Interconnectedness at The Ridges Sanctuary



Explore what makes this place so speacial

Jackson Graham

Table of Contents

Introduction pg. 3

Parasitism pg. 4

Mycotrophy pg. 6

Commensalism pg. 8

Mutualism pg. 12
- Lichen pg. 13
- Pollinators pg. 14
- Seed Distribution pg. 16
- Host Plants pg. 17
- Nitrogen Fixation pg. 20

Threats pg. 21
- Invasive Species pg. 22
- Disruption pg. 24

The Human Connection pg. 25

Exploring an area as beautiful and diverse as the Ridges is a pleasure that not enough people get to experience. It is such a unique ecosystem with so many rare and exceptional flora and fauna. It can be easy to get lost in the natural splendor of the sanctuary, missing how connected everything is. From the tallest spruce to the smallest insect, every organism plays a pivotal role in creating these majestic woods. All of it is important to conserve. No flower, fungi, or shrub is insignificant. This guidebook won't touch on every connection in the Ridges, but I hope it illustrates just how vital each part of this ecosystem is. We have a massive responsibility to care for this place, and you can only realize that responsibility when you see how interconnected everything is.



Photo by Andrew Pirrung

Parasitism

A relationship between two species, where one benefits and the other is negatively impacted.



Dwarf mistletoe has a parasitic relationship with spruce trees. By hijacking the vascular system, it absorbs sugars and water from the tree. Infection causes abnormal growth in spruce trees, causing witch broom formations which provide habitats for birds and squirrels. Dwarf Mistletoe spreads by sending seeds airborne to other trees at an initial velocity of 97 km/hr. While being a parasite, they are not invasive and are a natural part of the life cycle in the forest

Ticks are probably the most well-known of the parasitic organisms found at the Ridges Sanctuary. We can find Deer, Dog, and Lone Star ticks. All these species attach to a host and feed on its blood. They carry many different diseases, including Lyme disease.



Deer Tick by Erik Karits



Indian Paintbrush by Thomas Keller

Indian Paintbrush is an incredibly beautiful flower. However, many people often mistake what part is actually the flower. The orange bracts, which are modified leaves, are often confused for petals. It is the yellow tips that are the real flowers. Indian paintbrush is considered a hemiparasite, meaning it can produce its own energy but needs other organisms for the bulk of its nutrition. To do this, they have a specialized root-like structure called a haustorium, which pierces the roots of other organisms, particularly perennial grasses, and leeches carbohydrates and other nutrients from them.

Mycotrophy

A symbiotic relationship between plants and fungi, involving the exchange of nutrients. It can be mutualistic or parasitic (mycoheterotrophy).



Indian Pipe/Ghost Plant contains no chlorophyll, meaning it cannot produce its own energy. Instead, they take advantage of the mutualistic relationship between trees and fungi of the *Russula* and *Lactarius* species. By siphoning nutrients from the fungi, Ghost Pipe plants gain all the nutrients they need.

Most orchids start their life mycotrophic. Orchid seeds lack an endosperm, meaning they have no access to stored energy or nutrients. This forces them to rely on the presence of specific fungal mycorrhizae to germinate in the wild. While most species photosynthesize after germination, some are mycoheterotrophic for their whole life cycle. Most **Coralroot** *(Corallohiza)* species are obligate mycoheterotrophs. These orchids rely on the flow of nutrients from trees to their fungal partners. At the Ridges, you can find the Striped Coralroot, Spotted Coralroot, and Northern Coralroot, which is a partial mycoheterotroph.



Striped Coralroot by UW-Aquatic Sciences Center



Northern Coralroot by Douglas Sherman

Commensalism

A relationship between two organisms where one benefits and the other is unaffected.

