

## Ordway Prairie Preserve, South Dakota Lichen Interpretive Trail

### For this walk, you will need:

- 1) A small hand lens or pocket magnifier, which magnifies five to ten times normal size (5X to 10X)
- 2) Optional: A foam gardener's pad to kneel on while looking at rocks and bases of trees.

### What to expect:

This trail is basically a mini-course in lichenology. At the end of the trail, you will be able to identify 35 species of lichens found at Ordway, and you will have an understanding of some of the basic terminology, the significance of lichens, how they are identified and how to become an amateur lichenologist. Because there are so few lichen specialists in our region, after you finish this trail, you will be one of South Dakota's top lichenologists!

### Short on time?

If you want to zoom through the trail at top speed, feel free to skip the more detailed Lichen notes in this guide.

### A few lichen basics before we start out:

**What is a lichen?** A lichen (pronounced LIKE-in) is a unique and rather strange plant-like creature made by the fusion of two entirely unrelated organisms:

- 1) A **fungus** (plural: fungi), which provides the protective outer coating and provides nutrients and moisture; and
- 2) An **alga** (plural: algae), the microscopic green or blue-green cells that contain chlorophyll and make food by the process of photosynthesis.

Fungi are familiar to us as mushrooms and bread mold, while algae include the green scum on ponds. When the two organisms are combined in a lichen, they behave as a single organism, and do not resemble either parent. Familiar examples of lichens would include those that make bark or rocks look orange. Many people in our country call them "mosses"—though they are not mosses at all. Lichens have no roots, stems or leaves so they are not actually considered to be plants. They grow on all kinds of rocks and trees, as well as on soil, wood, and concrete. Different species of lichens grow in deserts, grasslands and forests; they are found worldwide from the tropics to both polar regions. Some lichens are among the **slowest-growing** and **oldest-known living creatures** in the world. Based on growth rates, the oldest lichen in Great Britain is estimated to be 800 years old. The oldest known lichen in the world is in Greenland, estimated to be 4,500 years old!

**Will they hurt me?** No. You can touch and handle lichens and they won't hurt you at all. In fact, there are some lichens that humans can actually eat. However, there are rare reports of individuals developing a rash if after handling large quantities of lichens over a prolonged period of time—for example peasants in Europe who used to harvest lichens for a living for the dye industry.

**What are lichens good for?** Lichens have an important role in every ecosystem. They provide food for some animals, for example, they are a major part of the winter diet of reindeer and caribou in the far north. In our region, lichens are consumed by land snails, mites and nematodes, and occasionally by deer in winter. Particularly on tree trunks, lichens provide shelter and camouflage for numerous invertebrates. Several birds use lichens as nesting material. Lichens help regulate atmospheric moisture in forests. They play a role in several nutrient cycles, for example, certain lichens are able to take nitrogen gas directly from the atmosphere and “fix” it or convert it into a more usable form. Some lichens help stabilize eroding sands and soils, while others help break down rocks in the formation of soil.

**Of what use are lichens to humans?** Some lichens are sensitive to air pollution and so are used all over the world to assess and monitor air quality, particularly in urban areas. But as to economic value, we might say that lichens are more like songbirds in that they are quite beautiful in themselves and worth preserving, even though they don't have much economic value to humans. Although lichens have been used in the past as medicines, dyes, perfumes, and food, their current economic value to humans is quite limited. This is probably fortunate for lichens!

**Can I grow lichens at home, like in a garden?** Scientists so far have had almost no success at growing lichens in the laboratory or under artificial conditions. If you take one home, it will probably just die—because each lichen needs very special conditions to survive and grow. So for example, the new fad in the Rocky Mountains of selling lichens to display in homes or over the fireplace just causes the slow death of all those beautiful lichens.

**Based on their growth forms, lichens can be divided into three general types.** We will see all three types on the trail:

- 1) **Foliose lichens (leaf-like)**—these are fairly **flat**, and if you wet them with water you can usually **peel them off** their **substrate** (what they're growing on). Foliose lichens often have finger-like **lobes** that reach out or radiate outward from the edges of the lichen.
- 2) **Fruticose lichens (shrub-like or hair-like)**—these grow either **upward** (like tiny shrubs) or else they **hang down** (like hair). Either way, you can **easily pluck** them right off their substrate; they come off easily.
- 3) **Crustose lichens (crust-like)**—these are **VERY FLAT**, and they are so strongly attached to their substrate that you can't possibly peel them off intact; instead, you have to take a chip of the underlying bark or rock with the lichen in order to collect it. Some crustose lichens grow partly *within* the bark or rock, not just on top of it.

**About the Four Sections of this trail:**

We have divided the trail into **four sections**, depending on the *substrate* (what the lichen is growing on). Substrates for this trail include:

- 1) **wood** such as fence-posts;
- 2) **concrete** such as sidewalks;
- 3) **rocks**, including granite and limestone; and
- 4) **bark** of trees and shrubs.

Here at Ordway there are also lichens growing on **soil**, but they are fragile and difficult to find, so we did not include any on this trail.

# PART 1: WOOD-LOVING LICHENS

## Station 1

Go to the wooden fence just in front of the south farmhouse at Ordway Preserve Headquarters; go to the very first upright post (all the way to the south), which has a rain gauge on it.

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### Green Octopus Lichen (Ramalina americana)

*[WHERE TO LOOK: See where the top rail joins the first upright post; look at the thin part of the upright post just in front of that top rail: you'll see a small pale green lichen that looks like a tiny shrub or a green octopus with arms sticking out.]*

This is a **fruticose lichen** that grows upward like a tiny bush. **Please be very careful not to knock it off the fence—it is only loosely attached!** The Green Octopus Lichen is an eastern lichen that is fairly rare on the prairie, particularly this far west. In fact, you may be looking at the westernmost documented sighting of Ramalina americana in this country! It usually grows in full-sun on twigs and branches, but on the prairie, it seems to prefer old wooden fences. However, the Green Octopus Lichen is not the happiest on fences or this far west—here they usually look beat-up and shriveled (by wind and drying). This one is indeed small and shriveled, but valiantly surviving. A healthy Green Octopus Lichen should be larger and the little “branches” should be flattened and longer.

**Lichen Note:** Another green **fruticose lichen**, one that HANGS DOWN instead of growing up like a bush, is Oakmoss Lichen (Evernia prunastri)—which grows on the Pacific coast of the United States. In Europe, Oakmoss is hand-harvested *by the ton* for use in perfumes and potpourris, since some of its chemicals have a delightful fragrance, and they have the unique ability to “fix” fragrances and release them slowly over time. It is estimated that as recently as 1980, more than 8,000 *metric tons* of Oakmoss were harvested annually in Europe by peasants who supplemented their meager incomes by collecting this lichen for cosmetic companies. In our country, Oakmoss does not grow in enough quantity to be utilized commercially.

## Station 2

Look at the upper rail between the first and second posts, about two-thirds of the way over towards the second post. You don't have to be very exact at this Station, since the two lichens we'll see are both growing all over the top rail.

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### Black-Button Lichen (Amandinea punctata)

*[WHERE TO LOOK: See the jet-black polka dots on a pale grayish-white background.]*

This lichen loves wooden fence-posts and fence-rails, and it sometimes grows on the wood of dead trees or on branches that have lost all their bark. It is especially fond of fences where animals are grazed, as it seems to like the nutrient-rich dust.

**Lichen Note:** Each lichen is made up of **fruiting bodies** (in this case **apothecia**, pronounced a-poe-**THEE**-shuh), and “everything else” (called the **thallus**). The fruiting bodies or apothecia make **spores**. On the Black-Button Lichen, the apothecia are the black polka dots (which are filled with spores), while the **thallus** is the gray-white background.

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### Orange-Dust Firedot Lichen (*Caloplaca microphyllina*)

*[WHERE TO LOOK: The brilliant orange lichen that covers much of this fence.]*

This is probably the most common lichen you’ll see on wooden fence posts and fence rails in the Great Plains. It often will turn an entire fence brilliant orange, as it almost does here. Look closely with the magnifier and you will see myriads of tiny orange granules, which are like tiny “seeds” called **soredia** (pronounced so-REE-dee-uh) that almost cover the surface of the lichen.

**Lichen Note:** Lichens have several ways of **reproducing**. The simplest way is for part of the lichen to break off and roll away like tumbleweed, then start growing somewhere else. Two common ways for prairie lichens to reproduce are by **spores** (made in the apothecia) or by **soredia** (little seed-like granules produced at the surface of the thallus). Usually lichens will make *either* spores or soredia, but not both. However, we will see some lichens today that do actually make both—perhaps giving those lichens a reproductive advantage.

