections were far more common than bird collections.

In the 1920's, after enactment of the first Migratory Bird Treaty, the collecting of birds, eggs and nests was prohibited except by special federal permit. The era of egg collecting for the amateur and the hobbyist was over. Today collecting requires state and federal permits and is limited only to specific research. Since egg collecting has been prohibited and is a thing of the past, it has been replaced by other pursuits, such as bird-watching, listing, song recording, photography, and bird-banding. Every year millions of people, young and old, from all walks of life marvel at the beauty and variety of birds. Many books and guides are available to enhance their pleasure and make identification easier. Many of the facts in those books, it must be remembered came from the old preserved specimens of birds and eggs. The precise notes and documented detail in the early systematic collections are invaluable to ornithologist and bird-watcher alike. Today they are being used more than ever before. State and federal biologists who manage endangered or threatened species consult the historical records for nesting locations and information on breeding biology, preferred habitat, nest-site selection and nesting phenology. Other researchers use the information in preparation of statements environmental impact on various projects. Egg shells have become invaluable as "indicators" of environmental quality. In the mid-60's it was found that man made biocides and other pollutants, especially the chlorinated hydrocarbon complex, somehow affected calcium metabolism of birds. Chemicals such as DDT, DDE and PCB's have several deleterious effects on the calcification of the eggs. By comparing shells found now with those in museum collections, it was learned that present-day shells were thinner and weighed less. These often broke and failed to hatch young. Today's technology including the electron microscope, tells scientists exactly how chemicals alter shell quality and structure. It is even possible to identify the pollutant that caused the damage.

Unfortunately, populations of certain predatory species such as bald eagles, ospreys, peregrine falcons and double-crested cormorants which obtained high levels of organochlorine biocides in their diet, declined very rapidly before the damaging substances could be either banned or better regulated. Many of these species are now either endangered or threatened. Eggs from highly exposed species such as gulls are now regularly collected to monitor pollutant levels in the Great

The Carl Richter Natural History Collection contains more than 11,000 egg sets, (clutches) and ranks number 10 in the US. Here the author sorts and catalogs some of the 113 sets of osprey eggs collected between 1890-1940. Collections like these and the field notes that go with them are valuable as standards for comparisons with today's conditions.

Lakes ecosystem and also to detect new pollutants hopefully before they become a health threat to wildlife and human beings.

An egg is the world's ultimate container, nature's perfect blend of beauty and function. Inside, at the center, is the germ cell and the yolk, which is high protein food for the embryo. The embryo is round and held in place by a strong membrane which allows the suspended yolk to rotate so as to compensate for any movement of the egg. The yolk also keeps the germ cell on top. Surrounding the yolk and filling most of the rest of the inside is a clear gelatinous layer of egg white or albumen. This is mostly water and acts as a cushion to the yolk. It also prevents dehydration and contains an additional store of protein. Two more membranes surround the contents to protect them from harmful bacteria and to act as a base for the limey outside shell.

The shell is composed mostly of calcium carbonate crystals arranged in an interlocking fashion, which although light in weight, are extremely strong. Throughout the shell are numerous tiny pores which allow oxygen for the embryo to enter and water vapor to leave.

To produce young by laying eggs is like having an external pregnancy. Birds share this method of reproduction with fish, amphibians and most reptiles. The fact that birds are highly evolved in many ways but still retain this somewhat primitive reproductive method probably reflects the overriding importance of reduced weight for flight. In some species, for example, a clutch of eggs weighs 25% more than the female that layed them. Egg reproduction also allows the mother bird to remain free to search for food and escape predators. Although they produce larger and fewer eggs than fish, amphibians and reptiles, birds are more successful at rearing young because bird eggs are laid in sheltered nests, inaccessible to predators.

Birds hasten development of the embryo by incubating the egg with their own body heat. The number of eggs any species lays, therefore, is limited to how many can be warmed or incubated. Most wild birds are considered "determinate" layers which means they lay a definite number of eggs per clutch. A few species, though, are "indeterminate." These continue laying past the normal clutch size when eggs are removed from the nest. The domestic chicken is a good example.

Although many creatures lay eggs, only birds have a wide variety of colors and patterns. Most are quite distinctive in shape, size and color.

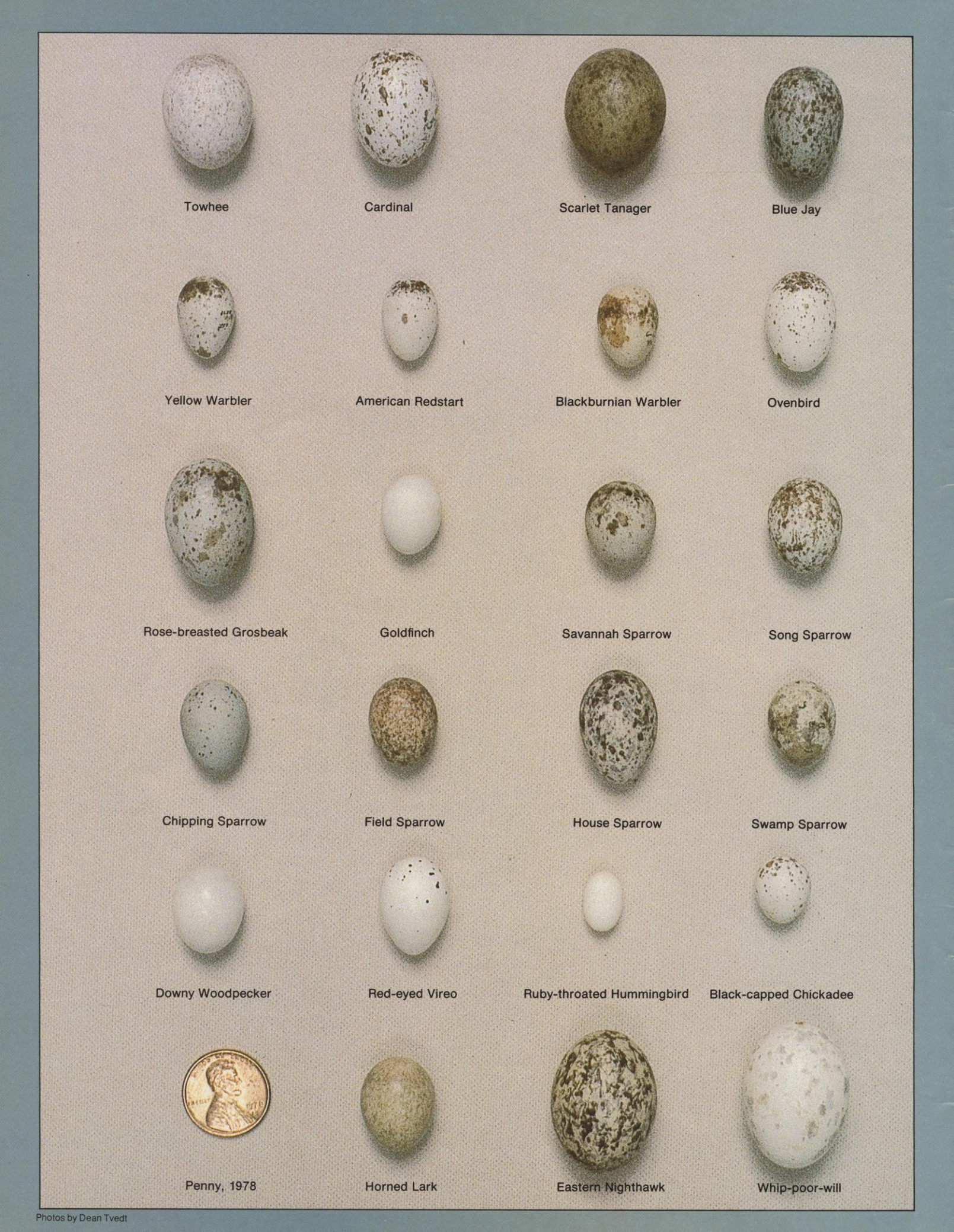
The typical egg-shape evolved because it allows plenty of room for embryo growth and development. The strongest possible egg would be perfectly spherical like a table-tennis ball but this would be too small and would probably hinder development. Diameter, of course, is limited by size of the bird's oviduct through which the egg must pass when laid. Many species lay eggs which are very distinctive in shape. Usually, those of owls and other birds of prey are almost round; cormorants and grebes, tapered on both ends; terns and shorebirds, pear shaped; and swallows, long and blunt on both ends.

Reasons for these variations are not always obvious. However, we know that terns and shorebirds usually use little if any nesting materials and eggs are often laid in a very shallow depression. The pear shape ensures that the egg will not roll away, but rotate in a small arc around its tip. Also, shorebird eggs are relatively large. When placed inward, the pointed ends fit very close together and the female has less area to cover. Because diving birds such as grebes, loons and cormorants have long, thin bodies, they lay elongated eggs.

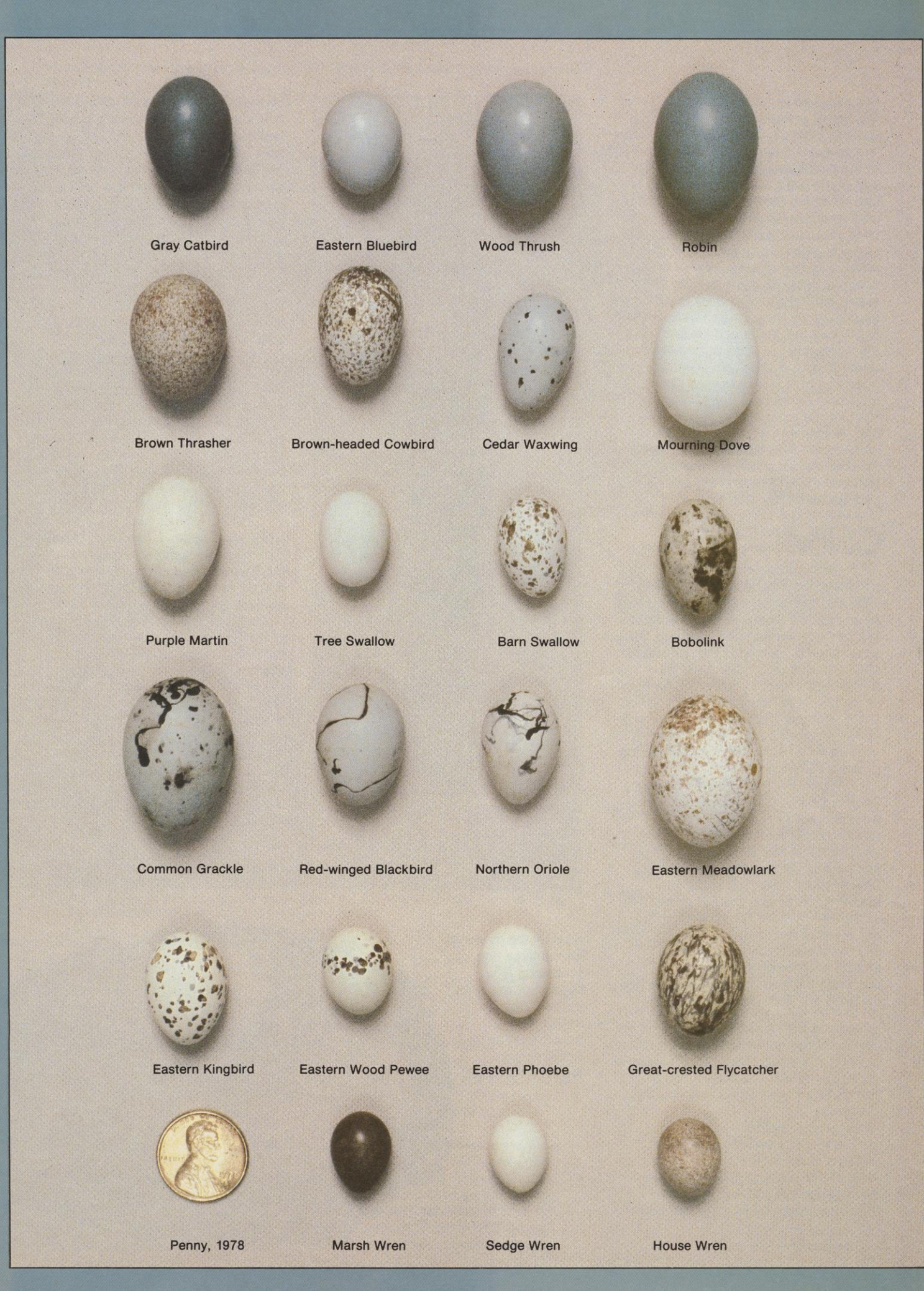
Size

Egg size is roughly related to bird size. Big species lay big eggs. Those nesting for the first time often lay fewer and smaller eggs than experienced nesters. In Wisconsin, the sandhill crane has the largest. It measures 3-3/4 by 2-1/2 inches. The ruby-throated

(Text continued on page 12.)