Since many orchids don't produce nectar for attracting pollinators, they engage in mimicry to trick pollinators into moving their pollen from flower to flower. This can be done in different ways. The **Ram's Head Orchid** uses visual mimicry to trick small halictid bees into visiting the flower. The coloration of the pouch (labellum) and vanilla fragrance attract the bees. Since there is no nectar reward, they rely on naive bees that haven't learned to avoid them. **Striped Coralroot** utilizes a different type of mimicry. The main pollinator for striped coralroot is male ichneumonid wasps. The labellum of the coralroot evolved to imitate a female wasp and replicates their pheromones to lure male wasps. During their false mating encounter, male wasps collect pollen and carry it to the next flower they visit.



Ram's Head Orchid by Douglas Sherman



Hines Emerald Dragonflies are the only federally endangered dragonfly in the US, and one of the few remaining populations is here at the Ridges. It spends 5 years as a larva living in wetlands, and then spends only a few weeks as an adult. To survive the wetlands freezing in the winter and drying up in the summer, the larva hides in crawfish burrows. While this helps them to avoid extreme temperatures, it also puts them in direct contact with one of their main predators. While only vaguely commensal, it is a crucial relationship to the survival of the species.

Female **Willow Pinecone Gall Midges** lay eggs on terminal buds on willow trees and shrubs in the spring. When the larvae hatch, they secrete chemicals that stop the normal growth of the bud and instead cause the growth of scale-like leaves. This forms the gall, which resembles a pinecone. The larvae will spend the winter in this gall, protected from the cold weather by the natural anti-freeze it produces. In the Spring, it emerges to continue the cycle over again. This process doesn't affect the willow.



One of the early successional shrubs that grows in the Ridges properties is the different **Juniper** species. Due to their ability to survive in harsh soil conditions, they proliferate quite well. This can benefit different conifer species growing nearby. The greater soil structure due to the presence of roots provides greater stability for the trees. Junipers are also naturally deer-resistant. They have a strong scent, bitter taste, and sharp needles. All of which deters deer from browsing on them, unless no other food source is available. This helps young conifer trees growing in patches of juniper, since they become less desirable as forage.



Snow Fleas often go unnoticed doing their work year-round. However, they play an incredibly crucial role in our ecosystem. Snow fleas eat leaf litter, fungi, algae, and bacteria. They break down organic matter and turn it into nutrients that is used by the rest of the ecosystem. During this process, they spread fungal spores around the environment, which allows for mycorrhizal fungi to spread to new areas. This increases the range of some plants, and allows for other symbiotic relationships to occur.



Snow Fleas by Hawk Mountain Sanctuary



Photo by Andrew Pirrung

Mutualism

A relationship between two organisms where both benefit.

Lichen

If you've ever been walking in the woods, you'll have seen lichen. Many people mistake it for a type of moss or a form of pollution. However, lichen is made of two distinct organisms. A fungus, which provides the structure, and an algae, which produces the sugars and nutrients both organisms need. Lichen can grow in three stages: first is crustose, which grows flat on the substrate, the second is foliose, which takes a more leaf-like structure, and the final is fruticose, which has a complex 3-D structure. Lichens are also an incredibly important indicator of ecosystem health. They are also able to improve the air quality of an ecosystem. Here at the Ridges, we have many species of lichen. For this guidebook, we will highlight some of the popular species you can find.



Photo by Douglas Sherman

British Soldier Lichen is a fruticose lichen with a very recognizable structure. The lichen forms from the relationship between a *Trebouxia* algae and *Cladonia cristatella*. The red caps are the spore-producing structure, known as apothecia.

Photo by Douglas Sherman



Reindeer Lichen is another fruticose lichen that grows well in boggy soil. It forms from the interaction between a *Trebouxia* algae and *Cladonia rangiferina*.



Powdery Sunburst Lichen is a foliose lichen that can be found growing on hardwood trees. Its bright yellow to orange coloring is a result of the relationship between the fungus *Xanthomendoza ulophyllodes* and a *Trebouxia* algae.