**What’s the difference between spores and soredia? Spores**, made within the fruiting bodies or apothecia, generate **ONLY** the FUNGAL partner when they germinate—so that in order for a spore to create a new lichen it must “capture” living cells of exactly the right species of algae in order to start growing into a lichen. In contrast, **soredia** are already complete: each soredium is consists of a few outer protective fungal cells wrapped around a few inner algal cells, so each soredium is ready to make new lichen wherever it lands.

**How are spores and soredia spread?** By wind, by splashing rain, by birds landing and getting them on their feet, etc.

### **Station 3**

Go to the second fence post to the north and look on the front (east) side of the post, near the top.

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#### **Black-eyed Day-glow-green Lichen (Cyphelium notarisii)**

*[WHERE TO LOOK: See the several square inches of a bright fluorescent-green area.]*

This is one of the most brilliantly colored of all lichens on the prairie—it's such a bright shade of day-glow-green sometimes it almost glows in the sun. This lichen loves wooden fences that are in full sunlight. With the magnifier, see the tiny "black eyes" which are actually sunken (**immersed**) cup-like fruiting bodies filled with soft masses of black spores. This lichen is not nearly as common as the two previous fence-lichens.

**Lichen Note:** All the lichens described at Stations 2 through Station 6 are **crustose lichens**.

These are very flat and so tightly stuck or glued to the substrate upon which they're growing that you can't possibly pluck them off or even peel them off with a knife. In order to collect a crustose lichen, you must carve off or chip off a bit of the underlying wood (or bark or rock), and take both the substrate AND the lichen as part of the specimen— all in one piece.

### **Station 4**

Look on the **flat top** of the fifth fence post to the north.

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#### **Stonewall Rim Lichen (Lecanora muralis)**

*[WHERE TO LOOK: See the eye-catching pale-green lichen, about the size of a dime]*

This species of lichen is found on stonewalls and rocks over most of the United States. The one on this fence post is rather courageous because normally this lichen doesn't grow on wood; it grows best on rock or concrete. We'll see it again, a bit happier, growing on **concrete** at Station 7 and on **granite** at Station 10. Stonewall Rim Lichen is a crustose lichen even though the thallus looks fairly thick and has lobes around the edges. It is stuck so firmly to its substrate (whether wood, concrete or rock) that you cannot possibly peel it off in one piece—it would just come apart into many small fragments. Stonewall Rim Lichen likes to grow where birds perch and fertilize the substrate. The fact that this lichen is growing here on the top of this fence post suggests that this is a favorite bird-perch.

**Lichen note:** Many lichens are very picky about where they grow and what they grow on. Each species has its favorite substrate(s) and its favorite growing conditions.

Some are so picky that they only grow on the bark of certain types of trees. Others will grow on acidic rock (for example granite) but not on alkaline rock (such as concrete or limestone). Some need a bit more moisture and shade and so must grow near the moist ground or in cool shaded crevices of bark or rock. Some lichens only grow on soil. Lichens are said to be confined to microhabitats—meaning that even if they have the proper substrate, all the other growing conditions must be just right as well in order for them to grow or survive. For example, a lichen happily growing on a large rock might not be able to survive on that same rock just 1 or 2 inches away!

**Treasure Hunt:** At Station 4, see if you can also find two small **Green Octopus Lichens**.

### **Station 5.**

Go midway between the sixth and seventh fence posts to the north and look at the top rail.

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#### **Hagen's Rim Lichen (Lecanora hagenii)**

*[WHERE TO LOOK: see the crowded BROWN apothecia with white rims (margins). Be careful not to confuse it with the Black-Button Lichen, which is mixed in.*

This is another crustose fence-post lichen that is very common on the prairie. The spores are made in the central BROWN part of the apothecia. The bright white **margins** (rims) around the apothecia help tell this lichen apart from the other fence-lichens here. Look along the top rail to the right and to the left to see different forms of Hagen's Rim Lichen. The apothecia have many different shapes and sizes, but the centers are always brown.

**Lichen Note:** Because so few people in our country have paid attention to lichens, very few lichens in the United States have common names. This is very different from songbirds or wildflowers or trees that typically do have common names, such as cardinal, bluebird, sunflower, rose, oak or maple. Lichenologists—even amateur lichenologists—get used to using the **scientific names** (which are given in parentheses in this Trail Guide). At first, scientific names can be very difficult to learn. So a few years ago, a Canadian lichenologist, Dr. Irwin Brodo, created common names for most North American lichens. These names are a great aid to newcomers trying to learn about lichens. Unfortunately, if you try to talk to a lichenologist by using one of these common names, the lichenologist won't have a clue which lichen you're talking about! Still, the common names serve a useful purpose, and we have used them in this Trail Guide. Sometimes the names created by Dr. Brodo don't quite fit our situation, and sometimes our Ordway lichens aren't in his book so we have freely made up a few names of our own. Dr. Brodo used a good system for creating common names: the last name corresponds to the scientific *genus*, and the first name

corresponds to the particular *species*. So for example, the various “Rim Lichens” all belong to the genus *Lecanora*, while the many “Firedot Lichens” all belong to the genus *Caloplaca*.

## **Station 6**

On the upper surface of the top rail, between the last two posts in this section of fence.

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### **Common Goldspeck Lichen (*Candelariella vitellina*)**

*[WHERE TO LOOK: look for the brilliant yellow-orange diamond-shaped lichen about 0.75 inch long]*

This lichen consists of a cushion of many crowded yellow-orange apothecia in the middle, and flattened yellowish-orange granules (the thallus) around the edge. This Goldspeck lichen is another lichen that should be growing on ROCK instead of on WOOD—so the one here is unusually courageous or tenacious. Many lichenologists have never seen Common Goldspeck Lichen growing on wood before, but here in the Great Plains such a sight is not uncommon.

**Lichen Note:** In Great Britain, where many people know more about lichens than Americans do, more of their lichens really do have **common names**. By 1981 British law, all rare or endangered lichens in their country must have an English or common name (to raise public interest in those species). Another project that helped the British gain awareness of their lichens was a recent nation-wide lichen survey done by their grade-school children, who monitored and reported on the pollution-sensitive lichens in their own towns. Just as in our country a person might go for a Sunday afternoon Bird Walk, a Brit might go for a Lichen Walk! We hope to get more people in North America interested in lichens too.

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### **Apothecia of Orange-Dust Firedot Lichen (*Caloplaca microphyllina*)**

*[WHERE TO LOOK: Drop down to the lower rail and look carefully (a little to the left is best) for the apothecia of this lichen, which are more RED than the rest of the lichen. These dark-red apothecia are hard to spot.]*

Orange-Dust Firedot Lichen often just makes **soredia** for its reproduction. But occasionally, under favorable growing conditions, it will also produce apothecia and make **spores** (as seen here).

**Lichen Note:** The genus name for Firedot lichens, *Caloplaca*, comes from the Greek words meaning “beautiful plate”—named for the beautifully colored round disks of the apothecia.

## PART 2: CONCRETE-LOVING LICHENS

### Station 7

Walk to the first square of sidewalk just outside the office door.

There are three common sidewalk lichens here:

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#### **Sidewalk Firedot Lichen (Caloplaca feracissima)**

*[WHERE TO LOOK: This is the one that turns the whole sidewalk ORANGE.]*

Look carefully at this lichen with the magnifier. Note that the Sidewalk Firedot Lichen is made up entirely of brilliant orange **apothecia**—and there is no visible thallus. The thallus of this lichen actually grows invisibly within the concrete itself. Anytime you see an orange sidewalk, it's probably the many apothecia of the Sidewalk Firedot Lichen causing the orange color. This is a very common lichen, which lives all over northeast and north-central U.S., even in the middle of our largest cities.

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#### **Elegant Sunburst Lichen (Xanthoria elegans)**

*[WHERE TO LOOK: The brilliant orange foliose lichen that has a thick thallus which stands up a bit from the sidewalk; it has crowded orange apothecia in the center of the thallus, and lobe tips that radiate outward at the edges.]*

**Lichen Note:** FINALLY, we have gotten to the THIRD type of lichen: the **Foliose lichen**. Foliose lichens are “leaf-like”; they often have a distinct lower surface, and are typically THICKER than crustose lichens. If you were to wet this lichen with water, you could carefully and slowly peel it off the concrete with a pocketknife. Also, note the “branches” or **lobes** that radiate or reach out at the edges, which is typical of foliose lichens.

