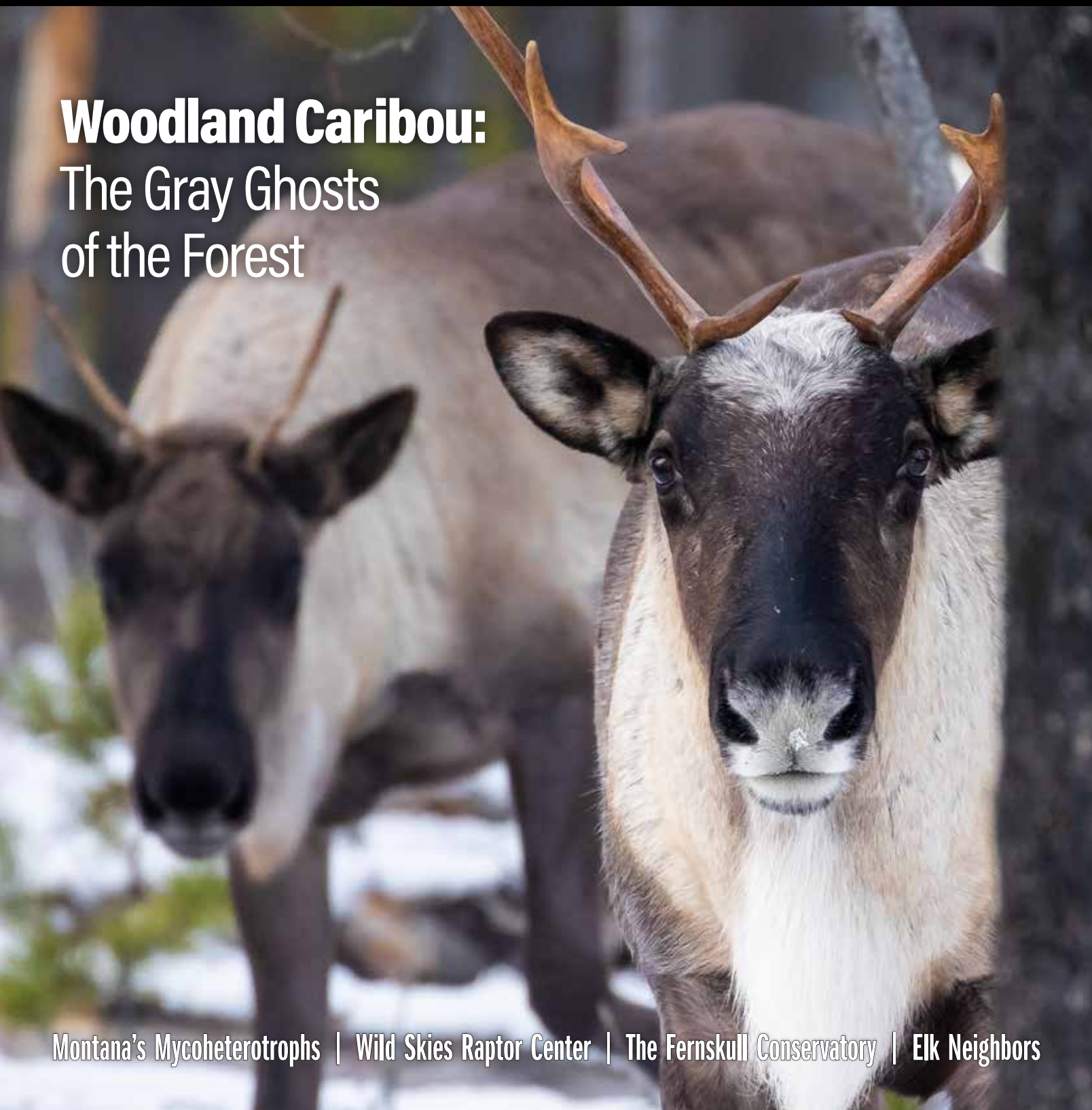
Montana Natural History Center

Fall/Winter 2022

MONTANA Naturalist

TO PROMOTE AND CULTIVATE THE APPRECIATION, UNDERSTANDING AND STEWARDSHIP OF NATURE THROUGH EDUCATION



Woodland Caribou: The Gray Ghosts of the Forest

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Cover – Two mountain caribou peer around a lodgepole pine in the boreal forest of the Hart Range of British Columbia. Photo by Cory DeStein. Find his work at cory-destein.squarespace.com and @corydesteinphotography on Instagram.

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MNHC's solar array brings joy to people of all ages! Here's one young naturalist who will only know this roof with solar panels.

ALLISON DE JONG

I remember the first time I climbed the utility ladder in MNHC's mechanical room, pushed up the heavy metal hatch, and stepped out onto the roof. Our building is not small. The roof is an enormous black expanse, flat with a slight slope to the south. My first, overpowering thought was, "This is a perfect space for solar panels."

This past summer, ten (or so) years after that first MNHC roof foray, I got to step onto that same roof, now covered with a glittering array of sapphire-blue solar panels, every single one of them converting the bright August sunlight to electricity. Let me tell you: it's a beautiful sight.

What was also beautiful was watching this project come to life: our staff being encouraged to dream big, our current strategic plan focusing on climate change education and initiatives, the unfailing support we received from our community, the generous USB grant from NorthWestern Energy that covered a majority of the cost, the knowledge and expertise of the wonderful team at SBS Solar.

It's been an inspiring journey.

I'm glad for something unequivocally wonderful to celebrate amidst our ongoing, soul-wearying challenges (climate change, pandemics, politics—take your pick). These panels will generate 99 percent of the Montana Natural History Center's electricity. Visitors can come inside on a smoky August day and enjoy air conditioning that runs on sunlight. Visitors will also be able to learn more about solar arrays and renewable energy in our upcoming solar exhibit. Perhaps someday they'll even be able to charge their electric cars with MNHC solar energy. There are so many possibilities, and we've seen what happens when we dream big.

This issue celebrates the work of other big dreamers. Brooke Tanner founded Wild Skies Raptor Center in 2010, and has rescued and rehabilitated innumerable raptors in the past 12 years (page 22). Writer Phoebe Bright tells the story of Canada's woodland caribou, and how First Nations are working with ecologists to revitalize the dwindling herds (page 4). Natalie Anne Helser, a 16-year-old naturalist and writer, created a beautiful natural history conservatory in her home (page 12). And writer and artist Kelsi Turner reveled in her wild ungulate neighbors while living in a tiny treehouse with her family as they built their dream home on their land (page 24).

I'm glad to be reminded in so many ways that our dreams, even big ones, can become reality. This year could be a good time to ask yourself: What am I dreaming about now? What seeming impossibility can I turn into reality? It might take time—a year, or two years, or ten. Let's get started.

Allison De Jong
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The Gray Ghosts of the Forest

BY PHOEBE MCILWAIN BRIGHT

While woodland caribou are effectively extinct in the Lower 48, herds still exist in the inland temperate rainforest in British Columbia and Alberta, though human activity is increasingly fragmenting their habitat.

New antlers thick and dark with velvet, a female caribou chews pistachio-colored arboreal lichen, known as old man's beard. Occasionally, she twitches her haunches to shake off mosquitos. She's grayish brown, with a creamy white neck. Beside her, a dun-colored calf prances energetically, lifting its hooves high and showing the pale underside of its knobby tail. At two days old, it can already outrun a human. This isn't a scene from the tundra, but from the largest inland temperate rainforest in the world—and from Montana's living memory.

Unlike other North American ungulates, such as deer and elk, caribou evolved in the Arctic, not the temperate climate of the Lower 48. Barren-ground caribou, the type of caribou most people are familiar with, still reside there today, where they migrate in herds of tens of thousands across the tundra. Their cousins, woodland caribou, live on mountaintops and in old-growth cedar-hemlock forests, where they survive winter by eating the old man's beard that hangs from branches in seaweed-like tangles.

JOSEFINE STENUDD, FLICKR.COM

WILDLIFE INFOMETRICS INC.

Left: Old man's beard lichen has very few nutrients, but it helps woodland caribou survive the winter.

Below: Caribou evolved in the Arctic, and thus are adapted to survive the cold, harsh winters of their high-elevation habitat.

"It's basically Gatorade," says Mark Hebblewhite, professor of ungulate habitat ecology at the University of Montana. "Lichen doesn't have much nutrition. It's pure carbohydrates. No one else wants to eat it, and it takes a long time to grow."

Yet woodland caribou have evolved to make a home in this increasingly rare ecosystem, including by recycling the nitrogen-rich parts of their urine to get more protein from the lichen. Thanks to their polar origins, they aren't bothered by temperatures of negative 40 or 50, and they can see UV light, letting them spot wolf pee on the snow, in the dark. Their large, concave hooves and spreadable dewclaws keep them from sinking in snowdrifts, even though they typically weigh 250 to 450 pounds. Greater snow depths actually function as step stools, letting them reach higher branches to access more lichen. While bulls drop their antlers in early winter, cows keep theirs until right before spring calving, making them more dominant during the cold months. (Reindeer are domesticated caribou, so yes, Santa's Rudolph is female.)

