

A close-up photograph of a green iris leaf. The leaf is the central focus, showing its characteristic shape and texture. A dark shadow of a dragonfly is cast onto the leaf, positioned in the upper right quadrant. The background is blurred, showing other parts of the plant and some brown, textured material in the lower left corner. The lighting is bright, highlighting the vibrant green of the leaf.

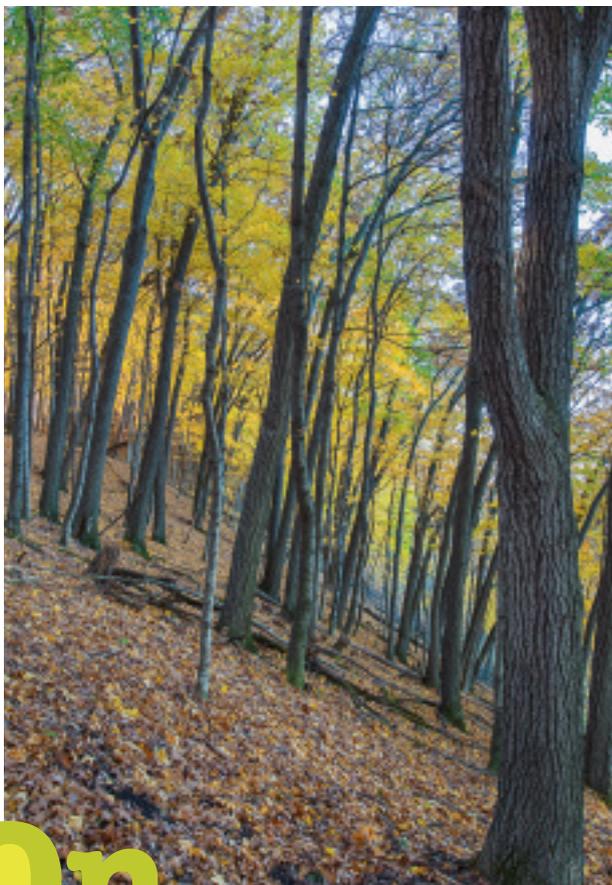
By *Hannah Texler*

Photograph by  
Richard Hamilton Smith



# The Big Reveal

In 2019, the Minnesota Biological Survey program began wrapping the fieldwork in a decades-long assessment of the state's ecological health. The results are both sobering and hopeful—not to mention pretty darn cool. A DNR plant ecologist pulls back the curtain on this important project.



GARY ALAN NELSON

On

a beautiful spring morning in 1994, I stepped out of my car and slipped on my daypack, ready to climb a steep bluff in southeastern Minnesota. As a plant ecologist for the Minnesota Department of Natural Resources' Biological Survey program, my job was to search for rare plant species and diverse plant communities and record my findings. Midway through my hike, in a forest of sugar maple, basswood, and red oak, I saw a splash of crimson near the ground. I could tell it was an unusual species of sedge with broad, evergreen-colored leaves and a bright red base. But it was unfamiliar to me. After making sure the population was large enough to sustain the loss, I collected a sample.

---

*Minnesota's Driftless Area (above). The author in the field (opposite) in 1991.*





COURTESY OF RICHARD HAUG

*In 1994, DNR plant ecologist Hannah Texler discovered the rare plantain-leaved sedge (left) in southeastern Minnesota. Opposite from left: Lee Pffanmuller, Carmen Converse, Welby Smith, Barbara Coffin, and Keith Wendt, circa 1985. These DNR employees would go on to play key roles in the state's biological survey.*

the completion of the first comprehensive survey of Minnesota's biological diversity.

Creating a picture of the state's ecological health is a big achievement. The picture itself, however, is sobering. Over the past 150 years, Minnesota has lost about 50 percent of its wetlands, 40 percent of its forests, and more than 98 percent of its prairies to agriculture and development. Thankfully, the state still has pockets of natural habitats, which serve a critically important role. Diverse natural systems are most resilient to change and provide food and shelter for wildlife, including the pollinators so crucial for our food supply. They also store floodwater, filter pollutants for our water supply, and build healthy soils. Many of these habitats are among our favorite places to recreate—beautiful settings in which to experience quiet, reflective time in nature.

But just how much is left of these diverse habitats, and where are they? How do we best protect and conserve them into the future? Through its landmark survey and ongoing projects, the Minnesota Biological Survey is working hard to find answers to these critically important questions.