At Ordway, there are many foliose lichens on **bark**, but the Elegant Sunburst Lichen is one of the few foliose lichens here that can survive on rock and concrete. It is also one of the most beautiful and eye-catching of our Ordway lichens. Because this lichen grows best on rocks that are fertilized by the droppings of birds and mammals, Inuit hunters use the presence of this lichen to help them locate the burrows of hoary marmots. Unfortunately, as Dr. Brodo notes in his book on North American lichens, poachers also use this method to find the nests of peregrine falcons. We'll see the Elegant Sunburst Lichen again at Stations 18 and 34, growing on limestone instead of concrete.

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### Stonewall Rim Lichen (Lecanora muralis)

*[WHERE TO LOOK: It's the prominent pastel-green lichen with pale orange-brown apothecia in the center; some of the lichens here have a white "frosting" (**pruina**) on the surface, and so look more **white** than green.]*

We saw this lichen previously on wood at Station 4, but it likes concrete and limestone best—it's a bit unusual on wood. Look at several of these lichens closely on the sidewalk and notice the crowded orange-tan apothecia in the center. These are making spores. Also note that some of these lichens have a white "frosting" on the surface, or a white coating called **pruina** (**prew-EYE-nuh**), which probably consists of calcium oxalate crystals secreted by the lichen.

**Lichen note:** Some lichens need rocks that contain calcium—such as limestone or concrete. Normally a lichen that will grow on concrete can also grow on limestone, and sometimes vice versa. In fact, all of these Concrete lichens at Stations 7 through Station 9 can also be found on limestone. Other species of lichens need acidic rocks such as granite for their substrate—we will see a number of those further ahead on the Trail.

### **Station 8**

Move over to the next square of sidewalk to the west, and then look **8 inches** in from the northeast corner of that square.

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### Black-and-White Firedot Lichen (Caloplaca nigrosorediata)

*[WHERE TO LOOK: See the faint smoky-gray area 2 or 3 inches in diameter; look closely with the naked eye and see it's made of tiny white "plates" (**areoles**) with black granules (**soredia**) around the edges of each areole.]*

This Firedot Lichen had never been reported from North America prior to 2004 when it was discovered on an old concrete foundation in South Dakota by one of the team members of TNC's Great Plains Lichen Survey. This lichen is very unusual because Firedot Lichens are usually ORANGE with little or no thallus, whereas this one has a distinctive WHITE thallus with black soredia around the edges of the white areoles. The apothecia of this species are orange but are rarely present. Look with the magnifier and see the tiny white "plates" (**areoles**, pronounced AIR-ee-oles). Around each white **areole** or plate, see tiny black granules—the soredia. No apothecia of the Black-and-White Firedot Lichen are present here on the sidewalk, but we will see those rare orange apothecia at Station 34.

**Lichen note:** At Ordway Preserve, this new-to-North-America species has been found both on old concrete and on white limestone—and the orange apothecia have been found on both substrates here, a very important discovery.

## **Station 9**

Go about 15 feet to the southwest, to the flat-topped 2-foot tall cylinder of concrete located between the parking area and the office building. The lichens are on the flat top.

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### **Scattered Rim Lichen (Lecanora dispersa)**

*[WHERE TO LOOK: These are the small gray islands consisting of crowded groups of apothecia. Each apothecium has a round brown center with a white rim.]*

This lichen has no visible thallus—the thallus grows between the rock crystals so it is buried in the concrete, just below the surface. Only the apothecia of this lichen are visible. The apothecia either can grow in groups as we see here, or scattered about individually (one here, one there). Scattered Rim Lichen is VERY COMMON on both concrete and limestone. It's a real survivor—it can live even in cities.

**Lichen Note:** Lichens are sometimes used as **pollution-detectors** because many species of lichens cannot grow where the air is polluted. Some cities and parks use lichens to monitor the air quality, watching to see whether certain species of lichens are doing well, looking “sick” or dying off.

## PART 3: ROCK-LOVING LICHENS

**Hint:** While looking at rocks, try to keep your own shadow off the lichen you're looking at so you can see it better with the magnifier. Some rocks on the Lichen Trail are better visualized during the morning, some at noon, and some in the afternoon—so you must have a lot of patience no matter what time of the day you go. Probably the best time to look at lichens would be mid-day on a cloudy or overcast day (to minimize glare and shadows)—but any time of the day and any amount of sunshine is acceptable.

### **Station 10**

Start at the telephone pole just northeast of the office and walk 50 feet due north. Find the 4-foot wide flat-faced slanted granite boulder that is facing east.

**Lichen note:** Most of the rocks on Ordway Preserve were brought in from the far north by glaciers during the Ice Ages thousands of years ago. The majority of the rocks and boulders here at Ordway are **granite**, but the glaciers also brought down some **white limestone** that we'll see later. Granite comes in different colors and textures, with different-sized grains or particles. Colors may be white, pink, gray, tan or dark—and individual particles can be jet-black, brilliant red or even bright green.

**Lichen note:** Lichens that grow best on tree-shaded rocks are **entirely missing** from Ordway Preserve, because we don't have much shade here on the prairie!

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### **Mint Moonglow Lichen (Dimelaena oreina)**

*[WHERE TO LOOK: See the many small round pale-green lichens growing all over the rock.]*

These are young thalli, much smaller in diameter than a mature thallus would be. Many granite rocks at Ordway are virtually covered with this lichen. Note that each thallus is round, that the outer edge of each thallus has **lobes** that radiate outwards. The center is made of **areoles** that are put together like a jigsaw puzzle, each piece outlined in black. Take a look at several of these Mint Moonglow Lichens and find the “black eye-spots” in the very center of some of the thalli—these are the apothecia (fruiting bodies) making the spores. The apothecia of this lichen are flat to the surface of the thallus. Mint Moonglow Lichen is the **dominant** or most common rock-lichen here at Ordway.

**Lichen Note:** Dr. Irwin Brodo, the lichenologist who invented most of the common names of the Ordway lichens, gave a great gift to the world when he wrote *Lichens of North America*, published in 2001. This fantastic book has over 900 beautiful color photos of lichens, and makes it possible for practically anyone to study lichens in our country. The book tells all about lichens, and then gives details on hundreds of the most common species of lichens in North America. In fact, most of the lichens on this Interpretive Trail have a photo and a description in Brodo's book. Ask at the Ordway

Prairie office to see a copy of this beautiful Lichen book—it's a real treat. But don't plan to take it with you into the field, because it is a huge book and weighs 10 pounds!

**LOOK-ALIKE ALERT!** Note that there are several GREEN lichens on this rock that look a lot like Mint Moonglow Lichen but are not. These look-alikes are actually the **Stonewall Rim Lichen** which we saw over on the sidewalk at Station 7; they have pale orangish-tan or greenish-tan apothecia in the center (instead of black eye-spots), and the color of green is very slightly different compared to the green of the Mint Moonglow Lichen. See if you can find one or two of these look-alike Stonewall Rim Lichens on this boulder. [Hint: One of them is large and is farthest down on the face of the rock.]

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### **Brown Jigsaw Lichen (*Acarospora fuscata*)**

*[WHERE TO LOOK: look for the small dark-brown splotches on the rock, and then use the magnifier to see that these lichens look like pieces of a brown jigsaw puzzle fit tightly together.]*

Each puzzle-piece is called an **areole**. You can see that some have a white “frosting” on them (called **pruina**—a thin coating of calcium oxalate crystals). The apothecia are darker-brown, irregular in shape, and are slightly **immersed** or sunken below the surface of the areoles. Some areoles may have more than one apothecium.

**Lichen note:** Over 600 chemical compounds are produced by various lichen species, and most of these compounds are not known to be made by any other creature in nature. One of these chemicals, **gyrophoric acid**, is produced by the Brown Jigsaw Lichen and is one of four lichen compounds that can be used to manufacture a brilliant red dye. However, you would never be able to collect enough Brown Jigsaw Lichen to get enough gyrophoric acid for dying! Other species of lichens that are much larger and easier to harvest are used in making dyes. Lichens have been used as dyes for centuries; the dye colors range from fawn browns to dark browns to brilliant reds. Lichen dyes are still used to some extent by weavers in Europe.