These "gray ghosts of the forest" spread out across the landscape, living in places other large mammals avoid. Mountain caribou, an ecotype of woodland caribou, once ranged as far south as Stanley, Idaho, and Lolo Pass, west of Missoula. In the 1970s, there was still a herd in the Yaak Valley, near Libby. Since then, caribou in Canada have occasionally crossed into Montana. But the gray ghosts are vanishing from the landscape.

At 40 million acres, the inland temperate rainforest stretches from northwestern Montana, central Idaho, and northeastern Washington into Alberta and British Columbia. It's the only rainforest to get a good portion of its water from snow. Several ecologists refer to it as the last inland temperate rainforest in the world: the others have been severely or fully logged. Moss-furred trees decompose on the forest floor, and tangles of black and green lichen hang from branches. At higher elevations, the forest shifts to Engelmann spruce and subalpine fir. From plops of snow slipping off hemlock needles to creeks flowing down mountainsides, the sound of water is everywhere. Home to mountain caribou and 1,000-year-old cedars, it's also a source of timber for the logging industry.

"Over the last century, as we have entered into [caribou] habitat, logging, oil, and gas exploration has fragmented that habitat," said wildlife photographer Cory DeStein in a presentation for the Montana nonprofit Swan Valley Connections. "The inland temperate rainforest has next to no secondary growth in it. The forest floor is pretty devoid of any shrubs or growth that deer, elk, or moose would like to feed on. But when we [opened up the canopy], we opened it up to all this secondary growth that those

DAN DWYER, FLICKR.COM

species absolutely loved. And with that came the predators that followed them."

Predators—which woodland caribou historically avoided through choice of habitat—also gain access via logging roads and hiking, skiing, and snowmobile trails. By way of example, Mark Hebblewhite points to the South Selkirk caribou herd, whose territory dipped into the Lower 48. A few years ago, a single mountain lion killed twelve members of the herd, and in 2019, the one surviving caribou was relocated to a herd near Revelstoke, British Columbia. Of the mountain lion, Hebblewhite says simply, "He was up there because of roads, logging, and whitetail deer."

Even though mountain caribou were listed as endangered in the United States in the early '80s, they are now effectively extinct here. In the early 2000s, mountain caribou were listed as "threatened" under the Species at Risk Act (SARA), Canada's version of the Endangered Species Act. The listing hasn't stopped the rainforest's destruction, and herds have been blinking out faster and faster. But there's a glimmer of hope.

Above: Maternity pens have proven to be an effective tool in caribou recovery. Here's an aerial view of the pen showing some of the opaque fencing used to shield caribou from predators.

Left: Here, a closer view—a cow and her calf in the pen. They will be released back into the wild when the calf is about two months old.

PHOTOS: WILDLIFE INFOMETRICS INC.

In 2013, two First Nations, the West Moberly and the Saulteau, started a woodland caribou recovery project north of Prince George, British Columbia. The local Klinse-Za caribou herd had gone from 250 animals in the '90s to 38 in 2013. The First Nations' efforts have focused on two short-term fixes and a significant, long-term solution. But it's one of the short-term components that's received the most attention: caribou maternity pens.

Since 2014, pregnant cows from the Klinse-Za herd have been trapped with netguns and brought to a 17-acre pen before calving. Monitored by two caribou guardians at all times, cows in the pen are protected from predators as they give birth and begin raising their calves. When the calves are about two months old, they and their mothers are released back into the wild.

The other short-term solution has been the reduction of predators, especially wolves. In his presentation, Cory DeStein, who's involved with caribou recovery efforts near Nakusp, British Columbia, pointed out that wolves have followed deer, elk, and moose into new habitats, where they didn't used to go. Mark Hebblewhite, who grew up in Ontario, also explained that in Canada, there are tens of thousands of wolves—making wolf culling different than it would be in the Lower 48. The First Nations' efforts have focused on killing wolves in a small area around the maternity pen. In terms of how much they've been helping, Hebblewhite says wolf culls and maternal penning are roughly a 50-50 split.

By 2021, the Klinse-Za herd had grown to 101 animals, shifting from a ten percent annual decline to yearly increases of twelve percent. In the spring of 2022, two scientific papers authored by members of the First Nations and university researchers in British Columbia, Alberta, and Montana were published in the peer-reviewed journal *Ecological Applications*. The analysis? The West Moberly and Saulteau were succeeding in revitalizing the Klinse-Za herd.

Hebblewhite was one of the university researchers, who together served as science advisors to the First Nations' members, helping them analyze the results of the recovery actions they had developed and implemented. What he's most optimistic about is the Nations' long-term solution of large-scale land conservation.

The West Moberly and Saulteau Nations' treaty rights include the right to hunt caribou, which are culturally important to them and were once so common, West Moberly elders described them as being like "bugs on the landscape." Because of declining populations, the Nations made a decision to stop hunting caribou in the 1970s. But in 2020, using the enforcement of their treaty rights as a legal tool, they secured an agreement with the Canadian government to protect and manage over 3,000 square miles of habitat, within their Treaty 8 territory, for the Klinse-Za herd. This Indigenous Protected and Conserved Area (IPCA) represents about 80 percent of a herd's needed acreage, and it's contiguous with the Muskwa-Kechika Wilderness, a conservation area the size of Ireland.

In protecting woodland caribou, "there have been so many failures," Hebblewhite says. "But the Klinse-Za herd isn't a failure

because the First Nations and their governments have held federal and provincial governments' feet to the fire and really made them enforce laws….All the efforts to protect caribou would be a waste of time if habitat wasn't protected." He adds, "That includes in Alberta, where they're killing wolves to supposedly help caribou but meanwhile destroying habitat for caribou."

Hebblewhite believes there's a hopeful note in the Klinse-Za story that's applicable to the Lower 48 as well—Indigenous conservation leadership. "The positive role that First Nations had in Canada with the Klinse-Za herd is similar to the role the Nez Perce had in reintroducing gray wolves to central Idaho," he says.

In 1995, after the federal wolf recovery program identified Yellowstone National Park and central Idaho as places for wolf reintroduction, the Idaho Legislature blocked Idaho Fish and Game from following through with federal requirements. "Idaho had no intention of reintroducing wolves," Hebblewhite says. But the Nez Perce offered to take the state's place and successfully reintroduced wolves to the reservation.

Hebblewhite thinks there's an important parallel between the Nez Perce's role in wolf recovery in Idaho in the '90s and the West Moberly and Saulteau Nations' leadership in caribou habitat conservation today. "The take-home message," he says, "is that tribal governments have and have had an important role in wildlife management."

As a Montanan, I've never seen woodland caribou, except in videos and photographs taken by researchers and photographers. The closest I've come is an encounter with reindeer on a trip to Alaska, their heads turning to track me as I traveled along a snowy roadway, half-visible in the blue-gray light. Primed on iconic images and sightings of Rocky Mountain bull elk, I marveled at their pale crowns of antlers, only to later learn that because it was April, those sentinels were pregnant cows.

"Will woodland caribou ever return to Montana?" I asked Hebblewhite, thinking of videos of spring-footed calves in maternity pens and even that moment with the reindeer—the feeling of being both watcher and watched.

But Hebblewhite said he doesn't think woodland caribou will return to the Lower 48 in our lifetimes. Although wilderness areas like the Bob Marshall and Selway-Bitterroot are important, the Bob's 1,500 square miles are a fraction of what a caribou herd needs and the Selway-Bitterroot is cut through with a road, well over a thousand miles of trails, and other legacies of human disturbance.

Because it takes old-growth forests a long time to recover, Hebblewhite estimates it would be at least a hundred years before Montana could have healthy enough habitat to support caribou again. "But more likely, it's hundreds of years—and that's only if we get our act together with climate change," he says. If rising temperatures and climate fires continue, he's doubtful that caribou will be able to survive south of Revelstoke.

Still, in Canada's mountain caribou habitat, local stakeholders continue to come together to support caribou recovery with conservation efforts and maternity pens, often on community-managed forestland, which is typically stewarded in a way that creates more jobs per board foot and uses more sustainable logging practices than international, industrial-scale corporations.

When I asked DeStein about caribou loss a few weeks after his SVC presentation, he said, "Every animal that has occupied the landscape naturally deserves to be there. If we are the greatest driving force behind their decline, then we have a responsibility to be the driving force behind their recovery." He quoted Aldo Leopold: "'If the land mechanism as a whole is good then every part is good, whether we understand it or not….To keep every cog and wheel is the first precaution of intelligent tinkering.'"

Hebblewhite also stressed the importance of taking a holistic view of the ecosystem. And it is more than even woodland caribou at stake. These animals are intrinsically linked to the inland rainforest.

"Their decline is a direct indication that their habitat is degrading," Cory DeStein told me. "They are the canary in the coal mine."

The question is, as always: how will we respond?

