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Revisiting the Northwoods

A LESSON IN BIOTIC HOMOGENIZATION

by Tom Rooney, Don Waller, and Shannon Wiegmann

In his essay "Song of the North," Sigurd Olson claimed to be drawn to the Northwoods the way a salmon is drawn to the stream where it was born. The song Olson heard was not the solitary call of a loon or a wood thrush, but of the land itself, of the forests he wandered and the chains of lakes he canoed. Like Olson, we too feel called by this region of forests and waters. The Northwoods have become a laboratory where we spend our field seasons collecting data and learning more about the plants that call this place home.

In northern Sawyer County, Wisconsin, lies our study site 3118. At first glance, it appears like many other forest stands in the region. The canopy of second-growth red maple, sugar maple, and red oak covers the undulating topography. Here and there, a lone red or white pine stands amid these hardwoods. The soil has a sandy texture. Perhaps as few as fifty years ago, this stand was an old-growth red pine-white pine ecosystem. These Great Lakes "pineries" are now recognized as one of the most endangered ecosystem types in the United States (Noss and Peters 1995). The stand we see today originated from intensive logging of one such pinery about five decades ago.

illustration by Dorothy Black

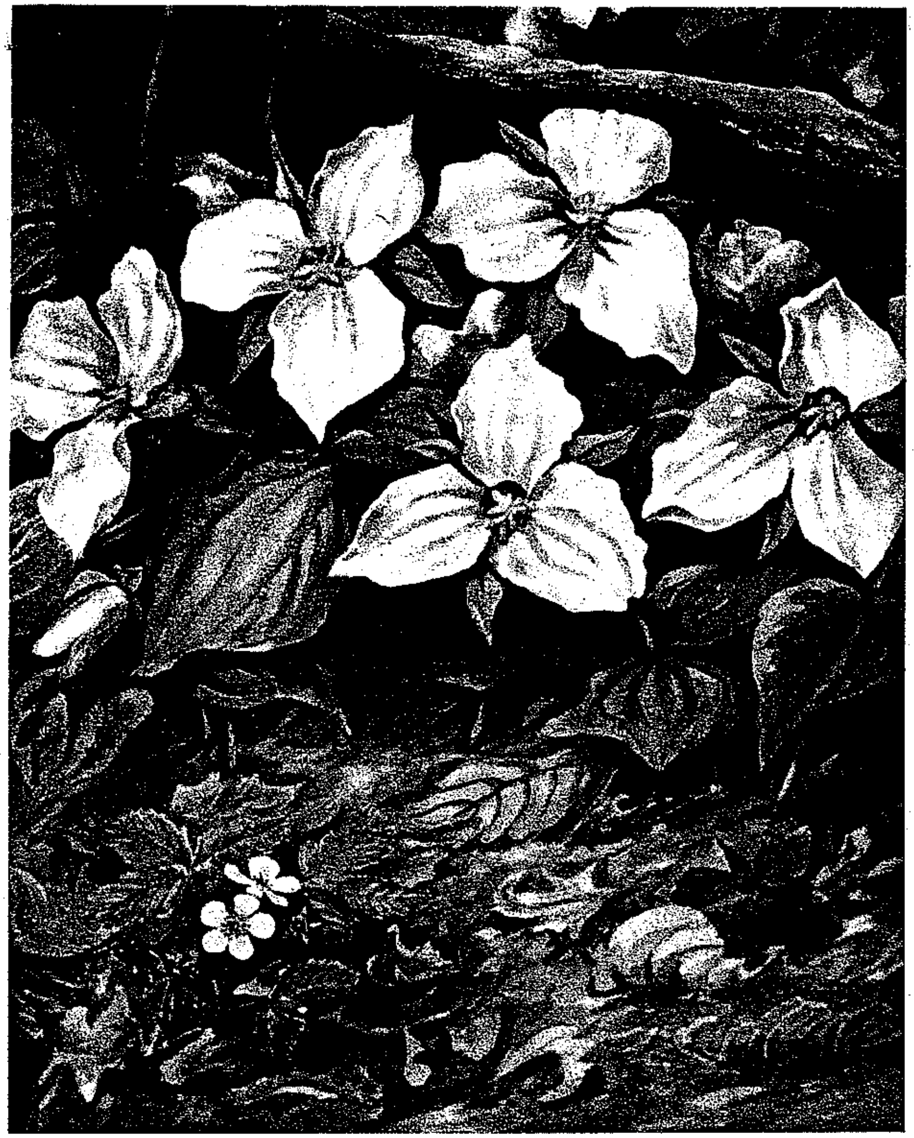
Logging over the past 150 years has dramatically altered the Northwoods. One of the more conspicuous changes can be seen in the relative abundance of particular tree species. Aspen and paper birch are now common throughout the landscape, though they were historically confined to areas that had recently experienced fire or some other stand-replacing disturbance. In contrast, some late-successional species such as eastern hemlock and white pine have declined precipitously. Past logging operations changed the tree composition of the Northwoods, but forestry is not the only agent of change, and tree composition is not the only ecosystem component that is changing. In recent decades, precipitation has become more acidic, UV-B radiation levels have increased, numerous exotic species have invaded, deer densities have increased, and vacation homes have appeared in the woods and along lakeshores. Taking the broad view, we are witnessing a collision between humans and Nature. This collision heralds a mass extinction event, much like the one brought on by the meteorite that fell from the sky 65 million years ago. In geological time, mass extinction events appear instantaneous. From the human perspective, however, the current mass extinction is largely imperceptible. While we can infer rates of extinction by combining rates of habitat destruction with the species-area relationship, we still see the same plant and animal species we saw ten years ago. Ecologist John Magnuson (1990) calls this paradox "the invisible present." He recognizes that we are limited in our ability to perceive changes that take place over decades.