Photos by Dean Tvedt

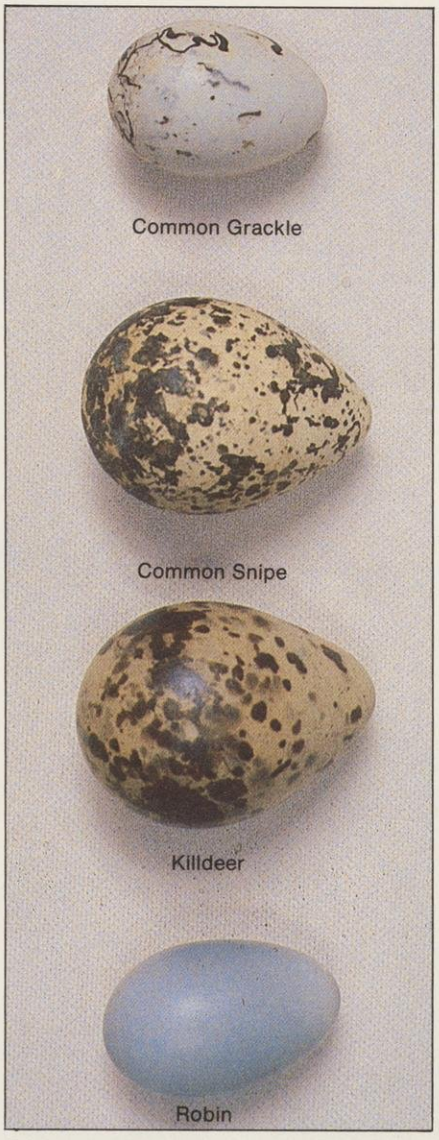

Gray Catbird
Eastern Bluebird
Wood Thrush
Robin
Brown Thrasher
Brown-headed Cowbird
Cedar Waxwing
Mourning Dove
Purple Martin
Tree Swallow
Barn Swallow
Bobolink
Common Grackle
Red-winged Blackbird
Northern Oriole
Eastern Meadowlark
Eastern Kingbird
Eastern Wood Pewee
Eastern Phoebe
Great-crested Flycatcher
Penny, 1978
Marsh Wren
Sedge Wren
House Wren

hummingbird lays the smallest — about the size of a pea. Generally small birds lay proportionally larger eggs. The house wren's egg for instance is close to 1/7th of the bird's total weight. At the other end of the scale, a cormorant's egg is only 1/25th of body weight. Small birds also generally lay more eggs than large birds. But among birds of similar weight and size, eggs vary a great deal. The robin, common grackle, killdeer and common snipe all weigh roughly the same; but the shorebirds lay much larger eggs than the song birds. This is related to the fact that snipe and killdeer chicks are "precocial" — that is they hatch ready to go, covered with down, eyes open and able to run around. Such advanced development requires more food for the embryo and thus a large egg. Robins and grackles, on the other hand, hatch naked with eyes closed, incapable of locomotion. They stay in the nest a long time and depend on parents for shelter and food.

Color

The coloring in bird eggs is produced by only two basic pigments, blue and buff-brown. These are secreted by the uterine glands and are related to the bird's blood and bile pigments. Blue, when present, pervades the entire shell as in the robin and other thrushes. Sometimes brownish colors are present on or just under the shell surface. On a white egg, this produces the yellow-buff-brown range of colors. When brown is present on a blue shell, colors are in the green-olive range.

Distinctive markings are made by another chemical substance which may appear black or red-brown. These markings can be incorporated at any level as the layers of the shell build up just prior to laying. When seen through blue or white shells, the spots may appear gray, blue or mauve. Spots added on the final shell layer often do not dry until sometime after the egg is laid. As a result, blotches, scrawls, streaks and marbled patterns are produced because the spots smear when the eggs are laid. Other eggs may have all the markings on the large end, producing a capped or wreathed pattern. Despite the endless array of possible patterns, eggs of most species are readily identified by shape, color and pattern. Individual variation is usually slight. Interestingly, only colonial nesting species have a great deal of variation. This may aid birds in locating their own eggs in dense colonies. A good example is a marine species, the common murre. Its colonies are especially crowded, and patterns vary a great deal from nest to nest.



Birds whose young hatch covered with down and ready to go (precocial) need bigger eggs than those that pip naked and dependant (altricial). Adults of all here are approximately the same size, but Common Snipe and Killdeer are precocial while the Robin and Common Grackle are altricial.

The function of color and marking seems to be for camouflage from enemies. Most hole-nesting birds such as woodpeckers, kingfishers, martins, small owls, etc., lay white eggs, unmarked, probably because they are well hidden. White also makes it easier to locate eggs in a dark nest. The large birds such as bald eagles and great horned owls lay white eggs in open nests as do a few smaller ones such as the mourning dove. Most of these species however, begin incubation as soon as the first egg is laid. The white eggs are, therefore, seldom exposed.

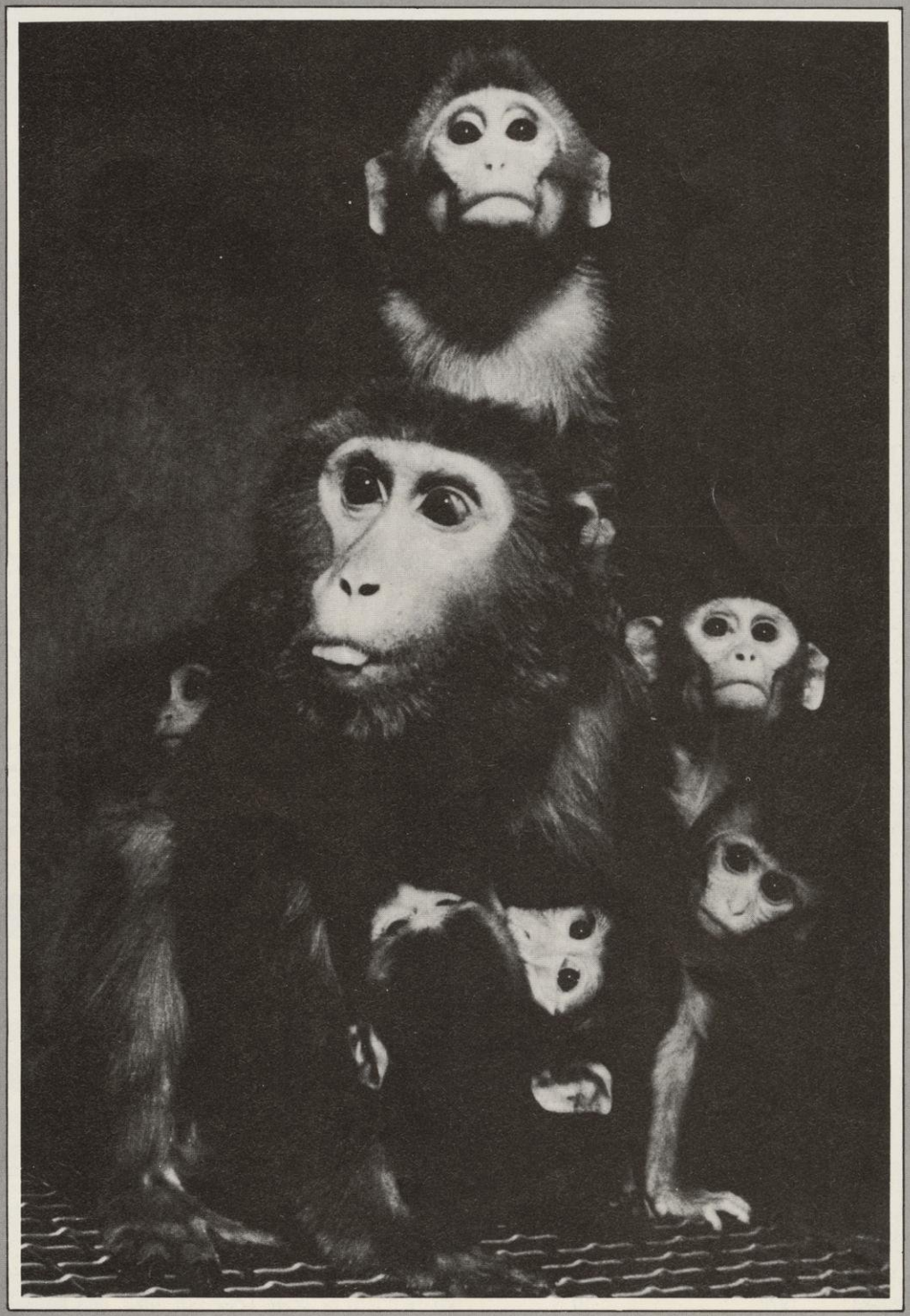
Many species have eggs with only a few small spots. It has been suggested that these are an intermediate evolutionary stage from patterned to white. For example, eggs of the barn swallow are slightly marked while eggs of the bank, cliff and tree swallows are white. The last three have enclosed nests while the barn swallow's is more cup-like. In the thrush family, eggs of the eastern bluebird are palest, because it nests in natural cavities and bird houses. In recent years, pure white bluebird eggs have been recorded. Blue eggs are often found in species nesting in heavily shaded locations. Buff-brown eggs are usually produced by ground nesters. The amount of marking often corresponds to location of the nest, open and exposed or well concealed. □

Pheasants hatching.
Photo by Staber Reese.

Don't monkey with PCBs!

The tolerance level set by health authorities for PCBs in fish is 5 ppm. Most of the big trout and salmon in Lake Michigan contain more than that. New tests on monkeys show the chemical to be dangerous and debilitating at infinitesimally low levels and tolerances will probably be ordered reduced to 2 ppm. Besides serious health considerations, the change will raise questions about the DNR stocking program.

Tiny amounts of PCBs fed to the mother give offspring skin rash and discoloration, hair loss and swollen eyelids. There is also learning impairment.