—Phoebe McIlwain Bright is an environmental writer. Her stories have recently appeared in The Daily Yonder, *MTPR's "Field Notes," and* The Changing Times.

A female mountain caribou in the Revelstoke maternity pen in 2019—safe, for the moment.

MARK HEBBLEWHITE

It's Not Easy Being Green:

The Secret Lives of Mycoheterotrophs

BY DREW LEFEBVRE

PHOTO: DREW LEFEBVRE

PHOTO: PETER STEVENS, FLICKR.COM

Green: it's the color of life, growth, renewal. It makes us feel refreshed and optimistic, and for good reason. A long, harsh winter always ends with a verdant spring. A weekend of toil in the garden results in first one tiny sprout, then another. A lush green forest, one dripping with mosses and ferns, feels just about as bursting with life as possible. Green entails water, implies food, and serves as a visible representation of health, prosperity, and relaxation. We have plants to thank for all this, of course. Green plants, a taxonomic clade representing 450,000 - 500,00 species, display their characteristic hue because they contain a bright green pigment called chlorophyll. Chlorophyll gives plants the remarkable ability to create their own food through the process of photosynthesis.

Left: The aptly named ghost pipe, with its pale pinkish-white color, grabs the attention when one comes across it, though we may not immediately recognize it as a plant!

Below: The equally odd-looking pinedrops, which can grow up to five feet tall, also defies our perception of plants. But if you look closely, you'll see that their urn-shaped flowers are similar to those of other plants in the heath family—huckleberries, kinnikinnick, heather.

Plants use chlorophyll to absorb energy from sunlight, then utilize that energy to convert the raw materials of carbon dioxide and water into carbohydrates and oxygen. Those carbohydrates provide the energy for the plant to carry out its life processes: to grow, branch, and, depending on the species, leaf out, blossom, and set seed. Humans and other animals need carbohydrates too, with the difference being that we need to find them rather than create them ourselves. Lacking photosynthetic capabilities, we must consume other living beings in order to acquire the carbohydrates we need. There's a word for that: heterotroph, meaning that we consume others. Plants, which generate food for themselves, are known as autotrophs. As the first link in the planet's food chain, autotrophs provide the initial, crucial connection between the sun's energy and the ability of all life forms to obtain nutrition. It's no exaggeration to say that plants provide the foundation for all life on Earth.

So what about that strange, reddish plant

we often spot growing under a ponderosa pine? It has a tall stalk and lots of delicate, urn-shaped flowers. There's no sign of green coloration at all, although it may tend toward purple or even orange. And then there's the fleshy, ghostly white plant often seen in shady conifer forests, the one with the single, downward-curving, scaly flowerhead. The whole plant is a waxy, almost luminescent white, sometimes with a tinge of pale pink. No green implies no chlorophyll, and no chlorophyll means no photosynthesis, right?

Right. The giant pinedrops and the ghost pipe, both native to western Montana, are two examples in the handful of North America's non-autotrophic plants. They are *achlorophyllous*—meaning they contain no chlorophyll—and can't create their own food. Instead, they rely on a fascinating evolutionary strategy to obtain their nutrients. Along with about 400 others worldwide, these species are known as a *mycoheterotrophs*. Like many anomalies in the natural world, mycoheterotrophs have been highly misunderstood over the years. It's only recently that we've begun to understand how they work—and what makes them so special.

If you're used to referring to these plants as saprophytes, you're not alone. Most of us learned that term at one point, and many plant field guides still use it. A saprophyte is an organism that receives its nutrition directly from dead organic matter, which is what we used to think these non-green plants did. But it's time to banish that notion! We now know that, while some fungi and bacteria consume dead organic matter directly, there are no true saprophytes in the plant kingdom. Instead, mycoheterotrophic plants have evolved their own indirect way of obtaining nutrients. But to fully appreciate the depth of mycoheterotrophs' strategy, we first have to know a little bit about regular old autotrophic plants and how they interact with fungi.

Perhaps you have heard of *mycorrhizae*.

They're a hot topic in ecology these days, and with good reason: it turns out they exist nearly everywhere and have been found in over 90 percent of plant species. Mycorrhizae are fungal roots that form a symbiotic relationship with a green plant. This occurs when a soil-dwelling fungus colonizes a plant's roots. Depending upon the species, this can happen in a number of different ways: the fungus may actually penetrate the plant's root cells, or it may just cover the outside of the root with a complex, branching network. Some fungi are host-specific, associating only with a certain family or genus of plants, while others are more generalist. And some plants, certain trees in particular, may host a dozen or more fungal species at a time.

Regardless of exactly how it happens, the mutualistic benefits of mycorrhizae are universal. The fungus, which as a heterotroph cannot produce its own food, receives energy from the plant in the form of carbohydrates. The plant benefits as well: the larger surface area provided by mycorrhizal roots helps the plant absorb more water and minerals than it ever could on its own. There's also evidence that mycorrhizae can provide nutrients in other ways, such as fixing nitrogen in the soil and, incredibly, through a form of hunting in which one species of mycorrhizal fungus can lure and kill tiny arthropods, providing itself and its associated plant with even more nitrogen. In short, mycorrhizal associations are mutually beneficial for both plant and fungus. And this is what makes them so susceptible to cheaters.

Producing carbohydrates through photosynthesis is hard work. So is scavenging water and nutrients to exchange for those carbohydrates. Our non-green friends the mycoheterotrophs have evolved to circumvent all of these tasks. They simply tap into mycorrhizal roots, reverse the flow of carbohydrates, and voilà: a consistent source of energy at virtually no cost. In this way, the mycorrhizal fungus acts as a sort of bridge between the two plants, with carbohydrates from photosynthesis flowing from the green plant, to the fungus, to the mycoheterotroph. It's no wonder these plants are sometimes called mycorrhizal cheaters.

This three-part network—autotroph, fungus, heterotroph—may seem overly complex and strange, but researchers have determined that it has evolved at least 46 independent times throughout evolutionary history, showing up in nearly all the major lineages of land plants. All mycoheterotrophic plants evolved from autotrophic ancestors, some quite a long time ago, demonstrating that this life strategy can persist and diversify over the course of evolutionary time. What's more, as plants evolve from autotrophic to mycoheterotrophic, scientists notice some correlated trends: fewer leaves and roots, reduced seed size and complexity, preference for shadier habitats, and increased specificity regarding their fungal hosts. These traits tend to show up across most mycoheterotrophic species. To observe them for yourself, there are a few notable plants to look out for.

Fairy slipper orchids split the difference—they produce chlorophyll, but they also obtain some of their nutrients via mycorrhizal fungi.

PHOTO: ALLISON DE JONG

The second largest plant family on Earth, the orchids, is notorious for its cheating tendencies—it accounts for over one-third of all species of mycoheterotrophs. Orchid seeds, tiny and dustlike, don't carry any nutrition for the developing embryo, so they can only germinate if they obtain food from a specific fungal host. This means that all of the world's orchids are initially mycoheterotrophic in their earliest seedling stages. Some species continue this strategy throughout their lifetime while others drop it later on in favor of photosynthesis. Some orchids can even have their carbon and eat it too by adopting a strategy of partial mycoheterotrophy: they receive some carbohydrates through photosynthesis and some from mycoheterotrophy, adjusting these ratios in response to environmental conditions such as amount of sunlight. One of western Montana's most beloved native wildflowers, the fairy slipper, is a great example of an orchid that contains chlorophyll and has a flexible strategy of partial mycoheterotrophy. In contrast, the well-camouflaged spotted coralroot remains mycoheterotrophic for its whole life, never transitioning to the green, photosynthetic lifestyle. Evidence suggests that this orchid has at least six different genotypes, each with a preference for a different fungus.

Orchids aren't the only plants known for mycoheterotrophy. In North America, many members of the heath family, *Ericaceae,* have developed this trait to varying degrees. Giant pinedrops and ghost pipe, mentioned above, are two striking examples. Look closely at either of these two bewitching plants and you'll see why they are included in the same family as huckleberries, heathers, and kinnikinnick. This family tends to sport urn-shaped flowers with fused petals; giant pinedrops and ghost pipe are no exception, though their lack of chlorophyll does help them stand out against their surroundings in a way that the average huckleberry bush doesn't.

Like orchids, both of these species are also quite selective about which mycorrhizal fungus they will tap into. Pinedrops is closely associated with fungi of the genus *Rhizopogon* while ghost pipe will feed only on *Russula*. This means that the habitat must be just right in order for these plants to germinate and thrive. There's something about this fussiness that makes them even more fascinating. Even poet Emily Dickinson fell prey to the beguiling nature of these plants. She called ghost pipe "the preferred flower of life," writing, "I still cherish the clutch with which I bore it from the ground when a wondering child, an unearthly booty, and maturity only enhances the mystery, never decreases it."