The problem of the invisible present can be clarified if we understand today's patterns as trends over time. Consider, for example, the cerulean warbler. In the 1999 North American Breeding Bird Survey, there was an average of 0.2 birds per route. By contrast, the black-throated green warbler averaged 3.0 birds per route, much more abundant than the cerulean warbler. Since these numbers represent single points in time, they have no historical context. If we were satisfied to say that there are probably fifteen times more black-throated greens than cerulean warblers in the world, we would miss a far more important trend: populations of cerulean warblers declined at the rate of 4% per year since 1966, whereas populations of black-throated greens remained relatively constant (Sauer et al. 2000). The broader temporal perspective gives context to observations made in the invisible present. North American birds represent the taxonomic group for which we have the best long-term data. In Wisconsin, frog and toad populations have been monitored since the 1980s (and most species are declining). But birds, frogs, and toads represent an exception to the rule—what we know about most species is veiled by the invisible present. This is particularly true for the smaller and less conspicuous species and for regions not yet hosting long lists of endangered species.

At site 3045 in Brunet Island State Park, amid the buzzing of orbiting deer flies and the incessant chatter of a red-eyed vireo in the canopy, come the calls of species tallies: "Quad 18. *Carex pennsylvanica, Maianthemum canadense, Trientalis borealis, Uvularia*—no, *Polyganatum pubescens*." Members of our field team are on their hands and knees, identifying and recording seedlings, shrubs, and herbaceous plants. This forest understory contains most of the forest's plant diversity. An acre of forest that might have ten species of trees often has a hundred or more herbaceous and small shrub species. These species, too, reside in the invisible present. One way to chart the changes in plant diversity in the woods is to establish study plots and monitor species changes in the understory layer over time. This exercise will take time to yield insights into vegetative change, and such studies may not tell us much if the area has already been degraded. Alternatively, we can seek out old but reliable plant survey records and revisit those sites to determine which species have declined in abundance and which have increased.

We are fortunate to inherit a legacy left behind by Wisconsin ecologist John Curtis and his students and colleagues. For 16 years in the 1940s and 1950s, they combed the state's forests, prairies, savannas, and swamps, systematically recording the plant species they encountered. These efforts culminated in Curtis's landmark 1959 book, *The Vegetation of Wisconsin*, which provided a comprehensive picture of the state's botanical diversity and helped change the way ecologists think about ecological communities. Curtis hardly anticipated, however, how valuable these data would prove as a baseline to document statewide changes over the last fifty years. We are now using his records to assess the widespread, but mostly invisible, changes occurring in the Northwoods. Perhaps if the results are dramatic enough, they may influence the way people think about conservation.