**Why do lichens make these many “lichen substances”?** Many reasons have been postulated. Some of the compounds are quite bitter, so may keep slugs and insects from eating the lichens. Some of the pigments may gather or scatter sunlight. Some have antibiotic properties and may protect the lichen from attack by bacteria and free-living fungi such as molds and mildews. Some of the chemicals suppress the growth of mosses and higher plants, giving the lichen a competitive advantage. But much of this remains a great mystery—for example why did so many different “lichen substances” evolve? We don't know.

**Treasure Hunt:** Locate the brownish lichen growing in the deepest crevice of this rock [at the left end of the boulder, about 8 inches in from the left edge]—this lichen looks just like DIRT!

Here is a good example of lichens needing a specific “microhabitat”—since this lichen only grows in the deep crevices where it’s cooler, more shaded, and where water pools. We don’t yet know the name of this lichen.

## **Station 11**

Go about 50 feet to the east, angling down the steep south side of the embankment, to the big tall granite boulder (an obvious rock).

See how the lichens love this tall rock! They get plenty of sun here. Note how the lichens fade out toward the bottom of the boulder where it’s heavily shaded by tall grass in summer. Notice that two of our old friends are happily growing here: **Mint Moonglow Lichen** and **Brown Jigsaw Lichen**. We will add three new ones here:

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### **Yellow Jigsaw Lichen (Acarospora contigua)**

*[WHERE TO LOOK: This is the brilliant yellow lichen all over the rock.]*

Note that its puzzle-pieces (**areoles**) are a bit thick and stand up from the rock. The fruiting bodies or apothecia are actually the brownish speckles and thin brown streaks in the center of each areole; these apothecia are partly **immersed**—meaning partly buried in the thallus or at least sunken below the surface of the thallus. Notice at the very edge of this lichen the thallus “fans out” and the puzzle-pieces there have no fruiting bodies. These are the **lobes** or outer tips of the lichen. Usually lobe tips don’t have fruiting bodies. The Yellow Jigsaw Lichen needs full sun in open arid sites.

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### **Dakota Rosette Lichen (Phycia dakotensis)**

*[WHERE TO LOOK: The small gray dime-sized lichen on the TOP of the rock.]*

This lichen is a brand new species to the world, so far found mostly in the Dakotas on granite. It’s actually intermediate between a foliose lichen and a crustose lichen—because you can’t really peel it off the rock, but all of its “close cousins” are foliose lichens (namely all the other Rosette Lichens, we’ll see more of them later). In the center of the thallus, see two kinds of reproductive systems: 1) round black apothecia with white rims (making **spores**), and 2) the abundant tiny dark granules (**soredia**) lying all over the top of the lichen. The Dakota Rosette Lichen is one of the most common lichens on glacial rocks of the northern prairie. Here at Ordway it’s extremely common near the office, but missing entirely from some parts of the Preserve (we don’t yet know why).

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### Common Goldspeck Lichen (Candelariella vitellina)

*[WHERE TO LOOK: Down the back edge of the boulder to see the myriads of small GOLDEN-YELLOW islands.]*

Many of the “islands” (particularly the larger ones) have crowded orange apothecia that are making spores. This is the lichen we saw previously over on the fence—but you can see it is more abundant on rock, which is its typical home.

**Lichen Note:** At Ordway, the Common Goldspeck Lichen sometimes carries a tiny parasitic Firedot lichen on its surface. We’ll see this unusual parasitic lichen at the next station. Very few lichens in the United States are **parasitic** (meaning they steal sustenance from another living creature).

### **Station 12**

Go six feet northeast and slightly up the slope, to the CLOSEST boulder to Station 11.

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### Piggy-Back Firedot Lichen (Caloplaca grimmiae)

*[WHERE TO LOOK: First look for the obvious Brown Jigsaw Lichen, which is about 0.75-inch long and is located about 9 inches “in” from the top corner; then go to the left of that to see the Orange Rock-Island Lichen. With the magnifier, see two brilliant RED apothecia sitting right on top of the Orange Rock-Island Lichen.]*

This is one of the most difficult lichens to find on Ordway Preserve because it’s so tiny! This parasitic lichen always rides on the back of Orange Rock-Island Lichen, and cannot live by itself because it depends on the other lichen for sustenance. Piggy-Back Firedot Lichen is almost invisible to the naked eye, although if you have excellent eyesight you may be able to see it as a tiny red dot on top of the Orange Rock-Island Lichen. Whenever our Great Plains Lichen Team finds the Orange Rock-Island Lichen, we always look very carefully to try to find the Piggy-Back Firedot Lichen sitting on top—it’s a thrill to find one! Because the Piggy-Back Firedot Lichen is so hard to find, it has rarely been seen or collected in the U.S. We don’t really know if it’s rare or not, as it may simply have been overlooked all these years.

### Station 13

Just three feet up from Station 12, see the four-foot long granite boulder facing north, at the top of the ridge.

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#### Granite Firedot Lichen (Caloplaca cf. arenaria)

*[WHERE TO LOOK: As you are facing SOUTH and looking at the face of the boulder, look at the upper part of the right-hand end of the rock. See the groups of orange apothecia.]*

This is a real find! At first, we thought this was going to be a new species to the world, but then it turned out this may instead be a new form of a previously known species, the Granite Firedot Lichen. Other Granite Firedot Lichens previously found in the U.S. have **no visible thallus** (the thallus grows within the upper layers of the rock and is invisible or barely perceptible), whereas this one has an underlying white or gray thallus. Also, see the tiny black speckles here and there on the thallus—these may turn out to be soredia (they have not yet been studied)—in which case this WOULD be a new species. Ordway Preserve has the richest source of this new form that we know of so far. It's very exciting to have this possible new species here at Ordway.

### Station 14

Go about 15 feet east and a little north of Station 13, on top of the ridge; see a ground-level 1.5-foot-diameter granite boulder. There are several interesting lichens at this station.

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#### Dark-Gray Map Lichen (Rhizocarpon disporum)

*[WHERE TO LOOK: Kneel at the north edge of the rock, you facing south: see the two dark gray thalli just a little above the center of the rock.]*

The lichens in this group are called Map Lichens because the shape of the thallus is typically irregular, and the outer edge of the thallus is outlined in black—like a country on a map. The thin black rim all the way around the thallus is called a **prothallus**, and is a distinguishing feature for this lichen. The prothallus here is more easily seen on the UPPER of the two lichens. With the magnifier, observe that the black apothecia of this lichen grow BETWEEN the areoles instead of in the center of areoles as is usual with most lichens species.

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**Speckled Cottage Cheese Lichen (Aspicilia cinerea)**

*[WHERE TO LOOK: Just below the Dark-Gray Map Lichens.]*

This lichen is fairly common at Ordway, often attaining a large size (several inches across). Note it is composed of thick rounded **areoles**, which look a bit like the curds of cottage cheese. The one on this rock does not have apothecia, but elsewhere on other rocks apothecia are fairly common and easy to spot (large black disks with thick white margins). Notice the black speckles all over the surface of this lichen, a distinguishing feature that is not always present.

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**Chisel-Steel Lichen (Aspicilia contorta)**

*[WHERE TO LOOK: Find this hidden gray lichen growing in the crevice that is just to the left of and slightly above the Dark-Gray Map Lichen.]*

The tall pillar-like cylinders with the chiseled-out centers are the areoles. Each deep “pit” or chiseled hole houses an apothecium at the bottom of the pit. This is a very distinctive and unusual-appearing lichen.

**Station 15**

Head down the ridge to the southeast toward the closest big metal gate; go 100 feet, and stop at the big granite boulder at the bottom of the next rise; the boulder measures 4 feet across. There are two interesting lichens here:

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**Gray Cottage-Cheese Lichen (Aspicilia limitata)**

*[WHERE TO LOOK: It's the big thick gray lichen sneaking down the north face of the rock.]*

Look with the magnifier at this lichen’s thousands of tiny black apothecia. The lumpiness of the thallus looks a bit like cottage cheese.

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**Green Rock Posy (Rhizoplaca subdiscrepans)**

*[WHERE TO LOOK: These are the little pale-green mounds and heaps, all over the east-facing side of the boulder.]*

This lichen loves acidic rocks fully exposed to the sun. It often grows with its cousin, the White Rock Posy, which we'll meet at the next Station. Note that the apothecia are convoluted and together look like tiny bouquets of daisies or posies.

**Station 16.**

Go ten feet due south to the next big boulder, which is almost covered with Green Rock Posies.