We can all relate to the thrill of a special find in the natural world, especially one whose mystery is enhanced, and not decreased, by more knowledge. But it's easy to let our own values get the best of us—we humans love to anthropomorphize. Maybe that's why we're so quick to think of mycoheterotrophs as cheaters. After all, they eschew the equal give-and-take of symbiosis, opting out of a system that feels

Common Mycoheterotrophs of Western Montana

Fairy Slipper
Calypso bulbosa
Orchid family
2-8 inches tall
Dry to wet coniferous forest; valleys, montane habitat

Spotted Coralroot
Corallorhiza maculata
Orchid family
6-10 inches tall
Moist to wet coniferous forests; valleys, montane habitat

Giant Pinedrops
Pterospora andromedea
Heath family
Up to 5 feet tall
Drier, coniferous forests; valleys, montane habitat

Ghost Pipe
Monotropa uniflora
Heath family
Up to 12 inches tall
Moist, deeply-shaded coniferous forests; valleys, montane habitat

FAIRY SLIPPER AND CORALROOT PHOTOS: ALLISON DE JONG; PINEDROP PHOTO: GARY CHANG, FLICKR.COM; GHOSTPIPE PHOTO: DREW LEFEBVRE

to us like a traditional fair trade. If a person behaved in such a way, they wouldn't be invited to your next birthday party.

But perhaps the morality of the natural world is not so anthropocentric. Plants must obtain nutrition however they can, and their specific methods are as varied and unique as the hundreds of thousands of species on Earth. We could condemn these mysterious plants as cheaters, or we could celebrate them as unique organisms that have evolved yet another fascinating way of surviving on this planet. We're only just beginning to unlock how they work—and this knowledge only enhances the mystery, never decreases it.

—Drew Lefebvre is the Museum Programs Coordinator at MNHC. She loves learning about weird plants and their life histories and sharing what she discovers with other naturalists.

Chasing Carbon: The Isotope Food Chain

How do we know where plants get their carbohydrates? If they could talk, it would be a lot easier to ask them what they ate for lunch today and where they got it. But botanical communication is a bit trickier for us to decipher, and scientists rely on other methods to determine exactly what a plant is consuming and how. The science behind the methods may surprise you. It all has to do with isotopes.

About 99 percent of the stable carbon on Earth is known as ^{12}C. The other one percent has an extra neutron in its nucleus, making it slightly heavier. This variety (or isotope) of carbon is known as ^{13}C. Plants will take in both isotopes of carbon from the atmosphere, but when it comes to building carbohydrates, they tend to use ^{12}C. Meanwhile, the ^{13}C gets passed along to mycorrhizal fungi through symbiosis. Scientists call this an isotope food chain. As you progress along the food chain from autotroph to heterotroph, organisms become more enriched in the slightly heavier isotope, ^{13}C.

By measuring the ratio of these carbon isotopes within an organism, scientists can determine where it falls on a food chain. Autotrophic plants tend to contain more ^{12}C, while heterotrophic fungi tend to contain more ^{13}C. So what happens when you measure the carbon ratios in a mycoheterotroph? You guessed it: they have very high amounts of ^{13}C, exhibiting carbon ratios more similar to fungi than to green plants. This is how scientists know that mycoheterotrophs aren't producing their own carbohydrates, but instead are receiving them indirectly from autotrophs.

There's yet another carbon isotope that helps scientists uncover the mysteries of mycoheterotrophy, and that's ^{14}C. This radioactive, slightly heavier isotope is less common in our atmosphere than other forms of carbon, and its biggest source is nuclear explosions. In the 1950s, atomic bomb tests were a regular occurence, and so plants growing during that time period contain higher levels of ^{14}C than plants do today. This means that scientists can analyze plant tissue and, based on its level of ^{14}C, determine when it grew.

In a recent study that only adds to the mystery, researchers in Japan analyzed ten mycoheterotrophic species, looking for ratios of carbon isotopes. They found that most of the plants contained high levels of ^{13}C, as expected for an organism far along on the isotope food chain. However, the remaining species showed elevated levels of ^{14}C, meaning that their carbohydrates were not sourced from present-day photosynthesis after all. The researchers concluded that these plants (mostly orchids) were receiving their nutrition not from symbiotic mycorrhizal fungi, but instead from saprotrophic fungi consuming dead wood from decades ago. It appears that when it comes to mycoheterotrophs' favorite meals, there's still much more to discover!

Notes and wonders from The Fernskull Conservatory

A collection of spring marvels

BY NATALIE ANNE HELSER OF ST. IGNATIUS, MT, AGED 16

A delicate butterfly wing, creamy-white coloured. A yellowing vole skull. A tin dish full of dried scraps of lichen. These rest below a string of dried flowers—pansies, calendula, chamomile, strawflower, pearly everlasting. And below that, on an old, rubbed-smooth shelf, sit crystals and rocks—dull pumice and lava rock, shiny quartz, ethereal satin spar and fluorite. Other curiosities—fragile bird's nests, aquatic exoskeletons, elegant pheasant feathers—fill the gaps, each one labelled with a date, an observation and a note or two, and two names—common and scientific. This is *The Fernskull Conservatory,* a museum of naturally found curiosities. Fascinated by the minute details of our ever-changing world, I created this wall-sized collection of specimens to document the abundance of life and wonder that fills our world. The exhibits change seasonally, with new flora and fauna and wonders to match.

Please note—all specimens collected for **The Fernskull Conservatory** *are done in an entirely respectful and non-harmful manner. Insects, bones, feathers, animals, and other living organisms are found and only used for the conservatory if they are already dead.* ***Thank you!***

A sampling of naturalist observations and drawings from Natalie's journal.

Late May, Afternoon.

Spring, the season of green and new beginnings and life. The lupine explodes in bursts of watercolour purple, the dandelions blossom in the thousands, looking as if the sun has rained drops of gold across the valleys. The apple tree mushrooms with velvety flowers, and the joyous lilac overwhelms yards and markets with their fragrant, lacy blooms.

One of my favourite flowers is moss phlox—a low-growing, lavender-toned flower that spreads *everywhere*. With little, spiky leaves and a love for sun, our once-tiny phlox plant has exploded across the front garden bed.

Another favourite spring green is aspen. Of course, the symphonic flutter of the leaves are infamous, but there really *is* nothing like it. Casting dappled, warm light over me as I sketch one of the intricately veined leaves, I watch as a little ladybug climbs her way up to the top.

A magpie pair in the nearby seaberry bushes chirp to each other, each debating over the best way to artfully craft their spiky, domed nest. Magpies nest in a curious way—building an egg-shaped nest with a hole in the middle. They tend to prefer thorny bushes or trees for nesting—the several nests on our property are all in thorn-covered seaberries or hawthorns.

If you're in search of excellent natural history reads this fall,

turn your attention to two newly published books by writers who have connections to western Montana and the Montana Natural History Center!

Writer and naturalist **Marina Richie** wrote two dozen Field Notes for MNHC in the '90s and early 2000s, and we are thrilled that she's now written a book featuring those unusual and charismatic birds: Belted Kingfishers.

Mike McTee is a wildlife researcher for the MPG Ranch in the Bitterroot Valley, and wrote an excellent article in the Fall 2018 issue of *Montana Naturalist* about MPG's research on scavenging eagles—a precursor to the book he's just published on lead poisoning in eagles.

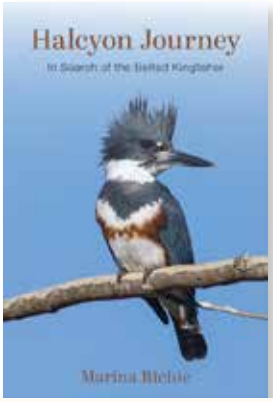
PHOTOS COURTESY RICHIE AND MCTEE

Marina Richie

Mike McTee

Halcyon Journey: In Search of the Belted Kingfisher

BY MARINA RICHIE



This book is a delight.

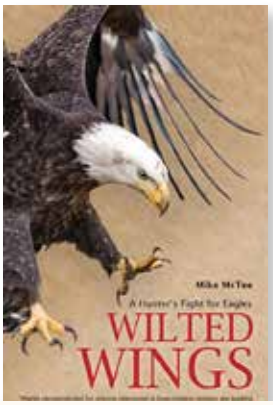
If you're looking for a captivating natural history tale interwoven with rich personal stories and sprinkled with myth and legend from the Greeks to the Salish, look no further. Whether you love Belted Kingfishers already or have yet to become enamored, Marina Richie's fascinating account of tracking a kingfisher pair for seven nesting seasons will give you new love and appreciation for these uniquely wonderful birds. Marina dives as enthusiastically into her journey as a kingfisher dives into a river, and the reader can't help but be swept along.

You'll share her joy of finally (finally!) tracking down the location of the kingfishers' nest, the disappointment of just missing the nestlings fledge, the thrill of making a citizen science observation never before documented. Marina takes readers around the world, seeking out kingfishers in Ndomo Game Reserve in South Africa, at Hampstead Heath in London, on the Lower Rio Grande in Texas, and more. But mostly, the story centers on Missoula's beloved Rattlesnake Creek and the Belted Kingfishers that nest and raise their young there. For readers who know and love Missoula, this book is a particular delight.