Photos by R. Dodsworth for the UW-Madison Primate Center

T. B. SHEFFY, DNR Toxic Substances Chemist, DNR Surveillance Section

On a calm summer morning, dawn and fishing arrive at the same time on the Big Lake. Boat launches and breakwaters from Baileys Harbor to Kenosha buzz with enthusiastic anglers pursuing the sleek, silver fish that teem in her waters. The talk is of downriggers, dodgers, J-plugs and grizzlies, cleos, crocodiles, and diving pink ladies. The scene is "salmo-mania," an incredible success story of a new sport fishery developed in Lake Michigan.

It's hard to believe, but 10 years ago the fishery didn't exist. The sea lamprey had all but decimated lake trout. Effective control didn't take effect until the early 60's. Then, another blow that looked like disaster, a population explosion of alewife. But alewife set the stage for salmon.

Wisconsin began stocking rainbows in Lake Michigan in 1963. Planting other trout and salmon was in full swing by 1968. Success exceeded all expectations. The fish not only survived well, but, feeding on the abundant alewife, grew at fantastic rates. Stocking has been so fruitful that sport anglers now catch an estimated 3.9 million pounds of trout and salmon from Lake Michigan annually on 1.9 million fishing trips. Success can also be measured by the millions of dollars contributed to the state's economy and by sale of more than 1.4 million licenses, not to mention control of alewife below the nuisance level. "Salmo-mania" is like a fisherman's fairy tale come true where everyone should live happily ever after - - - except for one small hitch.

At about the same time as the lamprey, another more subtle entity began invading Lake Michigan. Unlike the eel, however, this one went unnoticed until 1971 and uncontrolled until '77. Its initials anger sportsmen, annoy fish biologists, stir up environmentalists, concern the public and grey the hair of bureaucrats. The name is PCB (polychlorinated biphenyl) and every day we learn more about its history, effects and fate in the environment. Manufactured and sold since 1929, it was not until 1966, after many millions of pounds had been produced, that PCBs were discovered accumulating in fish and wildlife.

Highly stable, nonflammable compounds resistant to heat, acid and alkali, PCBs are relatively nonvolatile, excellent insulators, insoluble in water and soluble in organic compounds. They don't oxidize easily. Temperatures in excess of 1,000°C are required for complete combustion. Such combined characteristics make the compound ideal for many industries. Current use is restricted primarily to capacitors and transformers, however, in the past, PCBs were distressingly universal as this partial list of products shows:

—Coolant-insulation fluids in transformers
—Electric wire insulation
—Plasticizers
—Vinyl chloride polymer films
—Hydraulic fluids
—Lubricants
—Sealers
—Heat transfer agents
—Capacitors
—Molding waxes in precision casting
—Additives in machine tool cutting
—Oil
—Epoxy paints
—Protective coatings for wood,
—Metal and concrete
—Adhesives
—Carbonless reproducing papers

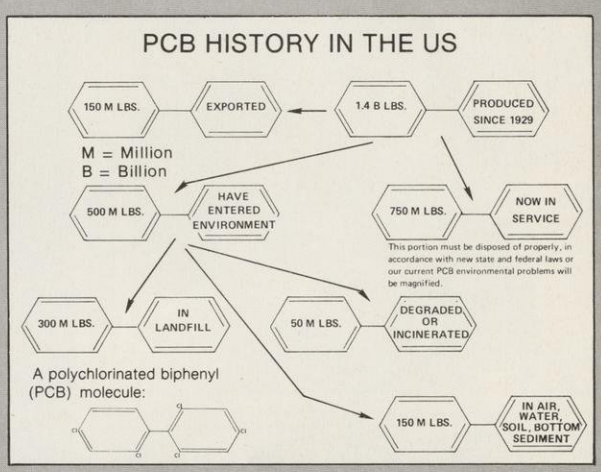
Right now PCBs are widespread in flourescent light fixtures. Every single one has a small capacitor which until a year ago contained about a 10th of a pound of PCBs. Multiplying this by the millions in homes, industry and office buildings across the nation, gives a hint of how much of this toxic chemical is still around.

The same chemical properties that

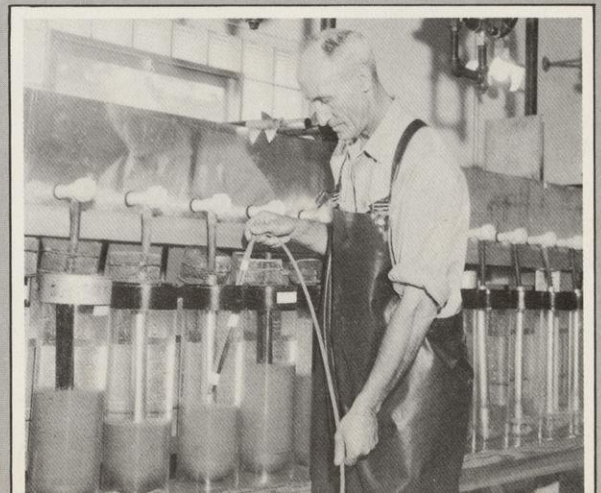
AVERAGE PCB BURDEN IN LAKE MICHIGAN SALMONOIDS 1971-1978

Species & Year	No. of Fish	Length in Inches	PCBs— Parts per Million	% Fat
Lake Trout				
1971	29	23.3	16.9	11.3
1972	10	21.4	22.4	—
1974	30	24.9	17.1	16.7
1975	62	22.0	8.5	10.1
1976	13	23.4	9.7	12.3
1977	3	13.7	1.2	3.2
1978	19	22.9	7.5	9.2
Brown				
1974	16	19.6	4.9	11.1
1975	12	19.7	3.4	10.5
1976	2	29.0	12.0	12.0
1978	10	23.8	9.5	9.6
Brook				
1976	12	18.0	5.1	11.9
1978	22*	16.0	13.2	6.6
Rainbow				
1974	1	23.3	3.4	8.6
1975	1	18.8	4.8	18.5
1976	2	18.5	4.8	12.8
1977	1	21.9	5.7	4.5
1978	10	22.4	4.5	4.2
Chinook				
1974	12	33.0	12.4	1.6
1976	4	29.8	8.5	2.4
1978	29	30.0	8.9	3.9
Coho				
1974	18	21.3	3.9	3.0
1975	3	20.3	4.3	5.3
1976	2	18.9	14.3	3.8
1978	10	23.3	7.3	3.9

*Includes brook trout from Sheboygan River which has unusually high levels of PCB



DNR may re-examine it's hatchery program. Photo by Staber Reese.



made PCBs ideal for industry account for the persistence in nature. They enter the aquatic environment from many sources: vaporization or incineration and subsequent atmospheric fallout, leachate from landfill, runoff from sewage sludge disposal, direct discharge in industrial wastewater, as municipal sewage waste, or through accidental spill.

One characteristic of PCBs is that they are highly soluble in fatty tissue and therefore accumulate in living organisms. Once in our waters, they pass on through the food chain, and ultimately reach human beings. Salmon and trout in Lake Michigan are especially susceptible because they contain a high percentage of fat and tend to absorb PCBs much like a sponge soaks up water.

Laboratory tests have shown the chemical to be toxic at very low doses. The fact that rats and mice develop liver tumors when fed PCBs suggest a carcinogen. But the potential effect on reproductive success in living organisms including man could be even more critical.

Because PCBs are highly toxic in very small doses, the U.S. Food and Drug Administration (FDA), in 1973 established a tolerance level of 5 parts per million (ppm). The rule is that fish containing more than that amount should be eaten no oftener than once a week. Expectant mothers and small children should eat no PCB-tainted fish at all. FDA has also banned interstate transport and commercial sale of fish with more than 5 ppm. DNR testing has confirmed that most Lake Michigan trout and salmon over 20 inches long are above the tolerance. For this reason, a consumption advisory is in effect and appears on page 22 of the fishing regulations pamphlet.

In 1976 the pervasiveness and persistence of this toxic chemical in the environment and its tendency to accumulate in food chains and man prompted lawmakers to ban manufacture and sale in Wisconsin. The law also calls for DNR to establish rules on PCB disposal. Goal of the rules is to eliminate or minimize further discharge into the environment. They are comprehensive and specify how to handle, store, transport, process and dispose of PCBs. In conjunction with the Administrative Code, DNR conducts an education and enforcement program. To date, about 75 major PCB users have been visited, including large utilities to make them aware of environmental problems and the need for proper management of PCB waste.

Since 1971, we have learned a great deal about PCBs in Lake Michigan. We know that most large salmon and trout exceed the 5 ppm tolerance. We know where PCBs were used and how they got into the lake. And we have taken steps to stop future discharge. But several important questions about the PCB salmonoid problem remain unanswered. These are troublesome and the answers often depend on whom you talk to.

Now that we have banned PCBs and eliminated most sources, how long will it take for the lake environment to cleanse itself? Although there are no known ways to get rid of PCBs now

Continued. . .

PCBs AND DNR

Two years ago the 5 ppm tolerance level in fish seemed to provide adequate protection to consumers. At that time, after conferring with The Department of Health and Social Services, DNR strenuously urged FDA not to reduce tolerances to 2 ppm because the impact on the Lake Michigan fishery would be devastating. The DNR position was based on health evidence available then. Now, new research data on toxicity means DNR will have to take a new look and make a new judgment.

Alewife. Main food for coho and lake trout, they contain 5 ppm. PCBs. Photo by B-Wolfgang Hoffman.

present, action already taken by industry and government should result in effective future control. But meantime, fish are a serious problem and PCB residues will continue to be found in them. It is known that naturally occurring bacteria slowly degrade the chemical, but in sediments, soils and landfills this will take many years.

Exactly how long the fish problem will persist is conjecture. Estimates range from several years to several decades. Comparing PCBs to its close relatives DDT and dieldrin, offers conflicting insight. DDT residues in fish dropped significantly in a much shorter period than predicted after use was restricted in 1969. It took only five years. On the other hand, dieldrin residues have not dropped at all since the 1969 ban.

However, despite dieldrin there is reason for cautious optimism. PCB data collected from 1969 to 1976 by the U.S. Fish and Wildlife Service and the Wisconsin DNR suggest, that levels reached a maximum in 1973-74. Since then there has been a very slight decline. Hopefully this will continue and become more pronounced as various control measures are implemented. A good "guestimate" of how long PCBs will persist at problem levels in Lake Michigan is 10 years, minimum.

If trout and salmon continue to be contaminated with PCBs for another decade, should we continue to spend money on stocking them? Wisconsin hatcheries direct significant production to the Great Lakes and about $418,000 is spent each year to put these species into Lake Michigan. The purposes of a good stocking program should be to maintain a fish population and a fishery, to provide an opportunity for high quality sport fishing, and to produce a usable resource. There is no question but what the present Lake Michigan stocking program maintains an abundant fish stock. But it produces a resource whose use is restricted. And it's likely to get worse before it gets better.

This is because even more restrictions are at hand, tossing cold water on the recent good news that PCB levels in Lake Michigan fish are down slightly. New experiments now show PCB toxicity to be so intense that FDA plans to reduce the tolerance level even further — lowering it from 5 ppm to 2 ppm. All signs indicate that two will be ordered by mid-1979. When this happens, human consumption of Lake Michigan fish will have to be restricted even more.

To appreciate the true meaning of "restricted fish" one must examine how the magic numbers — the current 5 ppm tolerance and the proposed reduction to 2 ppm were arrived at.

The five level was established in 1973, based in part on laboratory experiments with dogs and rats, and also on human data from a PCB poisoning incident in Japan in 1968. Extrapolation from rat and dog experiments indicate that an allowable level of ingestion would be about 210 micrograms per day for an average 150 pound person. This amount is a little less than a grain of salt. The Japanese data also indicated that a tolerance of about that amount would be right.