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**White Rock Posy (Rhizoplaca chrysoleuca)**

*[WHERE TO LOOK: if you look carefully amidst all those Green Rock Posies, you'll find the occasional WHITE ones with big orangish-brown apothecia.]*

**How to tell the two Rock Posies apart:**

**Green Rock Posy:** Has a green thallus of small bulbous warts and pale orangish-green apothecia; usually more difficult to pluck or peel off the rock.

**White Rock Posy:** Has a white foliose thallus and orangish-brown apothecia; usually easy to pluck off the rock, since it's stuck to the rock in only one place on the underside of each thallus (called an **umbilicate** attachment).

These two Rock Posies often grow together as they do here, and they often take over the entire rock they're on. We're not sure how they manage to be just about the only lichen species on "their rocks"—is there something special about those rocks that makes it difficult for all but the Rock Posy Lichens to grow? Do the Rock Posies somehow suppress the growth of competitor lichens, perhaps by giving off a certain chemical? We just don't know...

**Lichen Note:** Some lichenologists believe these two Rock Posies are the same species, just different color and growth forms. Others believe these are two distinct species.

## **Station 17**

Head due north until you come to the barb-wire fence, then turn west towards the road; when you reach the wooden posts near the road, walk 70 feet due south (heading straight towards the office); find the ground-level fairly-flat granite boulder which is almost covered with:

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### **Black Bug-Eyed Lichen (Lecidea sp.)**

*[WHERE TO LOOK: All over the rock, look for areas of white with dark-black "polka dots."]*

The black "eyes" are jet-black apothecia, which stand up above the surface of the gray-white thallus. The thallus looks gray to the naked eye, but more whitish when viewed through the magnifier. If you look closely, the white thallus is broken into up into tiny white "mounds" which lichenologists say look like tiny "warts." This lichen for some unknown reason is especially common at Ordway.

**Lichen note:** The scientific term for "looks like warts" is "**verrucose.**" Many lichens have a verrucose thallus, consisting of a sea of tiny back-to-back bumps or mounds or "warts."

## **Station 18**

Head for the telephone pole nearest the office (just west of the office) and walk 110 feet south towards the pole. When you reach the slight dip (which is the mouth of the broad ravine), you will see a smooth-faced rock which is about 1 foot tall and 2 feet wide. For best viewing, kneel on the south side of the rock.

This is an unusual rock for Ordway as it is SANDSTONE—not granite or limestone. With the magnifier, you can see the small sand particles in the rock, which were "glued together" under tremendous pressure over a prolonged period of time. In most sandstones, the "glue" is slightly acidic, but we know that this sandstone must be glued together with an ALKALINE chemical (calcium carbonate) because we see so many of the lime-loving, alkaline-loving, concrete-loving lichens on this rock. These include three species that we saw before on concrete:

**Elegant Sunburst Lichen**—gorgeous orange foliose lichen.

**Sidewalk Firedot Lichen**—the scattered or grouped orange apothecia without much visible thallus.

**Scattered Rim Lichen**—see these at the top left and covering the west face of the rock. The apothecia are GRAY in color when viewed WITHOUT the magnifier. Here the apothecia are seen both scattered and in groups; they have brown centers and white rims.

These lichens seem to LOVE the conditions on this locally rare sandstone boulder.

**Lichen Note:** Observe the several “bare spots” on this boulder just above (and a few below) the big crack or crevice. This is probably where Elegant Sunburst Lichens grew some time ago but then were knocked off or rubbed off. These are the only large foliose lichens-on-rocks common at Ordway Preserve. They tend to get knocked off fairly easily. All the rest of the common rock-lichens here are crustose, meaning deeply tied into the rock. Hopefully the rest of these Elegant Sunburst Lichens will survive, hold tight, and not be peeled off (by rain, snow, hail, wind or creatures) any time soon.

See also the scratches or “scar marks” running down the face of the sandstone from the top. Did bison or deer paw at this rock? Did someone sharpen their knife on the rock? Is this a scar left from glacial transport? We don’t know!

## PART 4: BARK-LOVING LICHENS

### Station 20

Head west to the fence corner across the Headquarters Road (i.e. to the black wooden posts), then continue west from the corner for another 20 feet, then turn south and go 10 feet to **the lone tree closest to the fence**.

This tree demonstrates four of the toughest prairie lichens known—since they are able to survive the many harsh elements of the prairie, such as howling winds, blazing sun, rain, hail, snow, drought, etc. These lichens are unsheltered and are fiercely battling for their lives.

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### Star Rosette Lichen (Physcia stellaris)

*[WHERE TO LOOK: It's the big gray lichen that has large BLACK apothecia in the center of the thallus.]*

Under good growing conditions, this lichen fans its lobes out beautifully, like the rays of a star. But here the Star Rosette Lichen is fighting for its life and instead of being a lovely flat star, it is heaped up, chipped off, folded under, retracted, curled, and anything BUT a perfect star or rosette! This is one of the most common lichens on small trees and shrubs. It grows like a “weed” and is found virtually all over the United States. It might be called the “dandelion of lichens” in this country, since it’s about as common as dandelions.

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### Sandpapered Wind Lichen (Physciella melanchra)

*[WHERE TO LOOK: It's the gray-white lichen that almost covers this tree on the west side from ground level to about two feet up or higher.]*

Look with the magnifier and see that all the “high ridges” of this lichen look like they’ve been sandpapered off, leaving only darker greenish-gray “prairie dust” behind. That greenish-gray “prairie dust” in the eaten-away parts of ridges is actually **soredia** which have burst through the upper “skin” (**cortex**) of the thallus and can now spread everywhere via the wind. Sandpapered Wind Lichen is definitely the winner of the Prairie Survival Award, as this species is incredibly tough and competitive. It often completely covers the trunks of prairie trees from top to bottom because it is well adapted to wind and harsh prairie conditions. So don’t feel sorry for this skinned-up Survivor! On the prairie you could also call this one a “weed lichen” since it grows like a weed—and it will grow on practically any substrate including bark, wood, rock, concrete, and even on gravestones!

**Lichen Note:** In Europe, many gravestones are so old (hundreds of years old) that they provide some of the best substrates or habitats for lichens. In fact, there are lichens in Great Britain and elsewhere that are found ONLY on gravestones, and there is even a whole specialty of just studying Gravestone Lichens. However, collecting them is problematic because, while you can peel off the foliose lichens, it

would not be in good taste (or legal!) to chip apart old gravestones in order to collect the crustose lichens. Recently, specialized techniques have been developed so that tiny pieces of the lichens from gravestones can be carried back to the lab for study, without damaging the gravestones.

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### Gold-Eye Cactus Lichen (Teloschistes chrysophthalmus)

*[WHERE TO LOOK: on the north side (fence side) of the trunk, about 4.5 feet up. This is the bright orange, shrubby-looking lichen.]*

This lichen should actually look like an orange “cactus,” with spines sticking out all over it. But you can see this one is really struggling here in the wind and weather, as its cactus-spines are reduced to a few short stubby pitiful things, and the apothecia are small and shrunken. Gold-Eye Cactus Lichen is common on shrubs and trees at the edge of woods where it gets good sunlight. It is a fruticose lichen, you can see it’s growing UP like a bush and it can be easily plucked off the bark. **(But please don’t pluck it off! We need this one for the Lichen Trail!)**

**Lichen Note:** The **fruticose lichens** have historically served as emergency food for humans—probably because they can be so easily harvested by plucking them off their substrates, and also because some of these lichens are quite large and grow in generous quantities so they can be quickly harvested in significant amounts. However, lichens produce acids and other substances that are bitter and can cause stomach upset and diarrhea in humans, so it is usually suggested to pre-treat the lichen before eating it. Suggested treatments include boiling in an alkaline solution (which may be produced by adding wood ashes to water in the pot), or simply soaking them in water for a few hours to dissolve-out the lichen substances. Two main lichens have been used for food by humans over the centuries. The first is called Reindeer Lichen or is erroneously called Reindeer “Moss” (*Cladonia* species) and it grows in profusion on the ground all over the tundra. Reindeer lichen has been a food staple of arctic semi-nomadic tribes such as Laplanders and Inuits, as well as for their reindeer herds. The second food-lichen is Rock Tripe (*Umbilicaria* species), which has been used as emergency-food in Europe and America, and is still consumed in parts of Asia. There are stories of people surviving starvation by eating Rock Tripe as a last resort—including people in famine areas, people lost in the wilderness without food, etc. The author of this Trail Guide has enjoyed eating Dixie Reindeer Moss (*Cladonia subtenuis*) collected in Kansas, pre-treated by soaking in water for a couple of hours, then adding the softened but still-crunchy lichen to Ramen Noodle Soup. She notes that Reindeer Lichen has excellent taste and texture, and is happy to report that she did not get stomach problems or diarrhea from this experiment.