At its heart, this book is a celebration. Of kingfishers, yes, but also of curiosity, community, and connection. It is a celebration of what happens when we let ourselves care deeply about the world around us, from the people and their stories and histories to the wild places and the wild creatures that call them home.

Wilted Wings: A Hunter's Fight for Eagles

BY MIKE MCTEE



In his book, biologist and hunter Mike McTee brings readers up close and personal with those most iconic of North American birds: eagles. Unfortunately, however, this isn't always a rosy experience, since many of the eagles he comes across are suffering—and, in too many cases, dying—from lead poisoning.

As a hunter who formerly used lead bullets without thinking twice, Mike shares his shift in understanding as he saw firsthand the effects lead has on wild creatures in the ecosystem. (Hint: it's not pretty.) As a wildlife researcher with MPG Ranch in the Bitterroot Valley, he began studying scavenger ecology and investigating how bullets fragment inside of an animal's body. He reached out to raptor ecologists across the country, gathering stories and research, and, armed with new information, began writing and educating about lead-free bullets.

As Mike weaves together eagle encounters, research, hunting stories, and history, juxtaposing human stories with those of wild animals, we get to see not only his love for the animals he studies, but the intricate layers of interdependency: how beautifully wild creatures are connected with each other and their landscapes. We also get to see how they're affected—not so beautifully—by humans. Perhaps most importantly, we get to see how we can help.

Wilted Wings is a cautionary tale, a call to action, and, ultimately, a story of hope.

To learn more about a local raptor rehabilitation organization, check out this issue's Community Focus on Wild Skies Raptor Center on pages 22-23.

get outside calendar

Programs for Kids

Join us for our Saturday Kids' Activities! On scheduled Saturdays families can drop in between 1:00 and 3:00 p.m. for a hands-on kids' activity. Check our website calendar for specific dates and topics—we plan on offering the program most Saturdays. Free with membership or cost of admission.

Join us every Thursday from 10:00-11:00 a.m. for our miniNaturalist program! Best for ages 2-4, though kids of any age are welcome. We will meet indoors and then head out to our Nature Adventure Garden for the rest of the program. Free with membership or cost of admission.

The Montana Natural History Center is a content provider for Streamable Learning (streamablelearning.com), whose innovative programming connects districts and classrooms across North America for live and interactive online educational events. Subscriptions for homeschools/families is just $14.99/month (first 30 days free). Check out our upcoming events!

OCTOBER

October 31
Super Spiders: Feeding + Trivia Myth Busting,
10:10 a.m., for grades K-2.

DECEMBER

December 2
Creative Creatures,
10:10 a.m., for grades 2-5.

FEBRUARY

February 10
Biomimicry and Bugs,
10:10 a.m., for grades 1-3.

APRIL

April 18
Biomimicry and Bugs,
11:10 a.m. & 1:10 p.m., for grades 1-3.

MNHC PHOTO

Volunteer Opportunities

Volunteers, it's been great to see you again this year! For upcoming volunteer opportunities, which include Visiting Naturalist in the Schools classroom visits and field trips, helping out at the front desk, and assisting with our drop-in kids' programs, and more, check our website or sign up for our volunteer newsletter at MontanaNaturalist.org/volunteer-with-mnhc/. We hope to see you soon!

The Montana Natural History Center is located within the traditional homelands of the *Ta̓ta̓yaqn* (Bitterroot Salish) and *Qlispélix*ʷ (Kalispel) peoples who have lived here since time immemorial. The Montana Natural History Center is dedicated to the recognition of the first peoples of Missoula and the integration of Salish language, culture, and Indigenous knowledge.

MNHC is currently open Tuesdays - Saturdays, 11 a.m. - 4 p.m. Please check our website and social media for details.

Admission Fees:
$4/adults (18+), **$1**/children (4-18), **$8**/family rate, **Free**/children under 4, **$3**/seniors and veterans

FREE admission for MNHC members, ASTC Travel Passport Members, and EBT card holders!

Programs and events held at MNHC, 120 Hickory Street, unless otherwise noted.

Programs subject to change. Please check our website calendar for the most up-to-date information.

Visit MontanaNaturalist.org to register for programs and become a member. For more information, call MNHC at 406.327.0405.

PHENOLOGY FOR OCTOBER-MARCH

OCTOBER

Western larch needles turn gold, then drop

Snakes enter their winter dens, often in large groups, sometimes with other snake species

NOVEMBER

Elk and deer move to winter ranges

Fall storms bring in Rough-legged Hawks

DECEMBER

Pygmy Nuthatches huddle together in hollow roosting cavities

Snowshoe hares have shifted from summer brown to winter white

JANUARY

American Dippers continue to feed in open water

Search the snow for tracks from deer, squirrels, mountain lions, coyotes, and more!

FEBRUARY

Snow flies crawl over the snow on warm days

Bear cubs are born

MARCH

Osprey return to Missoula near the end of the month

Buttercups bloom yellow across the hillsides

SNAKE: JOSEPH BERGER, BUGWOOD.ORG; HAWK: EUGENE BECKES, FLICKR.COM; HARE: TIM RAINS, NPS PHOTO, FLICKR.COM; BEAR TRACKS: YNP, FLICKR.COM; SNOW FLY: TRASROID, FLICKR.COM; BUTTERCUPS: MATT LAVIN, FLICKR.COM

In-person programming may include masks and distancing, depending on COVID numbers.

Adult Programs

Stay tuned for other fall and winter programming, including lectures, First Fridays, 2-3-hour outdoor Naturalist Field experiences, and more. Check our website and social media for the latest information, or sign up for our e-newsletter at MontanaNaturalist.org.

SEPTEMBER

September 28
Left Behind: A Lake Missoula Island Insect Resident with Gary Belovsky, 7:00-8:00 p.m. Free and open to the public.

OCTOBER

October 6
OpenAIR Artist Presentation and Reception with Gunhild Lien, 4:00-5:30 p.m. Free and open to the public.

October 8
Annual Banquet & Auction, 5:00-9:00 p.m. ***Join us at the historic Wilma Theater for a special night of supporting and celebrating MNHC's 31 years of connecting people with nature and 20 years of our Visiting Naturalist in the Schools Program!*** $65.

October 17
Raptors Up Close at Wild Skies Raptor Center, 9:00 a.m.-1:00 p.m. $45; $40 MNHC members. Registration required.

October 20
Parasite Day! with Mike Kinsella, 1:30-3:00 p.m. Get spooky and see real, creepy/cool parasites up close with a world-renowned expert! $10; $5 MNHC members. Registration required.

SAM GETTY

October 21, 22
DIY Owl Pellet Bone Box. $25; $20 MNHC members. Pick up materials for this DIY at-home event between 11:00 a.m. and 4:00 p.m. on Friday, October 21, or Saturday, October 22.

October 26 & 29 **Beginning Family Birdwatching, 2-Part Class.** Wednesday 6:00-7:30 p.m. & Saturday 10:00-11:30 a.m. $40; $35 MNHC members. Registration required.

NOVEMBER

November 1 - December 6:
Online Field Notes Writing Workshop, 6-Part Class, Tuesdays, 10:00-11:30 a.m. $120; $100 MNHC members. Registration required.

November 7, 14, 21
Geology Rocks! 3-Part Class with Bruce Baty, Mondays, 10:00 a.m.-12:00 p.m. $45; $40 MNHC members. Registration required.

November 16 & 19
Birding for Beginners, 2-Part Class. Wednesday 6:00-8:00 p.m. & Saturday 9:00-11:30 a.m. $55; $50 MNHC members. Registration required.

DECEMBER

December 3
Wreath Making, Montana-Style, 2:00-3:00 p.m. $45; $40 MNHC members. Meet at the Fort Missoula Native Plant Garden. Registration required.

JANUARY

Mid-January to early March, exact dates TBD.
Certified Interpretive Guide Training Course. In person at MNHC. $235; you can pay an additional $150 to become an official Certified Interpretive Guide through the National Association of Interpretation. Registration required. Visit MontanaNaturalist.org for more information and to register.

FEBRUARY

February 7 - May 9
Spring Montana Master Naturalist Course, Tuesdays, 4:00-7:00 p.m., plus two Saturday field days, February 18 & April 8. $450; $425 MNHC members. Registration required.

Hone your birding skills with MNHC's new Birdwatching Club!

Missoula County is home to over 200 bird species, and naturalist Elena Ulev can help you discover them! From migrating waterfowl, raptors, and warblers in the spring to flocks of red crossbills and breeding owls in the winter, each season is fun and exciting to bird in. In the Birdwatching Club, we will visit different sites twice a month throughout the year to find what species are present and how they use their habitats. All experience levels are welcome on this adult program and binoculars are available to borrow.

Cost: $25; $20 MNHC members. If you sign up for a program, you can attend one or both of the dates that month. (Yes, you can attend two programs for the price of one!) Registration required.