Pollinators

Potentially the most well-known example of a mutualistic relationship, pollination is one of the most important events in nature. Without it, we would witness an extreme loss of biodiversity. While a whole booklet could be written about the pollinators for the flowers found in the Ridges, this booklet will focus on some of the most important and iconic flowers found at the Ridges.



Lyre Leaf Rock Cress by Minnesota Wildflowers



Trailing Arbutus by Marybeth Anschutz



Marsh Marigold

Some of the most important species of flowers found at the Ridges are **Trailing Arbutus, Lyre Leaf Rock Cress,** and **Marsh Marigold**. When winter ends, and insects are looking for food, these are some of the first flowers to bloom and provide nectar. They are particularly important for queen bees emerging from hibernation and preparing to start a new hive. They also provide a source of food for early butterflies and different fly species.



Photo by Libby Humphries

Butterflies and **Moths** are important pollinators for many different species, including Arctic Primrose, Starry Solomon's Plume, Indian Paintbrush, Wood Lilies, Lance-leaved Coreopsis, Columbine, and Dune Goldenrod.

Beetles, while not as prevelant of a pollinator, still play a very important role, particularly with species like Wild Strawberry, Golden Alexander, Milkweed, and the different Goldenrod species.



Photo by Libby Humphries





Bees and **Wasps** play an incredibly important role in the ecosystem of the Ridges. They are pollinators for an incredibly large number of flora found here, including Buffaloberry, Nodding and Big White Trillium, Dwarf Lake Iris, Solomon's Plume, Gaywing, Starflower, Goldthread, Bog Rosemary, Bunch Berry, Labrador Tea, Blue Flag Iris, Twinflower, Showy and Yellow Lady Slippers, Grass Pink and Nodding Ladies Tresses Orchids, Wintergreen, Pink-flowered Pyrola, Turtlehead, and many more.

Flies also play a very important role as pollinators. They pollinate species like Northern Pitcher Plant, Jack in the Pulpit, Yellow Avens, Silverweed, Herb Robert, and Grass of Parnassus.



Photo by Erik Karits

It is important to note that while some flowers do have a single main pollinator, most species at the Ridges are pollinated by multiple or all of these groups of insects.

Seed Distribution

Animals are crucial for different roles in a plant's life cycle, one of which is distributing seeds. For some species like Forget-Me-Nots, this involves a burr that sticks to fur, other times it is as simple as a bird or squirrel eating a berry. However, there is work being done below ground as well that we can't see, and that is what will be focused on for this section.







Ants are incredibly important for the spreading of seeds from some very important plants here at the Ridges. This happens due to a process known as myrmecochory. The seeds of some flowers (Dwarf Lake Iris, both Trillium species, Downy Yellow Forest Violets, and Gaywings) have a nutrient-rich appendage called an elaiosome. The chemical scent from the elaiosome attracts ants, leading them to bring it back to their colony. After consuming the elaiosome, the ants discard the unharmed seed in their waste pits. This provides a fertilizer-rich and safe environment for the seed to germinate in. A similar strategy is used by Trailing Arbutus. Their seed is embedded in a sweet jelly. This similarly attracts ants, leaving their seeds discarded in a waste pit to germinate. This process is incredibly important for the propagation of these flowers.

Host Plants

Insects play an important role for plants, but plants can play as equally important of a role for the insects. A host plant is defined as a plant species that supports the feeding and reproduction of certain organisms. This means that it is crucial for an organism at a certain point in its life cycle.

While **Violets** are often seen as a weed or an undesirable plant, they are an important source of food for larval fritillary butterflies. Fritillaries, in turn are a vigorous pollinator for many other flower species.



Great Spangled Fritillary by Len Villano



Brown Elfin by Thomas Elliott

Bearberry is a host plant for many species, including the Hoary and Brown Elfin. Both species rely on bearberry for laying their eggs and providing a food source for their caterpillars.

Lyre Leaf Rock Cress, while being important for pollinators in early spring, is also a host plant for the West Virginia White caterpillars, a state special concern butterfly.