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## Bark Rim Lichens (Lecanora, Amandinea, Rinodina)

*[WHERE TO LOOK: Difficult! Right next to the Orange-Eyed Cactus Lichen and slightly to the right, see a faint darker discoloration of the bark which (with the magnifier) turns out to be groups of brownish-black apothecia with gray-white rims, not visible to the naked eye—in fact quite difficult to find at all. The apothecia are even more luxuriant about 1 inch to the right of the first group, and heading up the tree for a distance of about 6 inches.]*

This is a crustose lichen, which is one of the many Rim Lichens and Rim-Lichen “look-alikes” that grow on bark. We need a compound microscope to look at the spores and other microscopic features before we can identify these to species level.

**Lichen Note: How are lichens identified?** The good news: about 40 to 50 percent of the Ordway lichens can be identified in the field with just a magnifier. The bad news: the other 50 to 60 percent require other identification techniques including:

- 1) **Spot testing**—using chemicals to test for lichen substances while watching for color-change reactions under a dissecting microscope.
- 2) **Spore analysis**—including size and shape of spores, how many spores to a sac, etc. This is done with a compound microscope.
- 3) **Conidia analysis**—checking size and shape of the conidia within pycnidia.
- 4) **Thin layer chromatography (TLC)**—testing for Lichen Substances.

So lichen identification can be challenging, but many of them are easy to identify as noted above. Also, if you have a good checklist of lichens that are known to be present at a given site, you can do pretty well identifying the lichens you find by matching them with photos in the book *Lichens of North America* .

### **Can amateurs do any of the special testing at home?**

By all means, YES! Amateurs can easily do several of the chemical spots tests at home. If they have a compound microscope, they can also learn to do spore and conidia analysis at home.

**Note:** We will now look at some lichens on junipers. Please don't touch the lichens on the junipers, as the bark peels off very easily and could take the lichen with it.

## **Station 21**

Head west to the junipers nearest the fence, and go to the western-most juniper in that row.

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### **Lacy Lemon Lichen (Candelaria concolor)**

*[WHERE TO LOOK: At the **base of the tree**, the obvious brilliant lemon-yellow area.]*

This lovely and delicate lichen is a bit fragile—it needs some protection from wind, plus a bit of shade, and some moisture. So it likes the bases of trees and deep crevices in bark of older trees. On this specimen, the finger-like lemon-yellow lobe tips are mostly hidden by quantities of yellow granules (soredia), which make the tips look lacey or frilly. Lacy Lemon Lichen is normally a bark lichen. However, at the next station you'll see it on granite.

## **Station 22**

Walk 25 feet west to the obvious boulder.

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### **Lacy Lemon Lichen (Candelaria concolor)**

*[WHERE TO LOOK: on the south side of the boulder, near the ground, see the obvious splotch of lemon-yellow.]*

Here, with the magnifier you can better see the delicate tiny finger-like lobe-tips of this lichen. This lichen probably got its start from soredia that blew over from the Lacy Lemon Lichen on the base of the juniper at the previous Station.

## **Station 23**

Look south to the other juniper row, and go to the second juniper west of the gap in the junipers.

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### **Hooded Rosette Lichen (Physcia adscendens)**

*[WHERE TO LOOK: Two thalli are located at about two feet height on the north side of the trunk –one on a dead branch near the trunk, the other growing on the trunk nearby but partly hidden by a dead branch]*

This is a very unusual foliose lichen because as it matures, the lobes grow upright and then fan out at the tips to form little “hoods” with long whiskers sticking out. The hollow “hoods” produce soredia on the under-side (which are difficult to see because the “hoods” hide

them). Unfortunately, the hoods on this specimen are a bit hard to see because they are turned away from the viewer. But look closely and you'll see the long "whiskers" (**cilia**), which may be white or dark or both.

**Lichen Note:** Do lichens have a "blooming season"? Should I look for them at any particular time of the year? No, most lichens are visible all year round, they make spores year-round, and they don't seem to change much from one season to the next. That makes lichens particularly interesting as a hobby—you can see them ANY TIME of the year, except if they're buried under snow!

## **Station 24**

Go to the fourth juniper west of the Station 23 juniper.

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### **|Hairy Shadow Lichen (Phaeophyscia hirsuta)**

*[WHERE TO LOOK: See the lowest large branch coming off the thickest trunk. See the patch of pale gray lichens on the top of the branch. The lichens are very thin. **Caution:** We are NOT talking about the thick white Star Rosette Lichens with black apothecia, which are also on this tree.]]*

This lichen is usually easy to identify because of two special features. First, it has the darker-green granules (soredia) along its margins. Second, it has the unique feature of **tiny short white cortical hairs at the tips of the lobes**. These hairs are just barely visible with the magnifier, but you can see them if you look very carefully. Choose lobe tips that do NOT have soredia—it's here that the white hairs are easiest to see. This is the only sorediate lichen in the Great Plains that has these distinctive white cortical hairs.

**Lichen Note:** The Shadow Lichens, or *Phaeophyscia* (fay-oh-FISS-ee-uh) are a bit darker gray in color than most lichens, it's as if they are hidden in a shadow. These lichens are easy to miss when they are growing amidst other lichens, because their darker shadowy color hides them. They don't stand out unless they are growing by themselves, as at this station. Compare them to the color of the Star Rosette Lichens nearby, which are much brighter gray-white and stand out more.

## Station 25

Go two (2) junipers further to the west

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### **Speckled Greenshield Lichen (Flavopunctelia flaventior)**

*[WHERE TO LOOK: On the trunk at about 3.5 feet height, see a pale green lichen that is dime-sized and shaped like a four leaf clover.]*

This is a very young thallus—just a baby. When fully grown, a Speckled Greenshield Lichen would measure several inches across. This lichen grows best in open woods (plenty of sun), along roadsides, or at the edge of shelter-belts (as we see here). With your magnifier, find the white raised bumps or speckles on the thallus—these are a distinguishing feature of this lichen. When this lichen matures a bit more, it will produce soredia on the surface of the thallus. **The Speckled Greenshield Lichen is RARE at Ordway—so please be very careful!**

**Lichen Note:** The white speckles or dots are called **pseudocyphellae** (pronounced **soo-doe-SIGH-fell-ee**), which are actually little breaks in the surface or **upper cortex** of the lichen, through which white fungal filaments from the inner **medulla** grow up through to the surface.

**Lichen Note:** The special GREEN color of Speckled Greenshield Lichen (and of the bush-like Green Octopus Lichen that we saw on the wooden fence at Stations 1 and 4) is caused by a lichen chemical called **usnic acid**. Usnic acid gives such a distinctive green color that the color itself is now called (by lichenologists) “**usnic-green.**” Usnic acid is a weak antibiotic and is still marketed in Great Britain as a cream for skin infections, under the trade names of Usnaderm and Usnagram.

## Station 26

Go west 15 feet and stop at the outstretched branch of a green ash tree that blocks your path.

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### **Mounded Sunburst Lichen (Xanthomendoza hasseana)**

*[WHERE TO LOOK: On the lowest dead branch that blocks your path (and to a lesser extent on the living branch), see nickel-sized to quarter-sized brilliant-orange “mounds.”]*

This lichen is often found in the crooks of the branch-points of trees and shrubs, but it can also grow on the trunk or elsewhere on the limbs (as we see here). Note that the lobes of Mounded Sunburst Lichen are short and rounded-downward—a distinguishing characteristic. Generally this lichen grows singly, the small round mounded thalli scattered here and there (i.e. not grouped together). Note that

some of these mounded thalli have bright orange apothecia, while others have tiny dark-red-orange dots all over; the abundant red dots are a distinguishing feature of this lichen.

**Lichen Note:** The dark-red-orange “dots” are called **pycnidia** (pronounced pick-NID-ee-uh). These pycnidia have to do with reproduction, each containing thousands of tiny asexual spores called **conidia** (pronounced koe-NID-ee-uh). Conidia are usually much smaller than spores made in the apothecia; in fact, conidia are only about the size of bacteria! Now find the **LARGEST** thallus of Mounded Sunburst Lichen at this Station—which is the one farthest out on the low dead limb. On that large thallus, you can see **both** the **orange apothecia** and the brilliant **dark-red-orange pycnidia**, all on the same thallus.