### **The Thrill of the Hunt**

Minnesota is chock-full of natural advantages. Besides its famous 10,000 lakes, a shoreline of the largest freshwater lake in the world, and the headwaters of the Mississippi River, the state includes parts of four of North

That evening, I got out my stack of plant ID books and was amazed and excited to learn that I had found the plantain-leaved sedge, a plant that hadn't been seen in Minnesota since 1903 and was on the state's endangered species list. This discovery gave the DNR a better understanding of the plant's habitat and led to other sightings of the rare sedge.

An encounter with a unique plant might seem like a small thing, but in the context of a biological survey, it's an important puzzle piece. Since the launch of the Minnesota Biological Survey more than three decades ago, several hundred scientists have worked together to survey every county in the state for native plant communities, rare plant and animal species, and more common flora and fauna. Their efforts will culminate in



America's biomes. Its rich diversity of natural habitats includes boreal peatlands and forests, hardwood forests, prairies, savannas, fens, and the many species of plants and animals that inhabit them. In fact, MBS scientists have described more than 300 types of native plant communities in the state.

The indigenous people who have lived in the area for thousands of years have long possessed a great deal of orally transmitted knowledge about the plants, animals, and habitats of the state. In 1872 the state created a comprehensive natural history survey in which the Legislature entrusted the University of Minnesota to document the state's geology and native plants and animals. Though incomplete, this early effort uncovered information that today gives us a sense of what made up the landscape at that time.

By the 1980s, population growth and development had critically diminished and altered many of the state's ecosystems. Recognizing the need for new information that would build on the foundation of earlier surveys, the DNR launched the Minnesota County Biological Survey in 1987. The survey was largely funded by the state Legislature, and a significant portion of the funds came as recommended by the Legislative Commission on Minnesota Resources. "That legislative commitment reflects the widespread concern by citizens about the status of the state's biodiversity," says Carmen Converse, who coordinated the survey for 28 years.

Converse "had an amazing combination of skills for the job," says Barbara Coffin, a former DNR plant ecologist who hired her,



DEBORAH ROSE, DNR

*Four-toed salamanders crawl in the hands of DNR herpetologist Carol Hall, who was part of the team that discovered the species in Minnesota.*

“including a wide-ranging knowledge of Minnesota’s natural history, the ability to finance state funding year after year, and the ability to coordinate the efforts of a dispersed staff of biologists.”

But even when supported by solid leadership and annual funding, it’s no small thing to launch a statewide biological survey. To begin surveying an assigned county or region of the state, DNR scientists scour historic documents and files, interview local specialists, and examine aerial imagery. We then select survey sites and seek permission to visit them from landowners or land managers. Once we gain permission, the fun part

begins. Survey biologists visit the sites, examine them carefully, and document findings through written descriptions, different kinds of sample plots, and GPS recordings of locations. We use special methods to track down animals, from auditory recordings of bat calls to live traps for mammals and hand nets for butterflies. We also collect plant and animal specimens in order to document county records, rare species, and other species of note.

Rare plant and animal species are a primary focus of the Minnesota Biological Survey program. In Minnesota, 590 species are categorized as endangered, threatened, or of special concern. Surveys help us better understand the habitats of these species and their distribution in the state. In 1994, DNR scientists and Chippewa National Forest staff collected the state’s first recorded population



of the tiny four-toed salamander during an assessment of 18 forest stands.

“The thrill of documenting the first Minnesota specimen was magnified by the sheer surprise of finding it in north-central Minnesota,” says Carol Hall, a herpetologist who was part of the salamander survey team. Hall had originally expected the species to turn up in southeastern Minnesota, closer to areas of Wisconsin where it had previously been seen.

Hall’s work led to additional sightings of the salamander in east-central Minnesota, and the species gained a “special concern” designation. In all, Minnesota Biological Survey scientists have documented 35 plant and animal species never before recorded in the state. Examples include species of ferns, dogwood, bees, and a type of moth that had previously been found only in Mississippi.