West Virginia White by Wisconsin Butterflies

Pussytoes are one of the host plants for the American Painted Lady butterfly. Larvae rely on it as a food source.



American Painted Lady by Thomas Elliot



Milkweed is the only plant a Monarch butterfly will lay her eggs on, and caterpillars only feed on milkweed leaves. The caterpillars have developed a resistance to the toxins in the plant and use them instead as a defense against predators.

Creeping Juniper is the host plant for a variety of species, including the Evergreen Bagworm Moth and the Juniper Hairstreak. It is the preferred host plant for the Evergreen Bagworm, but it is the exclusive host of the Juniper Hairstreak.



Juniper Hairstreak by Thomas Elliott

Turtlehead is one of the host plants for the Baltimore Checkerspot butterfly. By consuming the toxins in the plant, they develop a bitter taste for birds



Baltimore Checkerspot by Thomas Elliott



Photo by Luke Collins

Nitrogen Fixation

Part of what has allowed the Ridges to develop into a unique ecosystem is ecological succession. Ecological succession is the change in the type and mix of species in an ecosystem over time. At the Sanctuary, it is what allows for a beach to turn into a coniferous forest. This is often done through a mutualistic relationship between a plant and a nitrogen-fixing bacterium.

At the Ridges, this is done by several plant species. In a research experiment conducted by one of our guided hike leaders, Janet Batzli, it was shown that **Russet Buffaloberry, Speckled Alder,** and **Sweet Gale** all fixed nitrogen in successional areas using *Frankia* bacteria. Russet Buffaloberry was found to be more active in drier, earlier successional areas. Black alder and sweet gale were found to be active in moister, later successional areas. By fixing nitrogen, these plants help provide nutrients for all other flora in the area.

Russet Buffaloberry







Sweet Gale by Reuven Martin

Lupine also helps provide nitrogen for the surrounding ecosystem through their symbiotic relationship with *Rhizobium* bacteria



Lupine by Kimberly Mackowski

Threats

We have a beautiful place here, and it takes more than just appreciating it to help preserve it

Invasive Species

One of the biggest threats to local biodiversity is the introduction of invasive species. Many people conflate non-native with invasive, but they are different. Non-native species aren't naturally present in an ecosystem, but do not cause excessive harm. Invasive species actively out-compete and cause a reduction in biodiversity in an ecosystem. Listed below are some of the invasive species present on the Ridges' properties that we work hard to remove.



Garlic Mustard by Serhii Barkanov

Originally from Europe and Asia, **Garlic Mustard** is one of our more prevalent invasives. Garlic mustard grows much faster than many native species, allowing it to grow and choke out other species before they can grow, disrupting the forest understory. Their roots also release a chemical that damages the underground network of fungi, which native plants rely on. The killing of this fungus may allow ticks to be more prevalent. Garlic Mustard flowers look similar to lyre leaf rock cress, and the West Virginia White can mistakenly lay its eggs on garlic mustard instead.



Canada Thistle

The different **Thistles (Canada and Bull)** are both invasive and have negative impacts on an ecosystem. Both outcompete and crowd out native species, as well as harm the soil composition and hydrology due to their deep roots and nutrient needs. These changes can damage the soil for many years, even after the thistles are removed.



Phragmites by David Kanigan

Another invasive found in the Ridges is **Phragmites**, the common reed. Phragmites grows in wetlands and can cause a decrease in wildlife habitat, reduce plant biodiversity, and lead to changing water levels due to trapping sediment. Since our wetlands are very crucial here at the Ridges, this is a very serious threat.

Some of the other common invasive species found at the Ridges, and all over Door County, are **Dame's Rocket, Forget Me Nots,** and **Lily of the Valley**. All of these are extremely prevalent on the penninsula and all outcompete native species for space.