The FDA's new proposal for a reduction is based in part on different experiments performed by J. R. Allen at the University of Wisconsin. Allen fed monkeys a *constant* diet of PCBs and they showed toxic effects such as skin lesions and impaired reproduction. These animals received more than *27 times* the allowable level for humans established by the FDA. Later Allen reduced this amount drastically. In his most recent work eight female monkeys were fed a little more than twice the current tolerance for humans. After a year on this diet, the eight showed no gross abnormalities, no inability to breed and no inability to conceive. They were all successfully bred and all appeared normal. But the offspring were not! Two of the females had stillbirths. The remaining six infants appeared normal at birth but subsequently developed abnormal activity patterns and impaired learning ability. A similar trial at the same time which used about five times the human tolerance also showed no abnormalities in the adult females, but offspring were again affected. In fact, one infant died of PCB intoxication showing the classical symptoms of skin rash and discoloration, loss of hair and swollen eyelids.

This evidence indicates that an amount only about twice the present human tolerance is very harmful to monkey offspring, though adults appear normal.

The FDA's proposed tolerance reduction is also based on the work of H. E. B. Humphrey of the Michigan Department of Public Health. Dr. Humphrey tested PCB blood levels in a group of Michigan sport fishermen whose diets included from six to 180 pounds of Lake Michigan fish per year (an average of about 25 pounds per person per year) . A significant positive correlation was shown between PCB blood levels and the amount of fish consumed. Blood PCB levels ranged from .007 ppm in the control group to a high of .336 ppm in the exposed group. The exposed group (which ate more than 24 pounds per year) consumed an average of 123 micrograms of PCBs, per person, about half the present allowable human tolerance of 210 per day.

The estimated U.S. per capita fish consumption rate is 19 grams per day (about 12 lbs. annually) . At the present 5 ppm tolerance level, the average person ingests 95 micrograms of PCBs per day. The per capita dietary intake from miscellaneous sources is estimated at eight micrograms per day. This gives a total ingestion rate of 103 micrograms per person per day. The 103 micrograms are comparable to about one-fifth of the dose that affected the monkey offspring in Dr. Allen's experiments. Frequent fish consumers in the Great Lakes area are likely to exceed this amount. But by how much? The unanswered question must be asked: will the effects of PCBs on infant monkeys show up in the human population in years to come?

Lowering the PCB tolerance level to 2 ppm in fish will give a tenfold safety margin. This translates to a U.S. per capita PCB ingestion rate of 54 micrograms per day, a rate about ten times less than the rate which affected infant monkeys.

Another important point to consider when interpreting experimental data on PCBs is that most toxicity trials involve the use of commercial compounds. But those ingested by

Continued next page. . .

ONE PART PER MILLION (PPM) =

An inch in 16 miles
A minute in 1.9 years
A square inch in one-sixth acre
A pound in 500 tons.
A penny in $10,000

WARNING!

The Wisconsin Division of Health has advised that fish consumers avoid eating more than one meal or ½ pound per week of the fish listed below; and, that lactating mothers, expectant mothers, and any females who anticipate bearing children, not eat any of these fish. The Division of Health also recommends that children ages 6 and under not eat these fish:

- Carp from Green Bay and Lake Michigan.
- Trout and salmon over 20 inches long from Green Bay and Lake Michigan.
- All species from the lower Fox River downstream from Lake Winnebago to Green Bay, except perch and northern pike in Little Lake Butte Des Morts.
- Bullheads and whitefish in Southern Green Bay south of a line from Pensaukee to Little Sturgeon.
- Catfish, carp and white bass in the Mississippi River from Prescott to and including Lake Pepin.
- All species in the Fox River from Portage north to, but not including, Buffalo Lake.

BANNED, BUT LEGAL UNTIL USED UP

The law now bans manufacture and use of PCBs for commercial purposes and starting July 1, distribution is prohibited. So is importation. However, if a manufacturer has some on hand that was purchased before July 1, it can continue to be distributed providing the PCB in the product is totally enclosed.

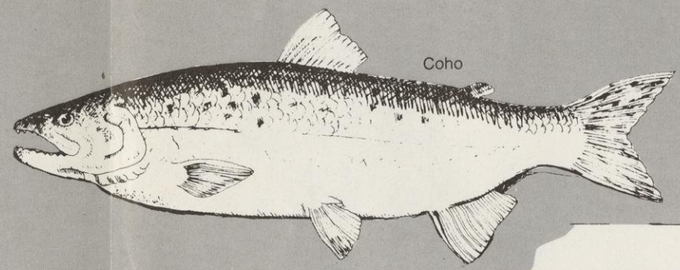
Disposal, though, is strictly regulated. Amounts of PCBs now in use that can still contaminate the environment are very limited. Exempt from disposal regulations as a practical matter, are products that contain less than three pounds of PCBs (two in Wisconsin) . Nationally, this totals 170-million pounds, in Wisconsin about 2-million. Most of the remainder (580-million pounds) is under control.

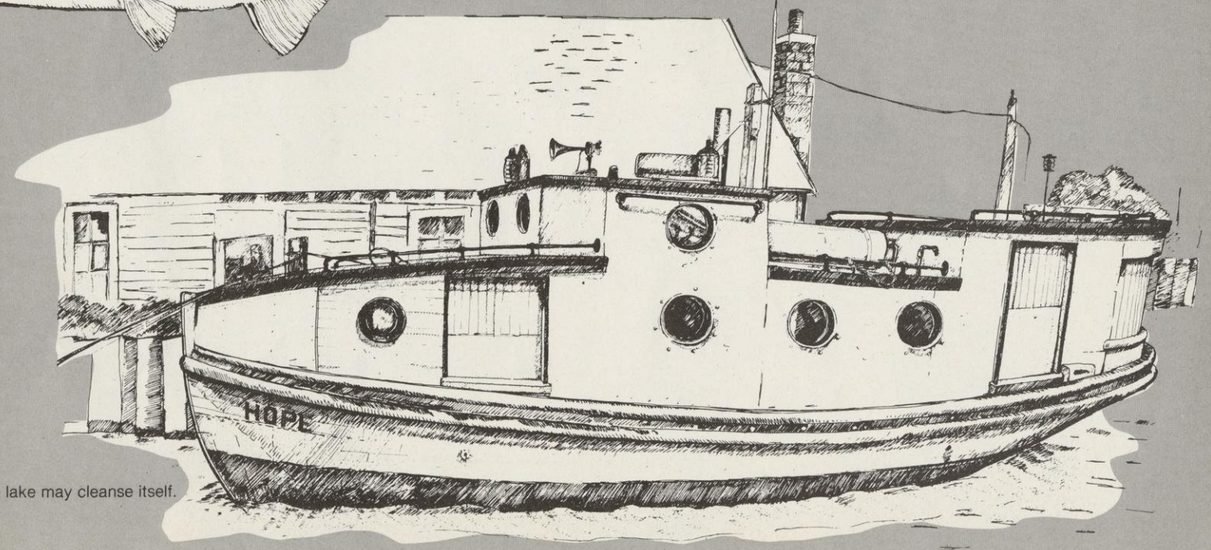
PCBs NOW IN SERVICE
(By millions of pounds)

EQUIPMENT	WISCONSIN	U.S.	SERVICE LIFE (YEARS)
Transformers	6	300	40
Large High Voltage Capacitors	4	200	20
Flourescent Light Ballasts	1.65	80	15
High Intensity Light Ballasts	1	50	20
Small Capacitors	1	50	15
Large Low Voltage Capacitors	1.35	70	15
Total	15	750	

PCB warning on the Sheboygan River.
Photo by Dean Tvedt.

Drawings by Mary Ellen Sisulak from the book *Reflections in a Tarnished Mirror* by Tom Kuchenberg, Golden Glow Publishing.





The lake may cleanse itself.

humans are not likely to be of the same exact composition as the commercial product. It's possible that PCBs from fish, when ingested by humans are less toxic than commercial mixtures. Further research is planned at UW-Madison where the PCB component fed to monkeys will come from Lake Michigan fish.

Establishing tolerance levels has a greater economic effect on commercial than on sports fishermen, although those who serve sports enthusiasts are certainly affected. FDA and state rules, on pain of punishment absolutely forbid the sale of fish that exceed 5 ppm. Sportsmen, however, are free to ignore warnings. One meal per week is purely voluntary. They could eat 10 if they were imprudent enough. When the tolerance level is reduced to 2 ppm, the remaining commercial fishery will probably collapse. But what about sport fishermen? Do we continue to require only voluntary compliance from them while putting the commercial operator out of business?

A related inconsistency exists in federal policy. There are more nicotine and carcinogens in three cigarettes than there are PCBs in a pound of average Lake Michigan salmon. Health authorities forbid the sale of PCB contaminated fish (over 5 ppm) but simply require a printed warning on cigarettes saying they are dangerous to your health. To be consistent, government should either forbid sale of cigarettes too or else merely require a printed warning on fillets of Lake Michigan salmonoids. The public may be losing faith in government warnings, tolerance levels and the like because of these inconsistencies.

Under present policy, DNR has a big commitment to stocking trout and salmon in Lake Michigan — 110,000 to 150,000 pounds annually. The long-range goal is even higher — to stock about 200,000 pounds. This follows through on recent legislation ordering purchase and development of a hatchery within 40 miles of Lake Michigan to help meet the higher goal. DNR also stocks walleyes and perch in Lake Michigan. These low fat species do not accumulate as much PCB as salmonoids but they're not a replacement fishery either.

Present policy, measured against the new data boils down to the fact that when FDA reduces tolerance levels to 2 ppm, DNR will have to ask a lot of old questions all over again:

- Should the whole stocking program be abandoned until the fish get a clean bill of health?
- Should stocking continue in order to keep alewife populations below the nuisance level? In the 1930's, hordes of strong smelling, rotten alewives lined Lake Michigan beaches and the clean-up job cost millions.
- Will risk from low level exposure to PCB outweigh benefits of a fantastic sport fishery that returns a harvest of up to 13 pounds for every pound stocked?
- Should stocking shift to low fat predator species like musky and walleyes? Will these be okay to eat?
- What about the economic impact?
- Should some of the money now spent on stocking be redirected into research on cleaning up the lake?
- Or are we over-reacting to something that in time will cure itself?

Bureaucrats, biologists, boat captains, anglers, industry and Chambers of Commerce will all have to wrestle with these PCB problems. Hopefully, answers will not come slowly. While we wait though, don't forget the warning. It should be scrupulously heeded: *if you eat those fish, more than one meal a week can be harmful to your health. If what we know so far scares you, even one meal a week may overdo. Until more answers are in, it's a matter of personal choice. But take care.* □

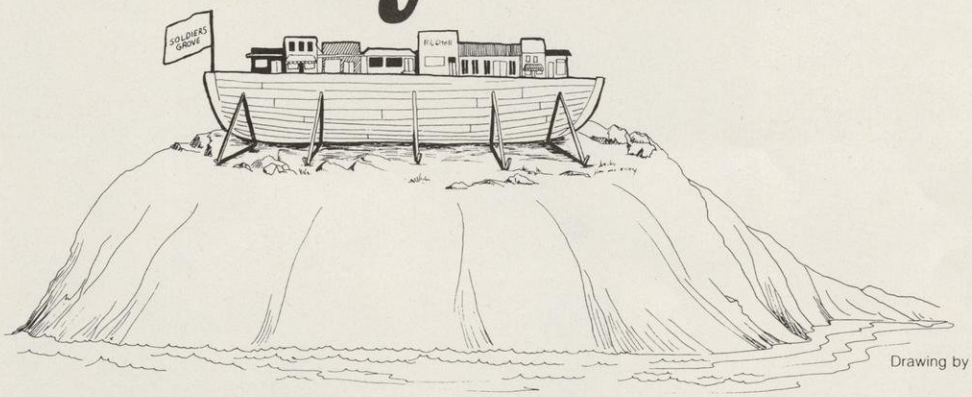
MINK AND FISH

In 1970 reproductive failure and death occurred in mink that were fed Lake Michigan coho salmon, bloater chubs and yellow perch. Research blamed something in the lake. Mink fed coho salmon from the west coast showed no ill effects.