Leach and Givnish (1996) have already tapped Curtis's extensive data to study patterns of species loss across the small and scattered patches of remnant native prairie. They revisited 54 prairies, and found extinction rates varied from 0.45% per year in dry prairies to 1.03% per year in wet prairies. The species-area relationship was a good predictor of the number of species that remained in these small patches, but there was more to the story. The species that disappeared from the prairies were small-statured, had small seeds, or formed a symbiotic relationship with nitrogen-fixing bacteria. In other words, extinction was concentrated in plants that depended on periodic fires for their persistence, and smaller areas are prone to reduced fire rates as well as species loss.



A ranger informed us that in the 1980s, *Trillium grandiflorum* was common in the stand. Today, there are no trilliums to be found, and the forest floor is dominated by grasses and sedges, looking more like a neighborhood lawn than a forest understory.

In the summer of 2000, we began re-surveying Curtis's northern hardwood stands to document patterns of understory extinction and colonization through time. While we have only begun to analyze the data, what we have observed in the field has been sobering. An amateur naturalist visiting Brunet Island State Park might be charmed by the large hemlocks, basswoods, red oaks, and sugar maples that line the Timber Trail. What may go unnoticed, however, is the herbaceous understory beneath the trees. A ranger informed us that in the 1980s, *Trillium grandiflorum* was common in the stand. He also told us that in recent times the area had too many deer (aided, sometimes, by unwitting human accomplices; local news once lauded the efforts of an area woman to feed over seven tons of corn to wintering deer). Today, there are no trilliums to be found, and the forest floor is dominated by grasses and sedges (collectively termed graminoids), looking more like a neighborhood lawn than a forest understory. When Curtis surveyed the stand in 1949, he found 25 understory species in an area of 20 square meters. When we returned to the site in the summer of 2000, we found 16 species in a more extensive survey area of 120 square meters. There has been at least a 36% loss in understory plant diversity. The understory species composition is converging into a few resistant groups, namely the graminoids.

Our current work is a logical extension of "then and now" comparisons of temperate forest understories conducted elsewhere. Warren Woods is an old-growth beech-sugar maple forest in southwestern Michigan; between 1933 and 1974, there was a 15% decline in the number of herbaceous understory species present (Brewer 1980). In Europe, Poland's Bialowieza forest is an old-growth oak forest that lost 45% of its 133 understory species between 1969 and 1992 (Kwiatkowska 1994). Middlesex Fells, a now-isolated 400-hectare woodland park in Boston, lost 37% of its 422 original species between 1894 and 1993, while 64 new species appeared (Drayton and Primack 1996). Most of these new species were exotics. The most startling data comes from areas where deer populations are large. Heart's Content is an old-growth hemlock-beech stand in northwestern Pennsylvania; between 1929 and 1995, one portion of

Trillium grandiflorum by Dorothy Black

the stand had lost 59% of its flora, while the other had lost 80% of its flora. All told, the diversity of plant families declined from 27 to 10 between the two censuses (Rooney and Dress 1997). Piney Point is one of the few remaining ancient red pine-white pine stands in northern Wisconsin. Between 1949 and 1999, the stand lost 48% of its 27 original understory species (Rooney and Millam 2000). While we strongly suspect such losses are occurring elsewhere, sets of baseline data are rare.

So far, we have revisited 59 of Curtis's original hardwood forest stands, sampling each more intensively than he did to be sure that missing species do not reflect inadequate sampling. At this stage, we have more questions than answers. We think species loss will be highest at sites where deer browsing intensity is greatest. We also suspect species loss will be highest at sites invaded by exotic plants. We anticipate certain species will be more vulnerable to local extinction than others. If we are correct, we expect (based in part on metapopulation theory) plants with restricted seed dispersal to be more vulnerable to local extinction than plants with seeds that are widely dispersed (and hence have greater colonizing abilities). Also, because they are more vulnerable to deer browsing, we expect plants in the lily and orchid families to be more prone to local extinction than the graminoids. If our general line of thinking is correct, we foresee different forest communities converging in their species composition. In other words, we will start to see the same plants in an oak-maple stand that we find in a hemlock-beech forest, indicating that our regional flora is becoming more homogenous.