Dame's Rocket by Thomas Keller



Forget Me Nots by Alexey Chudin



Lily of the Valley by Ilo Frey

Disruption


Labrador Tea

Disruption of the ecosystem at the Ridges could occur in many ways, as it is a very sensitive habitat. The Ridges is a true boreal forest, the southern-most in the United States. This means that we have several species in the sanctuary that would not be present in this region. Some of these are plants, like **Arctic Primrose** or **Labrador Tea**. Others are animals, such as the many **Warbler** species we have, that stop their migration here instead of further north. A boreal forest requires certain temperatures to host the flora and fauna native to those regions. With increasing temperatures, the stability of the ecosystem is increasingly at risk, and the presence of these species is in jeopardy. Some of the research being done at the Ridges is about how the ecosystem and specific flora will respond to the changing temperatures.


Cape May Warbler by Owen Deutsch

Due to the karst geology of Door County, water pollution is also a major concern. Many of our amphibian, bird, insect, and aquatic plant species are very sensitive to changes in water quality. The geology of the Ridges allows for water to easily seep into the swales along with any pollutants. Land disruption is also a worry due to the importance of the soil microbiome for many of our special concern plants.


Photo by Leo Villano

The Human Connection

You and I have a role to play in all of this as well!

Of course, all of what makes the Ridges so special wouldn't exist without the citizens of Bailey's Harbor banding together to protect this land in 1937, and the work of everyone involved since then. The impact of the people at the Ridges is incredibly varied. Our research team at the Ridges, as well as visiting scientists, improve our understanding about species found in the Ridges and the best ways to aid them in our changing world. The land management employees and volunteers maintain the trails and facilities, preventing invasive species from harming local species, as well as helping the trails have a minimal impact on the natural habitat. Our education and programming teams and volunteers provide educational experiences for all ages, helping to pass on a love of nature and a passion for conservation. Our visitors and members play the largest role there is, helping to finance all of these people and projects that allow the Ridges to be a pillar of conservation.

While it can be easy to focus only on the damage that humans are capable of inflicting on nature, we must also remember that our choices can protect and heal nature as well.



Bibliography

“American Ladies and Pussytoes.” Eye on Nature, 12 Jan. 2013, eyeonnature.wordpress.com/2012/05/15/american-ladies-and-pussytoes/.

“Arabis Lyrata (Lyre-Leaved Rockcress).” Blue Stem Natives, www.bluestemnatives.com/product-page/arabis-lyrata-lyre-leaved-rockcress. Accessed 12 Aug. 2026.

“Are Juniper Deer Resistant?” Plant Addicts, plantaddicts.com/are-juniper-deer-resistant/. Accessed 12 Aug. 2026.

Batzli, Janet MacCray, et al. “Distribution and Abundance of Infective, Soilborne Frankia and Host Symbionts Shepherdia, Alnus, and Myrica in a Sand Dune Ecosystem.” Canada Journal of Botany, Canada Science Publishing, May 2005, cdnsciencepub.com/doi/10.1139/b04-044.

“Baltimore Checkerspot Butterfly.” US Forest Service, www.fs.usda.gov/managing-land/wildflowers/pollinators/pollinator-of-the-month/baltimore-checkerspot. Accessed 13 Aug. 2026.

“Corallorhiza Striata (Striped Coralroot) Orchidaceae.” Lake Forest College, www.lakeforest.edu/academics/majors-and-minors/environmental-studies/corallorhiza-striataand160(striped-coralroot)-orchidaceae. Accessed 12 Aug. 2026.

DeLain, Beth. “Creeping Juniper.” JNI Knowledgebase, 28 Jan. 2026, kb.jniplants.com/creeping-juniper-juniperus-horizontalis.

“Dwarf Mistletoe Basics.” Forest Pathology, forestpathology.org/parasitic-plants/dwarf-mistletoe/. Accessed 12 Aug. 2026.