Kits died when their mothers ate a diet of 30% Lake Michigan coho prior to and during gestation. Adults died in three months when fed Lake Michigan coho by-products from canning plants. At the time, pesticides were thought to be the cause. PCB's were not tested, but many now believe they were the lethal ingredient.

Anglers wait for the coho run.
UW-Madison Ag Journalism photo.

Out of harm's way



Drawing by Jim McEvoy

Most of the stores in town are going to pick up and move to the high ground this year and next. Soldiers Grove is simultaneously making history and building a future.

WILLIAM S. BECKER, U-W Extension Energy Information Specialist

What does a community do when it is hit repeatedly by devastating floods from a nearby river? The customary answer has been to build a dam, construct a levee or rechannel the river. But despite more than $25 billion spent nationally on flood protection over the last 50 years, flash floods have become the nation's most menacing weather-related killer. Some federal estimates place annual damage at 200 people killed and $1 billion in property damage.

What to do about flooding has been a tough question too for the tiny Wisconsin hamlet of Soldiers Grove. Crippled by major floods throughout its 100-year history, the 524 residents have come up with a novel answer: abandon the waterlogged floodplain and rebuild on higher ground. Ninety-two buildings are involved in the move, including the town's entire central business district. The relocation, one of the first in the nation, is pushing the little village out of backwoods obscurity and into the national limelight. Among federal officials questioning the nation's flood control strategies and among small town officials struggling to keep rural settlements alive, Soldiers Grove may soon become known as the country mouse that roared.

Soldiers Grove's river is the Kickapoo, an oversized stream which snakes 100 miles through the hills and valleys of southwestern Wisconsin. In the early days, the Kickapoo was economic vitality: powered the local lumber mill and served as a roadway for logs. Later, it gave villagers their only electric power.

> "Environmentalists and some federal officials were beginning to question the wisdom of flood control structures in general. Dams and levees inspired people to build on natural floodplains."

Today, the river brings occasional canoeists to camp and shop. But over the years the Kickapoo has also brought havoc. Major floods hit in 1935, '51, '65 and '78.

A prospering rural center, at the turn of the century, Soldiers Grove had an opera house, dance hall, two doctors and a wide variety of businesses. Today, the old frame buildings sag from rotting, water-damaged substructures. The Army Corps of Engineers estimates that floods cause $127,000 average yearly property damage. After the 1951 flood, in which a five-foot wall of water swept down Main Street with enough force to push a number of buildings off their foundations, many businesses closed and did not reopen. Local construction experts predicted one more major flood would mean the end.

The problematic histories of Soldiers Grove and national flood control policy merged in 1962. Congress authorized the Corps of Engineers to build a large dam on the Kickapoo about 36 river miles upstream. The dam was to be supplemented by levees in Soldiers Grove. Combined, the two structures were to protect the community from anything in the future like the 1951 washout.

Construction of the dam began in 1969, but was almost immediately interrupted by objections from environmental groups. Among the arguments were that the dam's man-made lake would destroy a rare expanse of unglaciated terrain, wipe out colonies of endangered plants and rapidly become plagued by weeds and algae because of nutrients from surrounding lands. In addition, environmentalists and some federal officials were beginning to question the wisdom of flood control structures in general. Dams and levees inspired people to build on natural floodplains. This invites the kind of tragedy which hit Rapid City, South Dakota in 1972 when a dam gave way,

Continued next page. . .

killing 238 people and claiming 638 homes and businesses. Despite mounting opposition, construction of the dam proceeded.

In 1974, the Corps of Engineers announced final details for the Soldiers Grove levee system. It would cost $3.5 million, with the village paying $220,000 of the bill plus annual maintenance costs of $10,800. The dike made no sense to village leaders. Total tax levy was only about $12,000. The community could not even afford annual maintenance costs. And there was really no guarantee a dike would do the job. Besides for all the money it would cost, the levee would not solve the most pressing problem — the decrepit condition of the central business district. As one village official put it: "The levee would turn a decaying community prone to flooding into a decaying community protected from flooding."

"One day, our newspaper editor was talking with one of our businessmen," remembers Ron Swiggum, owner of the local locker plant and a village board member. "The businessman said off-handedly that we ought to just pick up the village and move it. We began to feel that if the river wants to flood, let it. Our newspaperman took the remark seriously and began to study the idea. The more he studied the better it looked. He published a booklet on it. The plan was to relocate Soldiers Grove using money that would have been spent to build the levee! The village board endorsed the recommendation and we submitted it to the Corps."

The engineers had briefly considered relocation in their environmental impact statement on the dam, but rejected the idea on grounds it would lack "social acceptability." Nevertheless, a survey of floodplain property owners found virtually all of them interested. So the Corps changed. In February, 1975, it issued a report recommending that the dam proceed as planned, with relocation substituted for levees in Soldiers Grove. But because of unrelenting pressure from environmental groups and new political opposition, work on the entire project sputtered to a halt. Two-thirds completed, the dam was abandoned. Soldiers Grove lost its main source of financing — the federal money which would have been spent on the levee.

Gays Mills is also considering relocation.

Photos by Kathy Fairchild, Bob Ganser, Bud Parker

DNR wardens rescue a Soldiers Grove resident.
Wisconsin State Journal photo

Courtesy of Wisconsin Department of Transportation

"We were determined to keep the relocation idea alive," says Swiggum. "It was the only way to save the community. We knew the project was a splendid opportunity for a national demonstration not only of innovative flood prevention, but community development and energy management too. We were going to build an entire business district from the ground up, and we wanted to make it a model of new energy technologies and new concepts in urban planning."

The village decided to hire a full-time worker to find a way to carry out the project. It chose 33-year-old Tom Hirsch, an "outsider" with a degree in architecture from the Illinois Institute of Technology. Born and raised in Chicago, Hirsch had lived in the Kickapoo Valley for five years. He has an artist's sense of beauty and an engineer's compulsion for order. Never a grantsman, and never directly involved in political decision-making, he suddenly found himself waist-deep in both, trying to locate funds for the Soldiers Grove project and lobbying for a change in federal policies.

"Residents here have always been independent, and we didn't feel good about asking for help," Hirsch explains. "When the Red Cross came to town in the 1951 flood, people asked them to leave. But in this case, we felt federal assistance was both necessary and justified. We were talking about a plan which would set a national example for a new way to deal with flood problems. More important, there were some new laws that threatened the life of the community even more than the Kickapoo had."

The flooding threw many homes off their foundations.

Street and structural damage were widespread.

Main Street, Soldiers Grove, during flood of July 1978. After relocation this area will become a municipal park.

Tom Hirsch, *left,* and Ron Swiggum, *second from left,* talk with Grace and Gene Batchelor, owners of a restaurant in the Soldiers Grove flood plain.

These laws limited major maintenance and repairs on floodplain buildings to 50% of market value. In Soldiers Grove it meant the entire central business district would eventually have to be abandoned. And if the Kickapoo flooded again, many businessmen would not be able to repair their buildings.

"When the Kickapoo dam was scuttled, an easy path to relocation went with it," says Hirsch. "We had to start knocking on doors."

With Hirsch's help, the village scrounged a small grant from a regional planning commission. The money was used to hire experts for the village's own study of relocation. Conclusion was that relocation was not only feasible, but the only sensible solution. A multi-disciplinary consulting firm was hired to fashion a detailed plan. The new business district would be 15-acres located within the village limits about 2,700 feet from the old downtown. Forty-four businesses and 50 dwellings would be involved. Virtually all would have to be new because the old buildings were not worth moving. Portions of the village not subject to flooding would remain in place. The plan called for the village to purchase floodplain buildings, using a combination of state, local and federal dollars. The old business district would be demolished and turned into a municipal park. Soldiers Grove's businessmen would use new mortgages and proceeds from sale of the old buildings to build new shops. Citizens helped determine the architectural styles, traffic patterns and layout of the business district. Village planners even took care to identify natural social gathering spots in the old business district so they could be re-created in the new downtown. Finally, the plan called for solar heating and other new energy systems wherever practical.

After the two initial grants, however, momentum stopped. The relocation idea was greeted enthusiastically by state and federal decision-makers. But none would provide the funds which, combined with

Continued. . .

local money, would allow the village to carry out the plan. It was a frustrating period. Morale sank and skepticism about the move was high. The village ran out of money to pay Hirsch, but he continued working without salary. Despite their disappointment, the village board continued committing resources. In June, 1977, they voted to purchase the relocation site. In early 1978, Hirsch managed to find sufficient grant money to extend sewer and water service. The village paid much of the bill, went into debt nearly to the legal limit. But the larger amounts of government support necessary for the move simply were not forthcoming.

As the village got ready to celebrate the Fourth of July last year the Kickapoo itself settled the issue. At 4:20 a.m. on Sunday, July 2nd, the river swelled to record volume, spilled over a temporary levee and surged into the business district. It pushed 13,000 cubic feet of water per second through the community sending residents scrambling for high ground and inflicting lethal damage on several buildings. Business inventories were wiped out and the water supply contaminated. It was the worst flood ever. Once again, the village joined the rolls of disaster victims in need of federal help.

Following the flood, government officials cascaded into town to survey damage. The governor and congressmen toured the mud-covered, debris-strewn streets. Among those who got a first-hand look was U.S. Senator William Proxmire, foremost opponent of the Kickapoo dam. Afterwards Hirsch and Swiggum spent an hour briefing Proxmire on the relocation.

"We explained we were not proposing a giveaway," recalls Hirsch. "The government's floodplain zoning laws had, in effect, taken away lifetime investments of our businessmen by destroying whatever little market value remained in their buildings. We wanted federal help to buy those buildings at fair market price and condemn them so the floodplain could be turned into a park. Our businessmen would pay the cost of rebuilding."

"We had studies verifying the feasibility of the move," says Swiggum.

Flood damage covers entire town.

"And a detailed plan for carrying it out. Before 1978, we pleaded in vain for help. Then came the flood."

In Washington, Proxmire called a meeting of several federal agencies and invited Swiggum and Hirsch. Swiggum had never been to Washington but talked to the group about the village's predicament and how much the survival of small towns like Soldiers Grove means to local residents and farmers. He pointed out that Soldiers Grove hoped not only to stay alive, but to do so in a way which would be useful to the rest of the nation.

> **"We are recognizing that small things are worthwhile — small communities included — and that they ought to be preserved. And we are learning that it is sometimes better to cooperate with nature than try to conquer it."**

"I think a lot of people have developed the attitude that small towns are expendable, that they aren't worth the time and money and effort that must be invested to keep them alive and healthy. But I feel small communities are worth the trouble. They are an important part of the character of this country, and provide a lifestyle many people prefer over urban living," says Swiggum.