*In 2010, entomologist Robert Dana used this light trap to collect a species of tortricid moth previously found only in Mississippi.*

### **Putting the Data to Work**

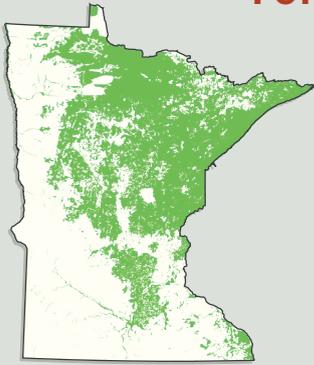
Once surveys are complete, biologists compile field notes, enter locations of species and plant communities into databases, prepare labels for plant and animal specimens, and map the boundaries of native plant communities using geographic information systems, or GIS. Biologists then hand over plant and animal specimens to the University of Minnesota’s Bell Museum and other institutions. Tim Whitfeld, collections manager of the Bell Museum herbarium, estimates that DNR botanists have submitted 45,000 plant specimens to the museum.

“We are lucky to have so many field bota-

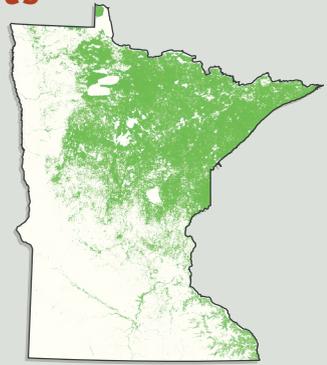
# Tough Losses

Over the past 170 years or so, Minnesota has lost large swaths of forest, prairie, and wetlands. The maps in the left-hand column are based on the work of the legendary cartographer F.J. Marschner, who mapped the state's historic vegetation using land survey data gathered between 1848 and 1907. The maps in the right-hand column reflect recent data compiled by the Minnesota DNR and the United States Geological Survey.

## Forests

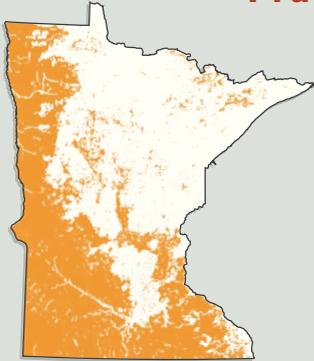


■ Marschner mapped forests



■ Forests today

## Prairies

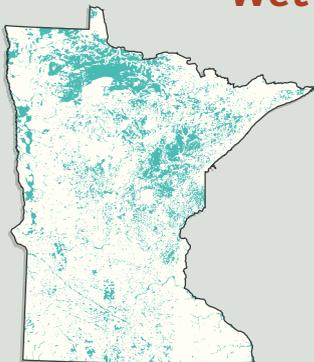


■ Marschner mapped prairies

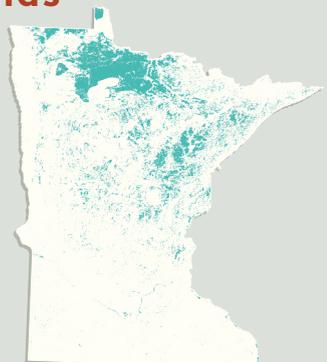


■ Prairies today

## Wetlands



■ Marschner mapped wetlands



■ Wetlands today

nists submitting plants to the Bell at a time when most herbaria have steadily been decreasing new collections,” says Whitfeld.

Survey data, meanwhile, often takes on a life of its own. Environmental reviews of activities such as development and mining rely on survey findings to limit harm to Minnesota’s most vulnerable species and natural areas. Government agencies and conservation groups use the data to determine what sites to protect in the form of parks, preserves, and other protected lands.

Meredith Cornett, science director for The Nature Conservancy in Minnesota, North Dakota, and South Dakota, describes the state’s biosurvey work as “foundational.” The national nonprofit environmental organization used findings from the Minnesota Biological Survey during a recent climate change resilience analysis of the Great Lakes region. “MBS data pointed us to current areas of biodiversity significance, which then shed light on the best opportunities for species movement in response to climate change,” she says.

Yet another important product of these surveys is the classification of the state’s native plant communities, encompassed in the three-volume *Field Guides to the Native Plant Communities of Minnesota*. Created in partnership with the DNR’s Forestry division and based on more than 5,000 vegetation plots throughout the state, the books

## Minnesota’s Unicorns

A few of the ultra-rare plants and animals discovered by the Minnesota Biological Survey.



### Four-toed salamander

First discovered in Itasca County in 1994, this species differs from the rest of the state’s terrestrial salamanders in that it has four toes instead of five.



### Bitter fleabane

Rare herbaceous plant rediscovered in 2000 in Lake County after 55 years.