WORLDWIDE, MANY SPECIES ARE SPIRALING TOWARD extinction. As Hobbs and Mooney (1998) point out, extinction is only the end of a process involving the progressive loss of local populations. For most species, we know little about this process, but can learn more by studying patterns of loss and biotic processes—such as shifts in disturbance regimes or the abundance of associated competitors, herbivores, and diseases. Some of these processes may be catalytic or irreversible. For example, the loss of an ant species could doom populations of violets or Dutchman's breeches that depend on these ants for dispersal. Declines in these spring ephemerals, in turn, could open up habitats to the invasion of exotics like garlic mustard, leading to further declines in native plants. Such processes are often obscure and difficult to predict, though clearly, weedy, widespread species that benefit from human disturbance are increasing in abundance.

Thus, we can classify species as losers or winners, depending on how they respond to human-driven environmental change. In the Indonesian rainforest, 22–33% of bird species were found to be intolerant of selective logging, while 11% benefited (Marsden 1998). In Wyoming river drainages, 46% of all fish have declined since the 1960s, and 14% have increased (Patton et al. 1998). In the Sierra Nevada mountains, 88% of the frogs and toads declined since 1915, and 12% became more abundant (Drost and Fellers 1996). In each case, the causes of population declines differ, but the general pattern remains the same. If present trends continue, numerous native and often locally distributed species will be replaced by a few widespread, weedy species (McKinney and Lockwood 1999). We are on a trajectory towards an homogenized biosphere.

As these trends continue, we find ourselves living increasingly on what David Quammen (1991, 1998) has termed a "planet of weeds." Many, perhaps most, of the losers will not disappear entirely. Instead, they will simply disappear from many of their current haunts, but still thrive here and there for reasons unknown. The winners will expand their ranges and move into communities vacated by the losers. The complexity and time-delays inherent in ecosystems ensure that our biota will continue to change even after we have acted to preserve it, often for reasons that won't be apparent without careful study. In his essay "The Land Ethic," Leopold (1949) described how the land has adjusted to humans in western Europe. Over thousands of years, swamps were converted into pasture, and forests were converted to fields and towns. Plants and animals that could not cope with these transformations retreated to the wildest areas or were extirpated.

Thus, it comes as no surprise that many of North America's weeds first emerged as winners in Europe's historic biotic homogenization. The latest unanticipated threat to Northwoods plant communities appears to be massive soil disturbance resulting from advancing waves of exotic earthworms. Who would have predicted that fishermen discarding nightcrawlers could be contributing to the simplification and restructuring of Northwoods plant communities?

Thankfully, trend is not destiny. We have a formula to halt and reverse the process of biotic homogenization. Parks and reserves are needed, but they alone are not sufficient. We also need restoration and rewilding (Soulé and Noss 1998). We need to preserve or restore the important biotic interactions that have maintained biodiversity since time immemorial. We need to limit the emissions of pollutants to the level where production equals the rate at which ecosystems can absorb, degrade, or assimilate them. This is the task of biological conservation.

In his essay "Hard Times for Diversity," David Ehrenfeld (1993) suggests that if we, as a society, relearn to value plants and animals for their own sake instead of their instrumental or utilitarian value, we will discover that we are no longer destroying the world. *Streptopus amplexifolius* (the clasp-leaf twisted stalk) has all but disappeared from mainland Wisconsin. This plant is not a keystone species. To our knowledge, it lacks specialist pollinators or herbivores. The species was never common, though it is growing increasingly rare due to deer herbivory. To find this plant today, botanists travel to deer-free islands in Lake Superior. A hundred years from now, should biological conservation succeed, *Streptopus amplexifolius* populations may again inhabit the mainland. Biologists will tell the story of how the species was almost lost, not because we did not know how to maintain populations, but because we did not have the will to do so. ☾

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POETRY

All Green

All green
things
are grateful
all fungi
rejoice
bark
shines
puddles
jump
in rain.

—Elizabeth Caffrey

Illustration by Dorothy Black