Upshot was an immediate $900,000 grant from the Department of Housing and Urban Development, about one-third of the outside funding Soldiers Grove needed. The Community Services Administration provided administrative money including salaries for Hirsch and Swiggum. Other agencies indicated interest. Back home, news of the breakthrough raised the spirits of the villagers and drew the attention of a number of communities elsewhere in the nation.

Soldiers Grove's downstream neighbor, Gays Mills, already has submitted a formal request that relocation be considered there too. A survey of Gays Mills' 670 residents found 88% receptive.

"The powers-that-be finally recognized the significance of the Soldiers Grove idea," Swiggum said. "It is a first in nonstructural flood control, no dams or levees. On an even larger scale, I think the project touches some developing new values in this country. We are recognizing that small things are worthwhile — small communities included — and that they ought to be preserved. And we are learning that it is sometimes better to cooperate with nature than try to conquer it."

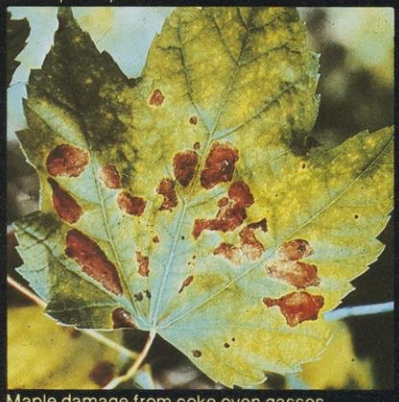
The first wave of buildings are scheduled to be built this spring. Exactly what impact the move will have on the community and its people is unclear at this time. Beyond the obvious physical and economic changes, there already is evidence that the project is causing a shift in the view villagers have of their settlement. They are being challenged to shift perspective from year-to-year survival to careful consideration of the future.

One thing is clear. Because of relocation, several things will never be quite the same — among them national flood control policy and life in Soldiers Grove. Trying to preserve a community and a lifestyle they love, the villagers have moved out of their quiet country existence and into a role as pioneers and innovators with many outside eyes watching closely. It is an exciting time and a relief too. Finally Soldiers Grove will be out of harm's way. The future is optimistic. □

Plants breathe too

Pole bean damage

White pine tipburn



Maple damage from coke oven gasses

Photos by Ted Tibbits

A dose of dirty air in the right place can cause green death. Scientists are working on a cure.

WENDY WEISENSEL, Public Information Air Management

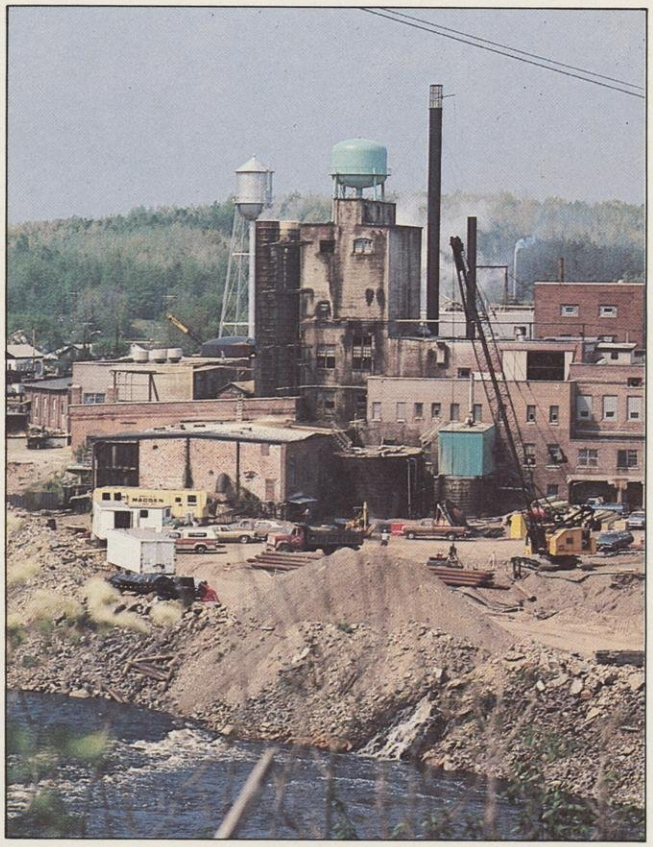
The end of last spring brought brilliant summer weather—temperatures in the 70s, light, southerly breezes and cloudless skies. But 12-year-old Sandy Davis of Racine, stricken with asthma since she was three, couldn't go outside to ride her bike or jump rope. Breathing hurt too much. It even hurt to laugh.

About the same time in what seemed to be an unrelated event 30 miles west of Sandy's house, farmer Tony Werner checked his soybeans. May had been warm and he had planted early. First growth was good but now, part of the 20-acre field was yellow. Leaves were dying. He couldn't figure out what was wrong. But Werner's county agent knew, and so did Sandy's doctor. The same thing that choked Sandy's breathing also yellowed Werner's soybeans. It was ozone.

Ozone is the air pollutant that prompted recent medical research into the relationship between human respiratory disease and dirty air. Not so well known is the parallel botanical research—an effort to assess and control the impact of air pollution on plants we grow for food and fiber. In Wisconsin, agricultural scientists and DNR air experts pool their skills to look at farm crops, forests and gardens. And they find damage statewide, not just in the southeast.

"Many people don't realize that air pollution exists in Wisconsin outside the southeastern corner of the state," says Horticulture Professor Ted Tibbitts of UW-Madison. "But you can find damage from air pollution on sensitive plants all over Wisconsin, even in rural or remote forested areas."

These far-flung pockets of ozone are produced on hot, sunny summer days when hydrocarbons from automobile exhaust and vapors from factory spray paints, industrial solvents and gasoline react with sunlight. Air also often has a natural ozone component. Prevailing winds transport even more contaminants into Wisconsin from states to the south. "All these automobiles



concentrated in nearby urbanized areas are the primary source of hydrocarbons in Wisconsin," says Richard Wales, DNR air engineer.

Other pollutants also invade air masses, though their occurrence isn't as widespread. Sulfur dioxide comes from point sources like power plants and paper mills, and fluorides from industrial processes that grind or heat soil minerals such as brick and tile or from the manufacture of phosphate fertilizer.

Air pollutants enter plants through the "stomata" — tiny pores on leaf surfaces. Unfortunately, pollution levels usually parallel the stomata's daily opening and closing. Concentrations of toxic gases are highest during the day when plants actively "breathe." At night, stomata close and nutrients and contaminants absorbed during the day are assimilated.

In sensitive plants, like alfalfa or white pine, acute injury can show up half an hour after exposure if pollution levels are high—two to five days otherwise. Chronic sublethal doses can be just as harmful. Though a plant may not respond so fast, constant exposure finally weakens tolerance.

After an initial dose, tips of young leaves turn yellow and wither around margins or develop black, white or brown spots.

There is also similar but more widespread injury to recently-matured leaves. Areas of tissue may bleach white, then turn brown, and entire leaves may look bronzed or patchy.

"The healthier a plant is, the more susceptible it is to air pollution injury," says Tibbitts. That's because stomata are more active in a growing plant than in plants experiencing a stress, such as drought. The more active the stomata, the more pollutants the plant will absorb.

Pollution exposure often triggers premature defoliation, as the DNR found with white birch near the Alma power plant on the Mississippi River in Buffalo County. Trees growing on bluffsides in nearby Buena Vista Park started dropping leaves. Fumigation from stack gases turned out to be the cause.

Sulfur dioxide from these stacks also damaged blufftop alfalfa fields. Two farmers sued and courts awarded damages. The power plant later built a 700-foot smoke stack to push its pollutants higher than the bluffs and forestall further damage.

Other point sources that damaged vegetation have had to respond similarly. Badger Ordnance, an ammunition factory near Baraboo was forced to switch from high sulfur coal to cleaner-burning natural gas. Forest pathologists had found white pine dying on hillsides near Devil's Lake. Cause was sulfur dioxide from Badger Ordnance stacks.

In all fairness, it must be said that sometimes, under the right conditions, air pollutants like sulfur dioxide and nitrogen dioxide can act as fertilizer and

Tobacco leaves. Photo by Dean Tvedt

actually help plant growth.

Weather plays an important part in dispersing most pollutants. But very high levels can accumulate during temperature inversions — those calm summer nights that start clear and starlit but end hazed and thick from pollution that has nowhere to go. This happens when warm, light air near the ground is prevented from rising by a cool, dense layer above it that acts as a lid. Vertical mixing doesn't occur, so pollutants concentrate and hover near the ground where both plants and people can be damaged.

Sometimes predicting plant injury in pollution episodes confuses even the experts. "So many factors are involved in attributing injury to air pollution that knowing when injury will occur is a complicated, difficult process," says Tibbitts.

During a diagnosis pathologists check to see whether industries surrounding the damaged area are releasing toxic gas. A great part of the field inspection is spent examining injured plants — noting which parts are affected and what the symptoms are. They look for resistant individuals within a species as a possible genetic answer. Environmental clues help too — wrong soil texture or subpar nutrient levels often produce symptoms similar to air pollution. Topography, drainage, light, temperature and humidity also influence plant response.

At DNR, plant pathologists who suspect pollution injury collaborate with air managers to pinpoint causes. For example, in 1972 a citizen from Brokaw in Marathon County discovered leaves on his sycamore tree yellowing for no apparent reason. DNR investigated, and found more plant injury to cabbage, tomato, kohlrabi, red and white pine, roses and lilac in home gardens downwind from a paper mill. "We discovered, based on air monitoring records, that a sulfuric acid mist emitted from the mill's acid towers was the culprit," says Allen Prey, DNR forest pathologist.

Prey has been studying pollution damage since the mid-1960s. "Back then we suspected some atmospheric gas was damaging trees, but didn't know what it was," he recalls. He used white pine as an indicator species because the tree is highly sensitive to even low levels of ozone and sulfur dioxide. Prey demonstrated white pine's susceptibility to the then unknown pollutant by enclosing branches in polyethylene bags to exclude atmospheric gases. Other branches on the same trees were left uncovered. "We watched developing needles and found that those in the bags remained green while uncovered needles turned brown," says Prey. Such "burns" on needle tips can be caused by both ozone and sulfur dioxide.

Crops and forests damaged by air pollution cost people money. "In '77, I got a good yield of 45 bushels per acre," says farmer Werner. "But last spring four acres of soybeans out of the 20 I planted were a total loss because of the ozone. The yield in the rest of my field was only 40 bushels. Market price was $5.96 per bushel."

White pine tipburn stunts growth which can delay harvest or devalue timber. Christmas tree growers lose because the reddish-brown branches on damaged pines are shunned by consumers. Spots on tobacco can downgrade a leaf from cigar-wrap grade to the lower-priced cut-tobacco level. In home gardens, planting labor and harvest expectations disintegrate when bean plants yellow and onion tips wither.

Despite many documented cases, Tibbitts doesn't believe plant injury from air pollution is a big problem—not yet, that is. He's encouraged when point sources install stack scrubbers and use low-sulfur coal and other fuel. But he's concerned about tomorrow.

"I worry about increased automobile use," he says. "We're a mobile society, and with a still-rising population I don't foresee car use changing too much for some time in the future. More hydrocarbons can only mean more ozone."