### Western Jacob's ladder

Rare perennial plant found in Itasca County in 2001. At the time, the plant had been seen in only five other locations worldwide.



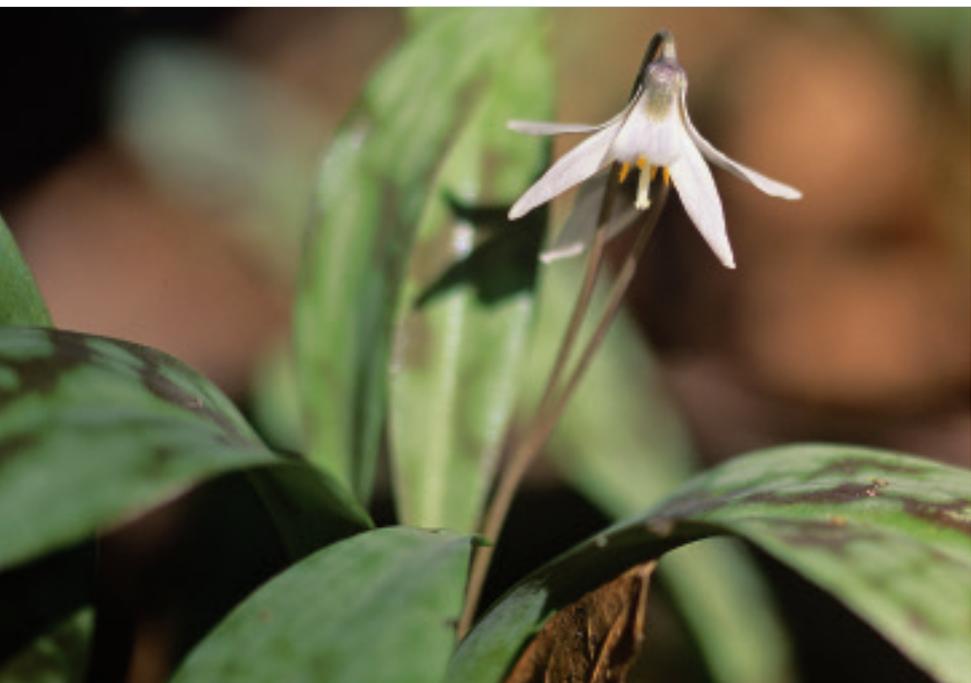
### Bog adder's mouth

MBS plant ecologists documented new locations of this elusive orchid in Becker and Hubbard counties during the 2005 and 2006 field seasons.



### Species of tortricid moth

Previously found only in Mississippi, this moth was collected in west-central Minnesota in 2010.



RICHARD HAMILTON SMITH



DEREK ANDERSON, DNR



DEREK ANDERSON, DNR

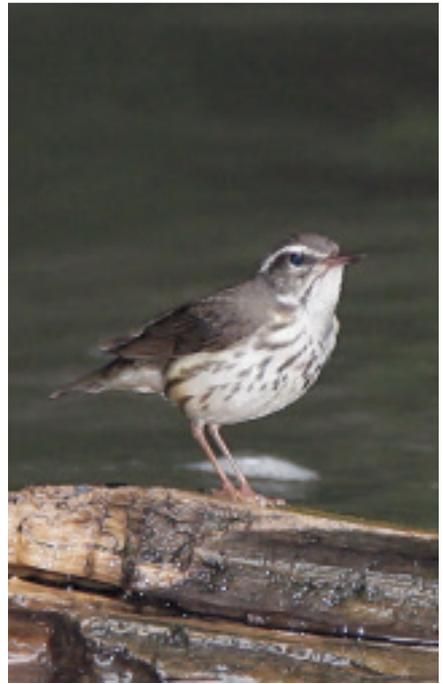
serve as ecology guides to the state's native habitats. In addition, lead MBS botanist Welby Smith has written popular books on the state's orchids, trees and shrubs, and sedges and rushes.

And what of all those data-hungry scientists who've worked on the survey over the years? A happy byproduct of the MBS pro-

*Clockwise from top: The endangered dwarf trout lily has been documented in Minnesota and nowhere else on Earth. MBS staff and volunteers collect data on the rare flower at the Clinton Falls Dwarf Trout Lily SNA.*

gram is that it acts as a kind of crash course for survey biologists.