## **Station 27**

Now go back one tree to the east. Look on the south side of the trunk.

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### **Birds-Nest Sunburst Lichen (*Xanthomendoza fallax*)**

*[WHERE TO LOOK: on the south side of the trunk, see the obvious ORANGE PATCH growing from about two feet high on the trunk up to about four feet high.]*

As the lichen matures, the upper and lower **cortex** (“skin”) split apart at the tips, making a shallow nest-like depression that then fills with greenish-orange soredia. These “nests” may be rounded or shaped like a crescent moon. If you look closely at one of the “nests,” you can see the greenish granules or **soredia**, and you can see that the “nest” is lined by a thin layer of **WHITE** cortex and medulla. Birds-Nest Sunburst Lichen is the most common **orange foliose** lichen on bark at Ordway. It likes dry arid conditions best, so rarely is found in the southeast or along the coasts, but it loves the Great Plains.

**Lichen Note:** What causes the various colors of lichens, and why all the different colors? Some of the color variation is caused by pigments that the lichen produces—for example, the bright Orange of the Sunburst Lichens, the lemon-yellow of the Lemon Lichens, and the usnic-green color of the Green Octopus Lichen are all caused by pigments made by the lichens. The structure of the lichen itself can make the color vary, and sometimes substances secreted on the surface (such as pruina) can change the color of the lichen. It’s not really known why lichens have so many colors, but for example, the brilliant white color of many desert lichens may help reflect sunlight away thus preventing too much drying, whereas the darker color of lichens growing in a shaded forest may then help absorb light so that photosynthesis can take place.

## **Station 28**

Walk straight north to the fence, then turn west to the row of shrubs. Go to the second clump of shrubs from the north. Walk around to the south side of the clump, noticing all the big white blotches.

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### **Fungus!**

*[WHERE TO LOOK: All the big bright-WHITE blotches and patches on the trunks and branches of these shrubs]*

This is a free-living fungus, meaning it is NOT a lichen, it does NOT have an algal partner, it cannot make its own food and it does NOT have the capability of photosynthesis.

**Lichen Note:** A fungus (plural “fungi”, pronounced **FUNJ-eye**) cannot make its own food; it does not have any chlorophyll of its own so it is not able to use photosynthesis to make food. We are most familiar with fungi as mushrooms or toadstools, but fungi also include molds and mildews, yeasts, “sac fungi,” and even ones that cause diseases such as athlete’s foot, potato blight and wheat rust. Lichenologist Trevor Goward has described **lichens** as “**fungi that have discovered agriculture**”—meaning they “cultivate,” water, protect and fertilize the algal partner that grows the food. Only the fungal partner seems to contain the genetic information needed to associate with a specific **photobiont** (algal partner) to create a lichen. We don’t know what “turns on” the fungus to grab its algal partner and create a lichen. Just putting the appropriate alga and fungus together in the lab does NOT result in the growth of a lichen. The whole process is still quite a mystery.

**Lichen Note:** In the past, the fungal and algal components of lichens were thought to have a mutually beneficial working relationship called **symbiosis**, where they equally helped each other out as peaceful partners. This mutually helpful and interdependent partnership was even put forth as a biological model for human relationships and for international relationships among nations. But the romantic idea of the lichen “partnership” has recently been squelched as scientists now theorize it’s really a master-slave relationship where the fungal component captures and enslaves the algal component. So much for lichens providing a model of peace, harmony and mutual interdependence!

**How can you tell that the bright white blotches aren’t lichens? How can you know tell free-living fungi apart from lichens?** The thallus of a lichen can actually be bright-white like the many non-lichenized fungus thalli we see here, but there are NO FRUITING BODIES on this thallus, which suggests that this is a non-lichenized fungus rather than a lichen. But there’s a way to tell for sure whether something is a lichen or not:

**[But PLEASE don’t do this to any lichens or fungi on the trail, as this will obviously damage and mar the thallus!]**

With a razor blade or pocket knife, slice deeply through the thallus in question and look closely at the cross-section. If you see a **green layer** or a **blue-green layer**, you are looking at algae and **this is a lichen**. If there is NO green or blue-green layer, it's a free-living fungus, not a lichen.

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### Comma Lichen (Arthonia dispersa)

*[WHERE TO LOOK: Look at the shoot farthest south in the clump; without the magnifier, you will see two quarter-sized blotches at 4-foot height, each having tiny black speckles or squiggles.*

This is one of the **Punctuation Mark Lichens**, which also include the **Asterisk Lichen** (whose black squiggles are in the shape of stars) and the **Frosted Period Lichen**. With the magnifier, if you look closely you can see that the tiny black squiggles really do look like **commas**.

**Lichen Note:** The fruiting bodies of the Punctuation Mark Lichens are a special type of apothecia called **lirellae** (pronounced ler-REL-ee). **Lirellae** are usually black and squiggle-shaped, thin and elongate, and the spores are made deep inside.

### **Station 29**

Walk south to the eighth clump of shrubs from the fence.

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### Black-Eyed Bark Lichens (likely Amandinea or Arthosporum)

*[WHERE TO LOOK: Go to the west side of the clump, look at the sturdy upright southernmost trunk and see the many little groups of black-eyes (apothecia) on a white thallus.]*

We don't yet know what species this is; the spores will be analyzed and the lichen identified this winter.

**Lichen Note: How many lichen species are there in the world?** There are about 14,000 species of lichens in the world, of which over 3,600 species are found in North America. Approximately 120 species have been found so far at TNC's Ordway Preserve, which is an impressive number for northern prairie.

## Station 30

Go one clump to the south, it has four trunks.

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### Hagen's Rim Lichen (Lecanora hagenii)

*[WHERE TO LOOK: Look into the CENTER of the clump of shoots/trunks to the inner surface of the DEAD trunk; at 1.5-foot height you will see some gray-white discoloration of the bark. With the magnifier, you will see thousands of crowded tiny apothecia.]*

Remember, we saw Hagen's Rim Lichen on the wooden fence at Station 5. When people see lichens on a fence, they often ask, "**Where was this lichen growing before humans came along and built fences? Where did this lichen come from?**" This station answers that question, for here you can see the "wild source" for this fence-lichen—namely barkless wood of dead trees and logs. In the Great Plains, Hagen's Rim Lichen prefers human-made wooden fences to its wild source on dead barkless trees.

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### Free-living Green Algae

*[WHERE TO LOOK: Just below Hagen's Rim Lichen, see a greenish discoloration of the bark. Even with a magnifier, it just looks like a thin green film or coating.]*

This is **NOT a lichen!** It does not have a fungal partner. Instead, it is a **free-living alga**. There are many species of algae. The one seen here needs shade and moisture, since it doesn't have a fungal partner to protect it from too much sunlight and from drying out. We don't know the species of the alga at this site, but it could very well be a species that some fungus might soon capture to make a lichen!

**Lichen Note:** There are thousands of species of algae, but only four main kinds: 1) golden algae; 2) brown algae; 3) green algae; and 4) cyanobacteria or blue-green algae. Typically, only the latter two are utilized as the **photobiont** partner in a lichen (though there are a few rare exceptions). The most common alga found in lichens is **Trebouxia**. But algae are changed somewhat when they are taken in by a fungal partner to make a lichen, and that makes the algal partner difficult for scientists to identify. Only about 2 to 3 percent of the photobionts in lichens have ever been identified to species level.

**Lichen Note:** Sometimes one lichen will **STEAL** the photobiont from another lichen growing next to it! Once a fungal partner has "captured" its photobiont (green algae or blue-green algae) to make a lichen, the brilliant green or blue-green color of the algae becomes more hidden. However, **you can often make the GREEN color stand out by wetting the lichen with water;** in many species the fungus will then instantly become more transparent, so that the green of the underlying algae shows through,

turning the lichen BRIGHT GREEN. This transparency of the fungus conveniently lets light through to the algae, and turns on photosynthesis at exactly the time when needed moisture is also available for photosynthesis. Slick!

### **Station 31**

Go south 12 feet and come to the first big tree in this shrub row.

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#### **Bark Firedot Lichen (Caloplaca holocarpa)**

*[WHERE TO LOOK: All over the west side of the trunk, see little groups of orange apothecia without any thallus.]*

This lichen loves cottonwoods and aspen (both are trees in the Poplar family, both have smooth bark at least when they're young). The thallus grows within the upper layers of the bark and is invisible. Look carefully at these groups of orange apothecia and see that the rim or "**margin**" of each apothecium is about the same color as (or a little paler than) the inner disk.