And more ozone can only lower crop yields, thin out forest canopies and cost people money in terms of health care, labor and cleanup. To confront these problems, people like Tibbitts, Prey and Wales attempt to come up with answers. "We're trying to develop resistant white pine strains," says Prey. Tests are run on different individual trees to assess tolerance to experimental fumigation of ozone and sulfur dioxide.

DNR air specialists are fighting pollution at its source by checking emission violations and encouraging mass transit which will curb auto use. They also follow through on federal legislation like the Clean Air Act which is designed to lower pollution levels and make air safe for both plants and people.

"I think if citizens are at least aware of air pollution and the problems it causes, we're on the right track," Tibbitts believes.

That awareness will surely spur action and someday Sandy Davis will be able to go outside to play when radiant sunshine and bright skies beckon. Farmer Tony Werner will be able to tramp his fields and find thick, green healthy soybean foliage. Clean air means good health and good crops too. They go together. □

Bad air can hurt these crops

Alfalfa	Kohlrabi	Rhubarb
Barley	Lettuce	Rye
Bean	Oat	Soybean
Beets	Onion	Spinach
Broccoli	Peas	Squash
Buckwheat	Potato	Swiss Chard
Cabbage	Radish	Tobacco
Carrot	Red Clover	Tomato
Cucumber		

And these trees

Green Ash	Boxelder	Tulip Tree
White Ash	Silver Maple	Poplar
Quaking Aspen	Alder	Sycamore
Eastern White Pine	Honey Locust	Weeping Willow
Jack Pine	White Oak	Apple
White Birch	Pin Oak	Pear
Larch	Black Locust	Juniper

Anglers are people*

A warden meets all kinds, with a full assortment of human virtues and frailties. There's often a grim humor in the addled explanations of those caught without licenses or otherwise doing wrong.

DAVE SWENDSEN, Conservation Warden, Spooner

All kinds of people are anglers. Millionaires and bankrobbers, druggists and alcoholics, law professors and illiterates, and even deep sea divers and garbage collectors fight to get out into the summer sunshine to fish, camp, and somehow get at least a few hours' relaxation in Wisconsin's outdoors.

Not even psychiatrists, traffic officers, welfare workers or marriage counselors have the opportunity to contact so many different people as does the conservation warden.

How do these various people react to, "How's luck? I'm a state conservation warden. I'd like to see your fishing license." Needless to say, reactions vary. Each time a license is checked, there is a different and sometimes a really unusual set of circumstances.

Come along with me on a make-believe check of fishermen, and listen to some of the conversations that actually take place. On this make-believe trip you'll hear some of the actual statements that have been made to me in the past five years or so while checking anglers in northwestern Wisconsin.

If you're ready, let's go. We launch our boat at one of the public landings, or maybe at a resort, on one of the more populated fishing lakes in northern Wisconsin.

The first boat we encounter has three occupants, a young woman and two older men. The two men quickly display their licenses. The woman says, "I'm actually not fishing. I'm just feeding the fish some worms."

Then she goes on to tell how she is really on her honeymoon, and just didn't think about a fishing license. When asked which of the two men was her husband, she said neither, her husband had to leave on business several days before, and would be back that night.

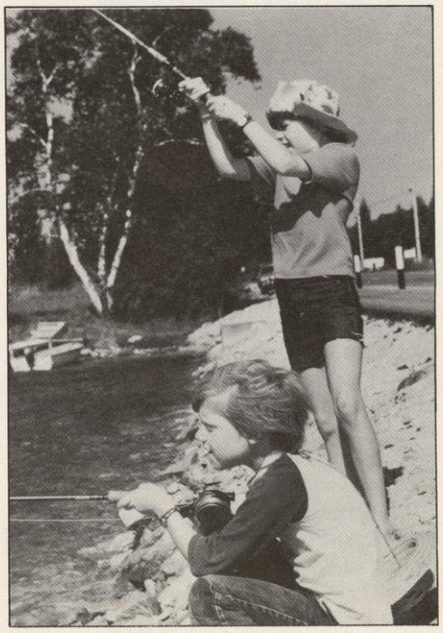
(He still wasn't back two days later when the woman appeared in court for fishing without a license. An unusual honeymoon?)

Fishing in the next boat are a young 82-year-old spinning rod enthusiast and his 78-year-old casting rod partner. The 82-year-old takes his pipe out of his mouth and says, "It's about time you young whippersnappers got around to check our licenses. We've been fishing this lake for 30 years and you're the first wardens to ask for them."

The next boat has two men in it. They are drifting back, back, into the lily pads. Both men are making some excellent casts without becoming tangled among the weeds and stumps. When checked, the man in the back climbs down off the seat he is standing on, and says, "Fishing! I don't even know how to hold a fishing pole." His friend, who has a license, says, "He just came out here to row the boat for me. He is only here for the afternoon." This first expert paid a fine that same day for fishing without a license.

Another boat has one lone man in it. I ask for his license. He just keeps fishing and looking at us. I ask him again and finally he points to his ears and shakes his head. So I point to my badge, then to his fishing pole. He could not hear nor talk, but proceded to get out his license and show it to me. We smiled and waved at each other as our boat moved away.

A boat sees us coming and is moving toward shore. We have watched the occupant fish for some time so we follow and ask him to pull over. It turns



*Reprinted from Wisconsin Conservation Bulletin, July-August 1961.

out he has no license, but was going to town tonight to get one. (He has been at his cottage for three weeks and is leaving in the morning for home.) He made a trip to court before he headed for home.

Checking another fisherman and his wife, he tells us they left their licenses in the car. "Do you still want to see them?" exclaims the woman. We say we will go with them to shore. A diligent search follows, first in the glove compartment, then the cabin, purses, billfolds, and luggage, all to no avail. Neither can remember where or when the licenses were purchased. After two hours of delay, and a search that would put the FBI to shame, the man says, "Truthfully officer, we just forgot to get our licenses this year."

The next fisherman hands us a license that has been through the washing machine twice, through two rains, and was in his pocket when he fell overboard the day before. It's a license all right, but we do encourage him to get a duplicate as soon as possible.

Fishing in the next boat are two big seven and eight-year-old fishermen, with their dad. After the father shows his license, one of the boys says, "Our dad always has a license. He teaches us never to disobey the law." (I really believe their dad did teach them just that.)

Here's a fisherman who has no license. We go with him to his cabin and find three poles set out on the pier with no one attending them. Waiting around behind the cabin we see where a fish has been cleaned, and by the scales and tail left behind we can see it was a northern pike. The season was closed on northerns at this particular time. Looking through some fresh diggings, we find the entrails of five or six more illegal fish.

When we are all through, this fisherman pleads guilty to: fishing without a license, fishing with unattended lines, fishing with too many lines, and possession of northern pike during the closed season. (He had 12 in his ice box.)

Before we finish for the day and beach our boat back at the landing, we have arrested—

One fisherman who says he always fishes with four lines, but just never got caught before,

Another fellow who said he wasn't fishing, as he tried to unwrap his plug and line from around his legs, after pulling it in hand over hand as we came up,

A woman who said she was just holding the pole for her two kids. (The children sat in the very front of the boat playing, while she fished in the back,)

A man who said he had a license on shore, and who had his wife run to the store and try to get a license backdated while we waited for him to come out of his cabin,

Finally a man who ran from the pier, jumped in his car and tore down the road to hide, so we couldn't find out he had no license. He was apprehended by one of our cars on the road, with which we had radio contact.

We also talked with—

Two elderly ladies who insisted that we have a cup of coffee with them on their pier,

A man who had his license checked four times in three days,

A man who lost his fishing pole over the side of the boat one year, and found it by hooking onto it while fishing in the same place one year later,

And finally a woman who had so much money in her billfold that she had to leave her license in her cabin. (And this was a true story.)

Now that you and I have landed our boat, I remember a case of an immigrant from somewhere in Europe, who after very professionally set-lining a lake, had to have an interpreter with him to make his plea in court.

And the case of a young co-ed who ran off the pier, and hid on the floor of her car, to avoid being checked for a license. The last case was further confused by the appearance of a sister, who looked very similar to the running girl. The sister did have a license. The right girl was finally discovered when she sheepishly emerged from the floor of the car the warden was leaning on.

I hope you enjoyed your little trip with me, checking fishermen and human nature.

After this tour, I think you will agree that conservation wardens meet some of the funniest, some of the nicest, some of the nastiest, and some of the goofiest people in the world, all by saying these magic words: "How's luck? I'm a state conservation warden. I'd like to see your fishing license." □

Photos by Staber Reese

An edge for city elms

The trees in town have a better chance to survive the epidemic than their country cousins. A cooperative federal, state and local program shows how and costs less than the chain saw too.

JEFFREY G. WISCHER, Coordinator, Dutch Elm Disease Control

The elm trees that most of us know live in town. Out in the country, along fencerows and woodlots, we can see the great grey arms of dead ones claimed by the epidemic. But the trees we love are closer, maybe in our own yard. Dutch elm disease hasn't killed them all. A lot still live, and now DNR, the U.S. Forest Service and local communities have teamed up to try and save the ones that are left.

The disease is a fatal wilt caused by a fungus imported from Holland on elm veneer logs in 1930. It has been in Wisconsin since 1956. The fungus, *Ceratocystis ulmi*, invades water conducting vessels of the tree and plugs them. The elm wilts and dies. Elm bark beetles which breed and over-winter under the bark of diseased and dead trees can carry the fungus up to several miles. Both European and native bark beetles are implicated. When they emerge from infested wood, they are covered with thousands of fungus spores. The beetles then feed on branches and twigs of healthy elms and introduce spores into the healthy tree's vessels, infecting them too. The fungus can also spread through root connections called grafts.

Dutch elm disease is found statewide because elms are a significant component of our forest. Volume is immense. According to a report by DNR Forester Harry Thorne and U.S. Forest Service Resources Analyst John S. Spencer, Jr., there were more than 300-million elm trees growing on Wisconsin's 16-million acres of forest in 1968. Of these, about 20-million were bigger than 12 inches in diameter and 2-1/4 million topped 20 inches. With such vast numbers in the woods, salvage is the only practical response to the Dutch elm plague. Cost of control would exceed the value of the trees and be an almost impossible job.

In an urban situation, however, intensive control is justified. There are not so many elm trees in town — under a million statewide; they represent high aesthetic, emotional and property values; and they're concentrated and accessible.

For individuals and communities who have lost the stately giants that once shaded parks, lawns and boulevards, the story of Dutch elm disease is sad, not easy to forget. They are gone, beyond recovery. However, many communities still have major populations of large, beautiful elms, either because the disease arrived only recently, or as a result of many years of diligent and faithful control effort. For these communities, the fight to control Dutch elm disease is very much worth fighting. And now there's help.

The plight of the urban trees recently captured interest of the U.S. Forest Service. It has allocated general Forestry Assistance funds for Dutch elm disease to California, Colorado, Georgia, Minnesota and Wisconsin. Purpose is to demonstrate ways of control using the best current technology. Overall objective is to show it to be cheaper, ultimately, to control the disease than allow it to run rampant through a city's elms. To this end, the Wisconsin Department of Natural Resources administered a grant of $275,000 to 19 Wisconsin municipalities in 1977-78 and will help to the tune of $423,000 in 78-79. The money supplements more than $1.7-million in local budgets and finances control efforts over and above existing ones. Included this year is $50,000 to try different utilization projects: elm chips for fuel, pulp and landscaping; logs for lumber scanned by metal detectors to find nails that break a saw; other trees for firewood.