"We've hired scores of field assistants over



the years, and some have continued the work in other positions,” says Gerda Nordquist, animal survey supervisor for the program since its early days. “A number of them have become professional zoologists who are now leading students in research of their own.”

### The Big Picture

As instructive as it is to look at individual data, it’s also important to view the survey as a whole. One big-picture narrative that emerges is just how much has been lost since the 1800s. We know, for example, that little more than 1 percent of the acreage of plant communities in the Minnesota native prairie remains. Another striking plot point: Only about 4 percent of the forests in Minnesota are old-growth today, compared with 51 percent in 1850. These changes, among others,

*Among the birds surveyed by Minnesota Biological Survey staff are the golden-winged warbler (left) and the Louisiana waterthrush (right).*

have left their mark, and much of the state is now a patchwork of intact native habitats separated by much more disturbed land. This affects movement patterns for plants as well as animals, and many functions of the former uninterrupted natural landscape are no longer present.

Minnesota’s losses speak to a larger trend. Recent studies have documented the precipitous loss of biodiversity throughout the world, leading to unsettling terms like “insect apocalypse.” The United Nations recently released a report estimating that around 1 million animal and plant species are now threatened with extinction. As a

result of human activity, the essential, interconnected web of life on Earth is getting smaller and increasingly frayed.

But it's not all bad news. On the home front, surveys reveal many highly significant natural places that still harbor a great deal of biodiversity. At more than 6 million acres, northern Minnesota's mostly unaltered peatlands are recognized regionally and internationally for their expansiveness and the spectacular patterns they create on the landscape. The peatlands house rare species that occur only in these habitats, including the northern bog lemming. The southeastern blufflands, for their part, have the highest biodiversity in Minnesota when measured by the number of state-listed rare plant and animal species and diverse plant communities occupying the steep slopes and river valleys.

Our biodiversity bragging rights extend to the one plant species endemic to Minnesota. The Minnesota dwarf trout lily has been documented in only three counties in the south-central part of the state. And we can take pride in the fact that we're home to more wolves than any state but Alaska, as well as one of the largest populations of golden-winged warblers in North America.

### **Next Steps**

The MBS survey is nearing completion, but there's a great deal more to be done. Many places around the state would benefit from additional survey, and biologists have barely begun to collect information on insects, lichens, mosses, and fungi. The landscape continues to change, so updates to the survey will be important in order to inform conservation needs.

Bird surveys continue to focus on search-



ing for and documenting uncommon and rare breeding birds, says MBS ornithologist Steve Stucker. The reporting of birds by birders has increased over the years, particularly with online apps like eBird. MBS continues to target remote, hard-to-access places seldom or never visited by birders.

"I conducted targeted surveys for the rare Louisiana waterthrush in their streamside forest habitats in southeast Minnesota last year," he says. "I was happy to find populations in the Whitewater Wildlife Management Area and in several other nearby locations."

MBS program supervisor Bruce Carlson takes a 30,000-foot view of state survey work.



*MBS staff as of October 2019. Front row from left: Nathan Dahlberg, Jason Johnson, Chel Anderson, Courtney Millaway, Bruce Carlson, Hannah Texler, Jeff Lee, Andrew Herberg, Melissa Boman, David Drons, Alaina Berger, Dustin Graham. Middle row from left: Kyle Johnson, Mike Lee, Derek Anderson, Erika Rowe, Tom Klein, Jessica Petersen, Margaret Edwards, B.J. Carré, Carol Hall, Welby Smith, Robert Dana. Back row from left: Fred Harris, Daniel Wovcha, Ethan Perry, Evan Host, Jenn Gillen Ashling, Gerda Nordquist, Nicole Gerjets, Jeff LeClere, Bob Dunlap, Rebecca Holmstrom, Steve Stucker.*

“I see the evolution of the program including an increased focus on how biodiversity is changing through time,” he says. “This will enable us continue to provide people with relevant and current information about how best to protect and manage Minnesota’s invaluable natural diversity.”

To that end, the new MBS Ecological Monitoring Network is looking at how changes in climate, land use, and invasive

species affect native plant communities.

As for me? Well, today I supervise the plant-related part of the MBS program and can only hope that the ecologists and botanists I oversee get to experience the same feeling of discovery I had on that steep bluff in southeastern Minnesota. Knowing you’re the first person to document a rare plant population, an old-growth forest, or a patch of intact prairie is one of the great joys of this important work. 