MNHC PHOTOS

Time: 9:00 - 11:30 a.m.; 9:00 a.m. - 12:30 p.m. for Lee Metcalf

Dates & Locations:
September 25 @ Kelly Island
October 7 & 23 @ Greenough Park
November 9 & 20 @ Lee Metcalf National Wildlife Refuge
December 8 & 18 @ Maclay Flat
January 11 & 22 @ Council Grove State Park
February 7 & 19 @ Kelly Island
March 6 & 26 @ Fort Missoula

Join us on our monthly Saunters with a Naturalist!

Bring your curiosity and your own naturalist knowledge and join MNHC Naturalist Ser Anderson on a naturalist saunter—choose morning, evening, or both! We will focus on exploring the changing seasons, making observations, following our curiosity, and learning from each other. Whether you are an experienced naturalist or just starting out, these walks are for you!

Cost: $10; $5 MNHC members. Registration required.

Time: Morning saunters are from 10:00 a.m.-12:00 p.m. Evening saunters are from 5:00-7:00 p.m. There are no evening saunters from November - February.

Dates & Locations:
October 18 (p.m.) & 20 (a.m.) @ Kelly Island
November 17 @ Greenough Park
December 15 @ Fort Missoula Native Plant Garden
January 19 @ Kim Williams Trail
February 16 @ Crazy Canyon trailhead
March 16 (a.m.) & 21 (p.m) @ Greenough Park

Kids' Corner

Our summer campers had a blast this year, learning about everything from pollinators to citizen science, and practicing all the components of a naturalist: science, writing & journaling, and art. Enjoy a sampling of the many fun projects our campers accomplished this summer!

MNHC PHOTOS

Calling All Kids!

Do you have any nature art, photography, poetry, or stories you'd like to share? We showcase kids' work in every issue in our "Kids' Corner" —and here's your chance for that work to be yours!

Send submissions to
Allison De Jong, Editor, at 120 Hickory Street, Missoula, MT 59801 or
by email to adejong@MontanaNaturalist.org.

MNHC PHOTO

MNHC's Amazing Crew of Adult Program Interns

Since summer 2021, MNHC has had a dedicated, creative, and inspiring cadre of adult program interns whose hard work and passion for natural history has allowed us to offer more and diverse programs than we otherwise could, and we are immensely grateful.

Our interns, who are all certified Master Naturalists, commit for a season—spring, summer, or fall—and take on a variety of tasks depending on our needs and their interests. **Sam Getty** led behind-the-scenes tours of the UM Zoological Museum and created a series of educational videos. **Roy Curet** led a bioblitz at Rock Creek and helped staff our Master Naturalist Rendezvous weekend last spring. **Maja Holmquist** and **Michele Esser** developed the curriculum for and taught a multi-session nature journaling club. **Len Johnson** assisted with the entire week of our intensive June Master Naturalist course. **Lisa Robertson** and **Penny Hegyi** coordinated and staffed a well-attended family program with Bear Aware. **Michelle Jensen** developed work & learn days for our Native Plant Garden at Fort Missoula and also ran a bioblitz at Rock Creek. **Ellen Knight** has just begun interning this fall; she'll be leading an upcoming bioblitz at Rock Creek and is researching opportunities for more programming.

We are so thankful for these amazing, generous, and talented individuals, and so glad they chose to give their time and energy to MNHC.

Interested in being an adult programs intern? This is an exclusive opportunity for certified Master Naturalists, and we're looking for another great group of people for next spring (February-May) and summer (June-August)! Contact Christine Morris at cmorris@MontanaNaturalist.org for more information and to apply.

Letter to the Editor

I enjoyed the Spring/Summer 2022 article on Grow Safe Missoula and alternatives to traditional lawn care.

While the article included some outdated and misleading information regarding the applicability of certain herbicides to turf management, I totally agree with the premise that we need to minimize our use of herbicides and fertilizers for environmental reasons. But I think the article stopped short of hitting the most important point on turf management, and that's the whole idea of lawns themselves.

We as a society are addicted to lawns and that addiction is growing rapidly. Folks are buying larger lawn mowers to cut larger lawns around the larger homes that are sprouting up all over Montana. From a Montana dirt farmer's perspective, we're pouring more herbicides and fertilizers on more acres of lawn, then using bigger lawnmowers, which use more gas, to cut what amounts to a very expensive hay crop. And then, rather than feed that hay to livestock, we pay garbage trucks to burn fossil fuels to haul the crop away to a landfill. Add in the environmental impacts of producing and distributing the herbicides and fertilizers, and the climate change impacts of the gasoline burned by lawnmowers, along with the water and electricity to pump the water to your lawn, and you've got almost as many adverse environmental impacts as a golf course.

According to Montana Fish, Wildlife and Parks, 2021 was the driest year in Montana in ***more than two decades.*** According to the Environmental Protection Agency, a new gas lawn mower produces as many volatile organic compounds and nitrogen oxide air pollution in one hour of operation as 11 new cars each being driven for one hour. EPA data has also found that gas-powered lawn mowers make up five percent of total air pollution in the US, and even more in urban areas. Homeowners spill some 17 million gallons of gasoline every year just refueling their lawn mowers. This spilt fuel can get into your lawn, garden beds, groundwater, and nearby ponds, and some of it evaporates into the air as volatile organic compounds.

According to WaterSense, an EPA partnership program, 30 to 60 percent of urban fresh water is used on lawns. And most of this water is wasted due to poor timing and application, all while we experience record droughts due to our warming, rapidly changing climate.

I'd suggest the solution is to reduce, phase out, or shrink your lawn. If you live in the Wildland Urban Interface, consider a narrow green zone consisting of drought-tolerant grasses around your home as a fire break. Beyond that consider native plants and xeriscaping. These solutions solve problems beyond simply those of chemical herbicides and fertilizers... and save homeowners money, too.

Andy Kulla,
Florence, MT

—Andy Kulla worked in noxious weed, herbicide, and recreation management for the Lolo National Forest for 32 years.

imprints

WOW, Wings Over Water Was Wonderful This Year!

It was a long time coming: after two years of postponement due to Covid-19, the Wings Over Water (WOW) summer teacher workshop finally took place this July, and it was a fabulous success!

A joint program of MNHC and the Montana Osprey Project, WOW brings together middle school STEM teachers from all over the country for a week of intensive professional development experience. Teachers become Osprey experts as they join peers, researchers, and STEM professionals to experience real, interactive field work and education.

This year's cohort of fourteen teachers helped band Osprey chicks, learned about the physics of flight, and studied aquatic ecology, plus spent time in Butte visiting the Berkeley Pit and active restoration sites. They also dove into the latest national science standards as they workshopped WOW's award-winning STEM curriculum and created lesson plans of their own. To finish up an action-packed week, the teachers celebrated with a rafting trip along the Clark Fork. We couldn't have asked for a better cohort and can't wait to welcome next year's group in 2023!

This amazing opportunity continues to be free of charge for all accepted middle school STEM teachers. To learn more and apply, visit MontanaNaturalist.org/wings-over-water.

WELCOME, ANDREA!

PHOTO COURTESY ANDREA PANAGAKIS

We are thrilled to welcome Andrea Panagakis as our new School Programs Manager. Andrea joined MNHC in July, and we're excited to have the Visiting Naturalist in the Schools Program in her capable hands. Andrea's life has always revolved around science and nature. Raised in upstate New York on beautiful Oneida Lake, she received her B.S. in biology from Cornell University. Upon returning from a year abroad in France, she fell in love with teaching and completed a master's degree in secondary science education at Teachers College, Columbia University. During her twenty-year tenure as a high school biology teacher in New York, Pennsylvania, and New Jersey, she chaperoned trips to Honduras and Mexico to conduct biodiversity surveys and study reef ecology. In addition to her tropical travels, she volunteered for Glacier National Park's High Country Citizen Science Program, where she became captivated by the alpine environment and its species. This prompted her to embark upon graduate coursework at the University of Montana and a master's degree in biology at Université Laval in Québec.

Andrea's research on the life history of mountain goats in the Canadian Rockies of Alberta deepened her understanding of scientific processes as well as her appreciation for the challenge and fulfillment of learning. It also happily led her back to the Treasure State, where she integrated western and traditional ecological ways of knowing the natural world as an instructor at the Salish Kootenai College STEM Academy. In her new role at MNHC, she is excited to share her commitment to connecting people with nature by cultivating new generations of environmental stewards through experiential, place-based education. When she's not in the office/classroom, she's a four-season explorer with a passion for all things outdoors: trail running, wildlife viewing, surfing, swimming, cross-country skiing, cycling, and hiking.

MNHC PHOTO

PAT LITTLE

MNHC Has Gone Solar!

We can't contain our excitement over our most recent upgrade: a 76-panel rooftop solar array that will generate 99 percent of the electricity we use. This has been a dream of ours for a long time, and we are thrilled that it's come to fruition. We could not have done it without the unfailing support of our community! Thanks to a generous USB grant from NorthWestern Energy and donations from SBS Solar and several dozen supporters, we were able to install our solar array in July, and we've delighted in watching the kWh pour in. Want to see how much energy we're generating? Look up Montana Natural History Center at monitoringpublic.solaredge.com/solaredge-web/p/home.