Each municipality admitted to the program had to meet basic criteria:

1. More than 50% of their original elm population intact.
2. A control program with adequate sanitation.

Sanitation includes detection, removal and proper disposal of infected trees. Eau Claire, for example, had kept annual losses on its 36,000 elms below 2% until 1978. Many communities did little and lost many. They failed to qualify. Others did not apply for aid.

Control measures subsidized by the grants were prescribed according to individual needs of the various communities. Some undertook intensive preventive injections of park and boulevard elms with the latest systemic fungicides. In the Milwaukee area, Shorewood provided homeowners with fungicide and equipment to treat elms in their block; Whitefish Bay also assisted homeowners with tree injections. Others employed college forestry and biology students to inventory elms, survey for infected trees, and provide homeowners with training on fungicide injection and general information on disease control. In Hudson alone, two UW-Stevens Point forestry students mapped the location of every public and private elm in the city — all 6,865 of them! This type of information is invaluable for monitoring movement of the disease through a city and evaluating effects of various control strategies.

Although sanitation is the responsibility of the individual municipalities, four of the hardest hit — La Crosse, Rhinelander, Tomah and Wisconsin Rapids — received supplemental grants to allow them to catch up with tree removal. These communities are faced with the most critical and expensive phase of Dutch elm disease, and are confronted with the greatest challenge to maintain the quality of their control programs. It is in these localities that the "state-of-the-art" of control will receive its most severe test.

One of the lessons the epidemic has taught is the folly of filling a community's streets with a single species of tree. Such concentrations become a sort of Petrie dish culture that invites disease. Variety is healthy. Some communities, to their peril, have ignored the lesson and replaced elm with solid plantings of other species. For them, new disaster is only a matter of time. In communities where incidence of Dutch elm disease has peaked and replacement has been discreet, a sort of ecological balance has been restored. The threat is much diminished — a little good along with the bad.

The program is expected to run for five years, of which 1978 was the first. Although overall success cannot be evaluated this early, several encouraging trends are evident. For those communities which have passed the peak, the grant program allows use of the latest technology to save their remaining elms. It is a reward for a job well done. Where the worst is yet to come, public morale has received a boost. Only time will tell if chain saws and stump removers will finally let these cities join the ranks of those like Milwaukee, where over 20,000 survivors of 22 years of Dutch elm disease await another Wisconsin spring.

Elm bark beetle
Artwork courtesy of *Arbotect*

$$ to remove vs. $$ to treat?

Cost for systemic treatment of your elm tree is anywhere from $20 to $40 and it has to be done about every two years. Often an infected tree can be saved if diagnosed and treated soon enough. Root graft barriers need be installed only once and cost $10 to $20 each. They're seldom necessary where single trees are involved. This contrasts with a price tag of $100 to $400 for removal of the tree.

Information on treatment and control can be obtained from your county agricultural agent or community forester.

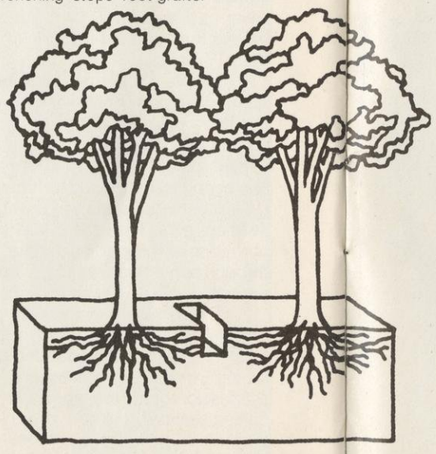
□

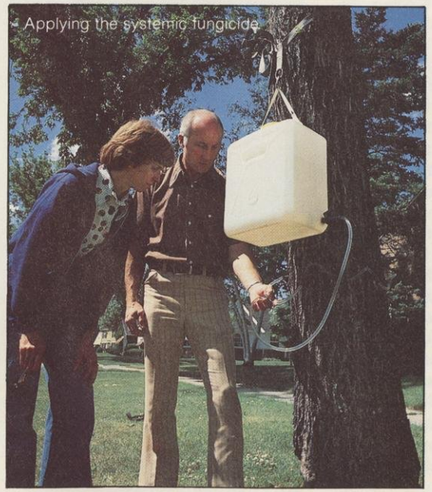
Communities in Wisconsin's Dutch Elm Disease Control Program*

City	1978 Elm Inventory	Elms Lost 1977	Elms Lost 1978	Grants 1978	Grants 1979 Proposed
Allouez	2,107	120	393	$ 9,500	$12,000
Bayside	4,600	60	90	5,000	6,000
Bloomer	1,642	37	30	11,000	11,000
Eau Claire	37,000	576	966	30,000	35,000
Elm Grove	4,950	123	247	5,000	6,000
Fox Point	4,600	278	280	5,000	6,000
Hudson	6,000	282	526	10,000	20,000
La Crosse	45,000	260	1,636	40,000	35,000
Milwaukee	26,000	2,862	1,681	9,500	27,000
Monona	2,400	96	488	5,000	9,000
Neillsville	4,100	220	219	7,500	12,000
Onalaska	1,800	300	186	8,500	12,000
Rhinelander	2,016	44	341	27,000	14,000
River Hills	16,200	630	600	5,000	8,000
Shorewood	2,800	583	342	5,000	6,000
Tomah	2,494	270	750	30,000	14,000
Wauwatosa	17,000	1,242	747	5,000	10,000
Whitefish Bay	5,021	381	317	5,000	9,000
Wis. Rapids	9,250	177	1,058	25,000	19,000

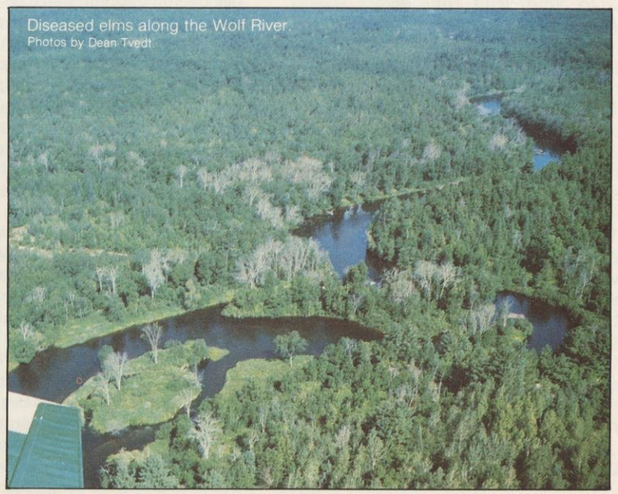
*Control programs include sanitation, survey, systemic fungicide application and root graft barriers.

Trenching stops root grafts.





Applying the systemic fungicide.

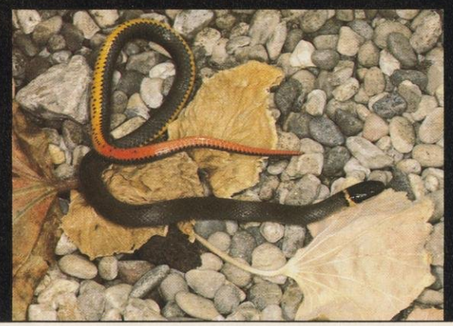


Diseased elms along the Wolf River.
Photos by Dean Tvedt

Wisconsin's small, secretive snakes

Large or venomous snakes get most attention. They have mystique. But the little, hidden ones have charm.

The ringneck snake, *Diadophis punctatus*, is found throughout the state. It is usually blue-black or gray with a yellow to yellow-orange belly and a ring around the back of the neck which is also yellow or orange. The ringneck seems to prefer woodland, but the prairie subspecies prefers bluffs along the Wisconsin and Mississippi River systems.



The brown snake, *Storeria dekayi*, is common in the southern two-thirds of Wisconsin. This is a very versatile and abundant species, which has occasionally found city life to its liking. However, asphalt, concrete and plowing, plus increased pollution and pesticides have forced this snake to withdraw from urban life. Its body is brown with a lighter mid-dorsal stripe bordered on each side by a row of dark spots. Its belly can be pale yellow, brown or pink.

The northern red-bellied snake, *Storeria occipitomaculata*, is found over all of Wisconsin. Although it is primarily a woodland reptile, it is also found in sphagnum bog areas of northern Wisconsin. It is usually reddish-brown or gray with a mid-dorsal line bordered by a narrow dark stripe on each side. It has a red or orange belly.

Art by Milwaukee Public Museum Artist Robert Frankowiak.

Milwaukee Public Museum photos by Janice Mahlberg.

The western worm snake, *Carphophis amoenus*, may be the most elusive of Wisconsin's small snakes. It was not even known to exist in the state until May of 1977, when Richard Sajdak found the first individual at Nelson Dewey State Park in Grant County. Later he found a second at the same site. These two are the only records for Wisconsin. The western worm snake has a cylindrical body, slate-gray above with a distinctive pink belly. It seems to prefer woodlands near water and also areas with slopes or bluffs.

JON SHAPIRO, Biologist, Milwaukee Public Museum

Wisconsin has four small, secretive snakes: the ringneck, brown, northern red bellied and western worm snakes. They range in size from six to 18 inches and though all are docile, they exhibit certain defense mechanisms. The ringneck sometimes uses tail coiling to startle a potential predator. The resulting momentary distraction allows escape. The worm snake uses a different tactic. It surprises enemies by jabbing them with the tip of its pointed tail. All four small snakes also emit a musky liquid that repels predators. These different tactics may pose problems for some of their small animal associates, but the small snakes have an unaggressive reputation and their defense mechanisms do little to tarnish it.

They are not readily observed under natural conditions. When discovered in open areas, as rarely happens, there is only a momentary glimpse before they escape underground or into the safety of dense vegetation and other debris. They typically live under logs, boards, rocks, bark, rubbish, leaves or any other convenient hiding place. Their hibernation cycle and their proclivity for cool, moist shelters in summer make them difficult to find during most of the year.

In Wisconsin, hibernation usually ends between late March and early April. Ovulation occurs around the end of May, with eggs laid in late June or early July. The young hatch from late August through September. Tiny and maybe even more secretive than the adults, the young are not usually found. A newborn red bellied snake, for example, is three inches long and could coil on a dime with room to spare.

Although these four species are active over a wide range of temperatures, they tend to maintain body temperatures in the approximate range of 23-30° C. Their surface activity is chiefly at air temperatures within or below this range, and at higher temperatures they often retreat underground. Their bodies are heated by contact with sun-warmed objects that they use for shelter. Occasionally, at relatively low air temperatures, they venture into the open and bask in the sunshine.

Their prey comes from a vastly different portion of the food chain than that of larger snakes. If their secretive world had restaurants, the menu would include such items as slugs, snails, insects, earthworms and spiders, plus various small amphibian and reptilian delicacies. They consume about three times their body weight in a normal growing season. In diet, as in morphology and homesite selection, there is a great deal of variability between the species.

Not too many years ago, natural predators were the main threat to these four species — small mammals, birds and other snakes like the milksnake. More recently though, habitat alteration, such as deforestation, intensified agriculture, increasing levels of pesticides and pollution, have actually destroyed some populations. In spite of man's detrimental activity though, many of these snakes have still managed to remain fairly abundant in several parts of their range. Fortunately for them, even where abundant, they have usually been able to keep their whereabouts secret. This can be an advantage or a detriment. They can be destroyed inadvertently. On the other hand, being almost invisible has great survival value. It is not unlikely that someday more species of these small, secretive snakes will be found in Wisconsin. All you have to do is lift the right rock! □

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