“Elaiosome - an Overview .” ScienceDirect Topics, www.sciencedirect.com/topics/agricultural-and-biological-sciences/elaiosome. Accessed 12 Aug. 2026.

“Elfin Season Is Here .” MBS News, web.colby.edu/mbsnews/2015/05/18/elfin-season-is-here/. Accessed 12 Aug. 2026.

Freudenstein, John V, and Craig F Barrett. “Corallorhiza Striata Is the First Example of a Pseudocopulatory Orchid in North America and an Instance of ‘Double Deception’ in Fully Mycoheterotrophic Plants.” American Journal of Botany, U.S. National Library of Medicine, Apr. 2026, pmc.ncbi.nlm.nih.gov/articles/PMC13103615.

“Garlic Mustard: Invasive, Destructive, Edible.” The Nature Conservancy, www.nature.org/en-us/about-us/where-we-work/united-states/indiana/stories-in-indiana/garlic-mustard/. Accessed 12 Aug. 2026.

Guidi, Michael. “Paintbrush: Colorado’s Vampire Plants.” Denver Botanic Gardens, www.botanicgardens.org/blog/paintbrush-colorados-vampire-plants. Accessed 12 Aug. 2026.

Lichens - Wisconsin State Herbarium, herbarium.wiscweb.wisc.edu/wp-content/uploads/sites/205/2017/10/lichens-of-wi-web-20170515.pdf. Accessed 12 Aug. 2026

Ludin, Matt. “Naturalist Notes: Snow Fleas as Snow Flees.” Yellowstone Forever, 13 Apr. 2026, www.yellowstone.org/naturalist-notes-snow-fleas-as-snow-flees/.

MacQuarrie, Kate. “British Soldier Lichen.” PEI Untamed, PEI Untamed, 20 Nov. 2024, www.pei-untamed.com/post/british-soldier-lichen.

MacQuarrie, Kate. “Willow Pinecone Galls.” PEI Untamed, PEI Untamed, 23 Oct. 2024, www.pei-untamed.com/post/willow-pinecone-galls.

“Milkweed and Monarchs .” National Parks Service, U.S. Department of the Interior, www.nps.gov/articles/000/milkweed-and-monarchs.htm. Accessed 12 Aug. 2026.

North American Orchid Conservation Center, goorchids.northamericanorchidcenter.org/species/cypripedium/arietinum/. Accessed 12 Aug. 2026.

“Plants for Pollinators: Violets.” Xerces Society, xerces.org/blog/plants-for-pollinators-violets. Accessed 12 Aug. 2026.

Rakowski, Julianna. “Lichen: What the Fungus Is It?: U.S. Fish & Wildlife Service.” FWS.Gov, 13 Dec. 2023, www.fws.gov/story/2023-12/lichen-what-fungus-it.

Thistle Plants and Other Invasive Species, www.ernstseed.com/thistle-plants-other-invasive-species/. Accessed 12 Aug. 2026.

Trailing Arbutus (Epigaea Repens) - Awesome Native Plants, awesomenativeplants.info/photo_galleries/photo_pages/epigaea_repens.html. Accessed 12 Aug. 2026.

West, Ashley, and Aaron Steil. “Indian Pipe: A Plant with No Chlorophyll.” Yard and Garden, 16 Aug. 2024, yardandgarden.extension.iastate.edu/how-to/indian-pipe-plant-no-chlorophyll.

“Host Plant - an Overview .” ScienceDirect Topics, www.sciencedirect.com/topics/agricultural-and-biological-sciences/host-plant. Accessed 12 Aug. 2026.

“Invasive Phragmites.” Wisconsin Horticulture, hort.extension.wisc.edu/articles/invasive-phragmites/. Accessed 12 Aug. 2026.

Krouse, Katie. “Nature Notes: Hine’s Emerald - The Hidden Gem of the Sanctuary.” The Ridges Sanctuary, 18 May 2026, ridgessanctuary.org/nature-notes-the-hidden-gem-of-the-sanctuary/.