**Lichen Note:** Lichens don't hurt or damage the trees, since they are not parasites. Lichens merely cling to the tree for an anchor or a place to grow—a place where they are exposed to the right amount of moisture, sun and wind-born or water-born nutrients. Lichens attach themselves to bark by means of tiny rootlets called **rhizines** (RYE-zines), which are very delicate and don't hurt the tree.

### **Station 32**

Walk south 25 feet to the first tree after the big open gap.

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#### **Moss**

*[WHERE TO LOOK: At the base of this tree on the east side, see the brilliant green plant. It actually has tiny leaves—which in this case look a bit like a miniature green juniper.]*

This is a true **MOSS**—which is actually in the Plant Kingdom (whereas lichens are NOT considered part of the Plant Kingdom). Mosses are brilliant green; they have chlorophyll and make their own food by photosynthesis. They have tiny leaflets. They are generally soft-to-touch like fur or felt (unlike most lichens, which are usually not soft). Mosses like a lot of moisture and they can tolerate quite a bit of shade. Therefore the classic place for a moss to grow is "on the north side of a tree"—but they can also grow on the ground, on moist shaded rocks, on moist wood. Some even live underwater.

The moss at this station is able to grow on the east side of this tree because it gets extra shade from the plum thicket just a few feet away, and it gets extra moisture from the run-off from the little mound of soil four feet its the east.

### **Station 33**

Go 60 feet to the south, heading between the fence and the big cottonwoods. Stop at the last big tree BEFORE the large fallen tree that blocks your way. Our tree has two trunks; go to the north side of the smaller trunk.

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#### **Island Sunburst Lichen (Xanthomendoza polycarpa)**

*[WHERE TO LOOK: Look on TOP and slightly DOWN THE NORTH SIDE of the smaller trunk, see the small (0.25-inch diameter) orange islands: they are round, and each has a clump of crowded orange apothecia in the center, with just a tiny amount of thallus visible (sticking out-from-under the apothecia all the way around the island).*

**Look-alike Alert!** Be careful here! Don't confuse the Island Sunburst Lichen with two other small orange lichens that are present on the same trunk: **Bark Firedot Lichen** (individual apothecia with no thallus) and **Birds-Nest Sunburst Lichen** (look for the "bird's nests"). This is a good place to practice identifying all three species.

### **Station 34**

For our final station, walk up the hill to the northwest corner of the white farmhouse, where you'll find a number of rocks (mostly various forms of granite) displaying the **Elegant Sunburst Lichen**.

**Why so many of the Elegant Sunburst Lichens here?** Elegant Sunburst Lichens thrive with the extra moisture dripping off the roof, plus they like the partial shade and shelter from the farmhouse.

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#### **Black-and-White Firedot Lichen (Caloplaca nigrosorediata)**

*[WHERE TO LOOK: Find the FLATTEST of the several rocks, which is made of white limestone. You can see where chips of the rock have been removed by the Lichen Survey Team. Look around the rock with the magnifier and view the BLACK colonies, and also see if you can find areas which have WHITE areoles fringed by BLACK soredia around the edge.]*

Under some growing conditions, this lichen starts making so much black soredia that the entire lichen appears black, but normally it appears as snow-white areoles with a black fringe (soredia).

**Lichen Note:** Before Ordway Preserve was surveyed for lichens in 2007, the **Black-and-White Firedot Lichen** had only been found on concrete (with the exception of its discovery on two small pieces of limestone in northeastern South Dakota). But here at Ordway, the “wild” form of this Firedot Lichen is found all over the limestone rocks and boulders—you can see it is abundant on this piece of limestone too.

**Lichen Note:** The limestone rock you’re looking at now is quite important to science for two reasons: **1)** It was the first piece of limestone to clearly show that the black soredia of this new lichen can become so thick as to turn the whole thallus **BLACK**; and **2)** this rock actually houses an example of the rare orange **FRUITING BODIES** (apothecia) of the new **Black-and-White Firedot Lichen**, for which the Lichen Team had been diligently hunting. What a find this rock was!

**You can see for yourself the rare apothecia of the Black-and White Firedot Lichen (still present on this rock) by carefully following these instructions:** Kneel on the south side of the rock, you facing north. Look at the southern-most edge of the rock, then move your gaze back in 2 inches (i.e. 2 inches to the north), then look 3 inches to the right; there you will find a small 0.25-inch diameter **HOLE** in the rock; just **ABOVE** this hole, and also slightly to the left, look with the magnifier at the block lichen and search slowly for a group of eight to 10 tiny nearly-microscopic pale yellow-orange apothecia. **These are very young apothecia**, so they show up as tiny pale yellowish-orange “rings,” each with a shallow hole or depression in the middle. (Don’t be fooled by the nearby presence of large orange **Sidewalk Firedot Lichen** apothecia, or by the **BROWN** apothecia of **Scattered Rim-Wall Lichen**—these are just “hitch-hikers” on the new **Black-and-White Firedot Lichen**.) *If you are able to find these apothecia, you will be one of the few people in North America who has ever seen them.*

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**Congratulations! You have just completed a Mini-course in Lichenology**, and have been introduced to the fascinating and exquisitely beautiful World of Lichens. The United States has a great need for more amateur lichenologists of all ages. And in particular, our country desperately needs more professional lichenologists as well. There are less than two dozen doctorate-level lichenologists left in the U.S., and most of them will be retiring soon. But even if you are not interested in becoming a professional lichenologist, know that amateurs can make a tremendously significant contribution to the science of lichens. Many regions of this country have never been surveyed for lichens, so we don’t know what species are out there, and thus we don’t know how to protect them from extinction. There are also unlimited interesting studies and projects that can be done by the amateur, which would greatly advance our knowledge about lichens. The field of lichenology is wide open. So please join this dying breed of naturalists, help us keep the light of knowledge burning, help us to advance the knowledge of North American lichens so that we can preserve these beautiful creatures.

A good place to start is to borrow or purchase a copy of Brodo's **Lichens of North America** (with its 900 color photos)—there is a copy for you to look at in The Nature Conservancy office here at Ordway. This book makes it possible for someone without any previous training to get started in lichens. Enjoy!

### **Suggested Reading:**

- 1) **Lichens of North America**, by Irwin Brodo, Sylvia Sharnoff and Steve Sharnoff. 2001.  
[The “Bible” of North American lichens, with 900 color photos. This book has revolutionized lichenology in North America for the amateur. There is a copy in the TNC office that you can look at.]
- 2) **Lichens**, by William Purvis. 2000. Smithsonian Institution Press.

## Alphabetical List of Lichens on this Interpretative Trail

[Species that have photos in *Brodo's Lichens of North America* are listed in **Bold** type]:

<u>Station:</u>	<u>Lichen species:</u>
11	<b>Acarospora contigua</b>
10, 11	<b>Acarospora fuscata</b>
2	<b>Amandinea punctata</b>
28	Arthonia dispersa
14	<b>Aspicilia cinerea</b>
14	<b>Aspicilia contorta</b>
15	Aspicilia limitata
13	<b>Caloplaca arenaria</b>
7, 18	<b>Caloplaca feracissima</b>
12	Caloplaca grimmiae
31, 33	<b>Caloplaca holocarpa</b>
2, 6	Caloplaca microphyllina
8, 34	Caloplaca nigrosoediata
21, 22	<b>Candelaria concolor</b>
6, 11	<b>Candelariella vitellina</b>
3	Cyphelium notarisii
10, 11	<b>Dimelaena oreina</b>
25	<b>Flavopunctelia flaventior</b>
9, 18	<b>Lecanora dispersa</b>
5, 30	<b>Lecanora hagenii</b>
4, 7, 10	<b>Lecanora muralis</b>
17	Lecidea sp.
24	<b>Phaeophyscia hirsuta</b>
23	<b>Physcia adscendens</b>
11	Physcia dakotensis
20	<b>Physcia stellaris</b>
20	<b>Physciella melanchra</b>
1, 4	<b>Ramalina americana</b>
14	<b>Rhizocarpon disporum</b>
16	<b>Rhizoplaca chrysoleuca</b>
15, 16	<b>Rhizoplaca subdiscrepans</b>
20	<b>Teloschistes chrysophthalmus</b>
27, 33	<b>Xanthomendoza fallax</b>
26	<b>Xanthomendoza hasseana</b>
33	<b>Xanthomendoza polycarpa</b>
7, 18, 34	<b>Xanthoria elegans</b>