Stay tuned for details on the indoor and outdoor solar exhibits we'll be adding, where you can learn more about solar energy in general and our array in particular!

As To The Mission

Building a Strong Foundation: MNHC's Operating Reserve Fund

A tenet of organizational health is having financial resources to lean on in tough times. It doesn't matter if you're Nike, Coca Cola, the United Way, or the Montana Natural History Center. When times get tough, you need access to capital, preferably money you don't have to pay back. You need a solid foundation.

And having this strong foundation allows an organization, like MNHC, to be more assertive, decisive, and strategic in our planning. Just what a healthy organization needs to carry out its mission.

MNHC PHOTO

In 2019, MNHC started a multi-year journey to not only extend our days of operating capital from a yearly average of three months but to create a fund to hold three months of operational money. Now, perhaps you're wondering: if MNHC has an average of 90 days cash on hand at any given time, why bother to do this? The answer: because an "average operating capital" number can be volatile and easily affected by events way beyond our control—as we were about to observe.

We ended the 2019 fiscal year with a budget surplus that we socked away into our newly born Operating Reserve Fund.

As we shared news of this momentum with some of our funders and partners, we were met with approval and urges to keep going. At the same time, the novel coronavirus emerged. Not to be deterred, MNHC took advantage of SBA grants and programs, and we ended the 2020 fiscal year with very little Covid impact and another modest amount to add to our Operating Reserve. Equally as important, a big opportunity emerged to continue growing our Operating Reserve Fund!

After hearing about our 2019 success and subsequent efforts, the Kendeda Fund offered to match donations dedicated to our Operating Reserve Fund in 2021 and 2022. And that's where the fun and good work really began—with many supporters stepping up and giving generously to help us build our goal of three months of dedicated operating reserve money, helping to ensure a solid financial future for the Montana Natural History Center for decades to come.

In addition to the many generous Reserve donations we received, we were honored to receive several legacy gifts during this period. Wanting to honor and steward these gifts in the best possible way, we used portions of each to help build the Reserve.

Now, with some great work in the rearview mirror, we are shifting gears into a more public phase of fundraising for this very important, mission-insuring effort.

To date we have raised $250,000 in matched donations by the Kendeda Fund toward our goal of $300,000—a solid foundation for the future. We are asking you, dear supporter, to help us get to the finish line. Every gift from our supporters from now until the end of 2022 will be matched dollar for dollar by the Kendeda Fund, doubling your impact. Please consider a generous gift today to strengthen the Montana Natural History Center.

Thank you, friends, volunteers, board members, supporters, and community members. We couldn't do this without you.

Thurston Elfstrom,
Executive Director

Donate online at MontanaNaturalist.org/reserve/ or scan the QR code:

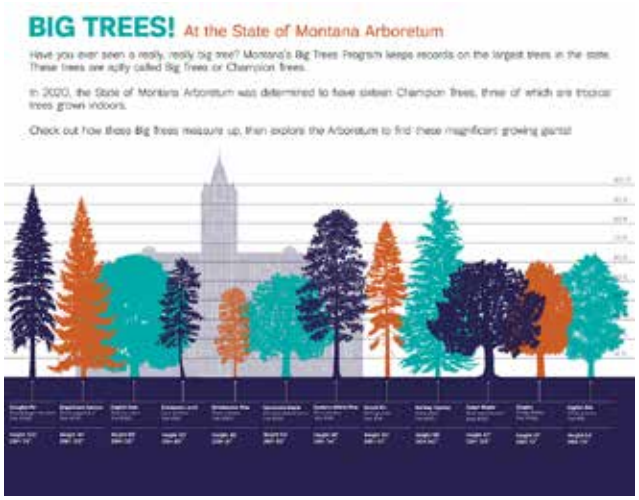
Check Out Our New Exhibits!

Naturalist Field Station Welcomes the State of Montana Arboretum

It's that time of year again: time to welcome our latest guest into the Naturalist Field Station, our rotating exhibit featuring local naturalists. This latest exhibit features the State of Montana Arboretum and wow, is there a lot to see!

Did you know that our state Arboretum is right here in Missoula? Stop by our Field Station exhibit to learn about its history and the trees it contains. You'll also get the inside scoop on what it means to be an arborist, learn about several trees common to the Arboretum, take a virtual tour, observe specimens up close, and more! Younger visitors can practice their skills with a microscope, make leaf rubbings, and enjoy some quiet reading time under a giant tree sculpture.

As always, a visit to the Naturalist Field Station is free with the cost of admission. The exhibit will remain in place for six months, so stop by soon and dive into the world of trees!



2022 Artists in Residence

MNHC once again partnered with OpenAIR Missoula this year, hosting two talented artists-in-residence.

COURTESY DAVID LUSK

In spring 2022 we welcomed **David Lusk,** a Missoula-based artist who specializes in detailed relief printmaking. From a tiny leaf moss to towering megafauna, his subject matter spans the natural world. During his residency, David's detailed observations of our Montana Ecosystems exhibit and Nature Adventure Garden came to life through his prints. David engaged with visitors as he carved and sketched at the Center, and shared a deep-dive into his process during his final artist presentation. Find his work online at anomalpress.com.

COURTESY GUNHILD LIEN

This September, we welcome **Gunhild Lien,** a Norwegian visual artist whose work addresses themes of social and environmental issues. She uses a variety of media including drawing, photography, painting, and installations that often contain fragments from nature, photographs, old family pictures, and found objects. Join us for her final presentation and reception on Thursday, October 6th, at 4:00 p.m. Find her work online at gunhildlien.com.

Coming Soon: Dig into Montana's Geology

Ancient Stories Connect Us with Our Landscape

MNHC is excited to announce our newest permanent exhibit, Stories on the Landscape. For billions of years, geologic processes have worked their magic on Montana's landscape. Mountains rise and fall, sediments erode, and waterways spring to life. New habitats are born and animals and plants take up residence. These forces all act as characters in an ancient, geologic story.

What about humans? We have always intertwined with the stories on our landscape. Geology impacts where we live, what we do, and how we travel. Unearth the geologic stories of our region and you can celebrate the landscape and your place within it! Stay tuned for more information on our new exhibit, which is set to open by the end of the year. We can't wait to welcome you to learn more about the stories on our landscape!

MNHC PHOTO

PHOTO COURTESY STORYCORPS

StoryCorps:
Sue Reel and Lisa Bickell Reminisce about MNHC

MNHC had the honor of participating in this year's StoryCorps, which visited Missoula in June. StoryCorps, which began in 2003, preserves and shares stories to build connections between people, to show the richness of our shared humanity, and to create an invaluable archive for future generations. Sue Reel, one of MNHC's founders, and Lisa Bickell, MNHC's education director from 2004-2019, shared a delightful and inspiring conversation about MNHC's early days and how it's grown and changed over the past 31 years. It's a wonderful story! Listen to it here: archive.storycorps.org/interviews/sue-reel-and-lisa-bickell/.

COURTESY OLSEN FAMILY

Remembering Arnie Olsen

We were saddened to learn that **Arnie Olsen,** MNHC's previous Executive Director, passed away in August. Arnie was at the helm of MNHC from 2007-2015, and under his leadership MNHC grew in many remarkable ways: we not only paid off our building, but also underwent an extensive remodel, steadily grew our programming, increased our staff, and, always, found new and deeper ways to connect people in the community with the natural world. We remember Arnie's love for nature, his deep commitment to family, his sense of humor, his kindness. He was a good boss, a compassionate leader, and a thoughtful human. He will be missed.

MNHC Embraces Diversity, Equity, & Inclusion

The Montana Natural History Center is committed to improving diversity, equity, and inclusion (DEI) in the Center and throughout its programs. In 2022 MNHC began partnering with Empower Montana to provide DEI training for staff, board, and seasonal employees. All staff received training in the use of pronouns this summer, and will engage in a larger, all-day DEI training this fall. We are also focusing on partnerships that include more of western Montana's diverse community, working with groups such as Latino Outdoors, Youth Homes, the YWCA, and more to provide free memberships to the Center and equitable financial access to our programs. MNHC also installed a land acknowledgement recognizing that the Center is located in the traditional homelands of the *Ta̓ta̓yaqn* (Bitterroot Salish) and *Qlispélixʷ* (Kalispel) peoples who have lived here since time immemorial. MNHC has plans for further partnerships with local tribes to bring more of their Indigenous knowledge and experiences into our programming.

If any of our readers have more ideas to continue strengthening our commitment to DEI practices, please reach out! We love hearing from our members and community about how to be more equitable and inclusive to the diverse communities we serve. Send your ideas and suggestions to Jennifer Robinson at jrobinson@MontanaNaturalist.org.

PHOTO: ANTONIO IBARRA OLIVARES

Remembrance and Gratitude:
Ruth Royter and Beth Thompson

MNHC was the recipient of two generous estate gifts this year, from people who gave much time and energy to MNHC during their lives, and continued that generosity after their deaths.

Ruth Royter was a long-time volunteer and supporter of MNHC. Her list of volunteer activities is long, and stretches back to programs that no longer exist at MNHC—Watershed Festival, Elderhostel, docent—as well as programs that are still running strong: Field Notes and Visiting Naturalist in the Schools. She was deeply involved with MNHC for many years, one of our rockstar volunteers, and we are so grateful for her time, energy, and generosity.

Dr. Beth Thompson was also a long-time supporter of MNHC, both during the years she worked tirelessly in medicine in the Missoula community and after she retired. We loved having her volunteer at our front desk; she was kind and open and made everyone feel welcome. She loved hiking and skiing and exploring Montana's wild places, and her support ensures that many others in the Missoula community will have the chance to fall in love with the natural world, too.

Beth's and Ruth's legacy gifts will allow us to expand our school programming, further our organizational health, offer more benefits to our staff, and accomplish our diversity, equity, and inclusion strategic goals. We are so grateful for both of these women and all they've done for MNHC, the Missoula community, and future generations of naturalists.

If you'd like to discuss impacting the stewardship of nature by leaving your legacy at MNHC through an estate gift please contact Mark Schleicher, Development Director, at 406.327.0405 or mschleicher@MontanaNaturalist.org.

Wild Skies Raptor Center: *Educating, Researching, & Rehabilitating*

BY ALLISON DE JONG

On a gorgeous June day I found myself in the forested hills of the Blackfoot Valley, surrounded by raptors.

I was visiting Wild Skies Raptor Center, a nonprofit organization focused on providing care, rehabilitation, and, ultimately, the release of injured raptors. Their 12.5-acre property is tucked away amongst a forest of ponderosa pines and Douglas-firs near Potomac, and is home to founder and executive director Brooke Tanner, her partner, Jesse Varnado, and several dozen raptors.

Brooke and I walked around the property, swishing through the tall grass to visit the various enclosures and say hello to the residents while Brooke told me the story of Wild Skies. Founded in 2010, the organization filled the space left empty by the dissolution of the Grounded Eagle Foundation in Condon in 2009. "They were one of the original raptor rehab facilities in the U.S.," Brooke told me. It was also the place she'd worked for several years, finding her way there via Ohio, where she grew up; Colorado, where she attended vet tech school; and Seeley Lake, Montana, where she worked at Paws Up before being offered full-time work at Grounded Eagle. "It was my dream job," Brooke said, and when the organization dissolved, the best way she found to keep doing what she was doing was to create her own nonprofit.

With support and guidance from Rob Domenech at Raptor View Research Institute, she founded Wild Skies. Jesse joined her two years later, and two years after that they purchased their current property and began the slow and steady process of transitioning it from former hobby farm into raptor care facility. Brooke's been rehabilitating raptors ever since.

Every year has gotten busier, with more phone calls and a shorter span between busy seasons. In 2021 Wild Skies took in 124 raptors, and they're on track to beat that number in 2022. Add to that the 17 education birds that live on site year-round, the research projects Wild Skies participates in, and the education programs they offer, and the result is a not insignificant workload (Brooke hasn't taken a vacation in over five years).

But Brooke loves her work, even when it's hard—and it's often hard. Of the birds Wild Skies takes in that don't die within 24 hours, about 60 percent are successfully rehabilitated. But even rehabilitation and release don't guarantee survival; Brooke recounted multiple stories of released birds who died after only a few months or years. Several died from lead poisoning. Others were shot. Still others died of rodenticide poisoning. "There are just so many things working against these birds," Brooke told me. "It's all these human-related issues that are killing them."

Even their initial injuries and illnesses are almost solely human-caused: vehicle collisions top the list, while the birds also suffer from electrocution, run-ins with barbed wire fences, window collisions, and the ever-present lead poisoning. Brooke and Jesse do almost all the rehabilitation on site, with the exception of x-rays and surgery that are done for free at the Missoula Vet Clinic, where Brooke works one day a week. But the lab work, diagnostics, medicating and bandaging, and the various steps of strengthening the birds' bodies and flight muscles are all done right at Wild Skies.

Brooke showed me where the birds end their rehab, a big blue horse barn that she and Jesse renovated completely. They removed all the stalls, then built two 30-foot flights and two 40-foot flights—spaces that are specially designed to encourage birds to fly.

"There are just so many things working against these birds."


Brooke examines a Great Horned Owl after removing it from the grill of the pickup that hit it the previous night.

Larger raptors like eagles and Red-tailed Hawks get finished off in the huge, sloping flight field next to the barn. Brooke puts an anklet on, say, a Bald Eagle, and attaches it to a creance, a 100-foot paracord line. Jesse then tosses the bird, so it flies down the slope, while Brooke breaks the line to encourage it to flutter down gently. Then she walks the bird back up to Jesse to do it all again. And again. Raptors are smart, and get the idea pretty quickly.

When I asked what permits Wild Skies needs for the hundred-plus birds that come through their facility each year, Brooke told me that they have two

separate types: one for rehabbing the birds, which are all federally protected species, and the other for their education birds. Because the education birds are permanently injured and non-releasable, they have to apply for a permit for each bird individually. Brooke was thrilled that their eagle exhibition permits have finally come through after two-and-a-half years; their captive eagles haven't begun doing programs yet, but Brooke and Jesse have started to acclimate them to people. (Stay tuned for future eagle programming!)

Most of the permanent residents have their own enclosure, though some of the smaller raptors, whose enclosures are in the "little bird" room inside of the main house, get paired up for companionship and enrichment. Wild Skies' education birds include: Roland the Swainson's Hawk, injured from a tangle with an electric wire; Minerva the Screech Owl; Prairie the Prairie Falcon, injured from a barbed-wire fence collision; Frith the Great Horned Owl, an ambassador bird since 2015; Daya the Northern Saw-whet Owl, who only perches on flat surfaces; and a tiny Northern Pygmy Owl who's just started doing programs.

Education has become an important part of Wild Skies' work. "When I started, I had no desire to do education," Brooke told me. "But the longer I do this work, the more I realize how important the education part of it is." Wild Skies' eagle permit requires them to be open to the public 400 hours a year, and they've been focusing more on onsite programming, with Audubon groups and buses full of students coming to learn about raptors. (MNHC is bringing a group to Wild Skies in October—see our calendar for details!) Visitors love seeing raptors up close and hearing their individual stories, and many are inspired to learn what they can do to keep other birds from suffering the same fates.

What can we do to help raptors? Brooke says there are a few important changes we can make. "Give them a brake" may be the most important, with the most positive impact. Vehicle collisions are a huge cause of raptor injury, and simply slowing down when you see an eagle on the side of the road can mean the difference between life and death (or debilitating injury). Keeping feeders away from your windows and decorating your windows so that birds don't smack into them will benefit songbirds as well as small raptors. Hunters can switch to copper bullets instead of lead, which will help prevent truly horrifying raptor deaths—a lead-poisoned eagle is something you never want to see, but Brooke deals with them on a regular basis.

The hardest thing about her work, Brooke said, is seeing the intentional ways that people hurt raptors. "I know what these birds go through to survive in a day, to raise their young, to migrate long distances," she told me, and it breaks her heart to see them shot down with a pellet gun. Education, she knows, can help change that.

But Brooke's favorite aspects of her work have remained consistent throughout the years: getting to know the birds and their individual personalities, and getting to release birds they've worked so hard to nurse back to health. "When you first see them struggling and in pain, and you get them to a place where they can get back out there and do their thing—it's awesome."

A Northern Pygmy Owl after getting an x-ray at Missoula Vet Clinic. He was unable to fly after a window collision.

Interested in getting involved?

You can learn more and donate at wildskies.org. Brooke accepts volunteers, but is particularly looking for people who can commit to a regular schedule and don't mind doing a fair bit of cleaning (think: cleaning up after 30 meat-eating, captive birds), so that the trained staff can focus on the rehab work.

Wild Skies RAPTOR CENTER

A Bald Eagle is released in Whitefish after being treated for lead poisoning—one of the moments that makes all the challenges worthwhile.

Brooke talking about Northern Saw-whet Owls with a class from Superior on their field trip to Wild Skies.

PHOTOS: WILD SKIES RAPTOR CENTER

Elk Neighbors

STORY AND PHOTOS BY KELSI TURNER

I was living in a 144-square-foot treehouse with my family the first time I encountered a herd of elk.

Straightening the quilt on one of the cots, I glimpsed movement through a window and rushed—barefoot—to the narrow deck to see what it was: a herd of 200 elk galloping along each rise and dip of the valley below the treehouse.

The vibration of their hoofbeats flowed across the land, up through my feet and, eventually, my heartbeat synchronized with it. It was the loudest quiet sound I'd ever heard.

Their long legs brushed and crushed the foliage as they ran, activating a perfume of mint, grass, wind, sage, soil, and fir needles overlaid with the scent of elk, which is not unlike that of a horse, though wilder and deeper.

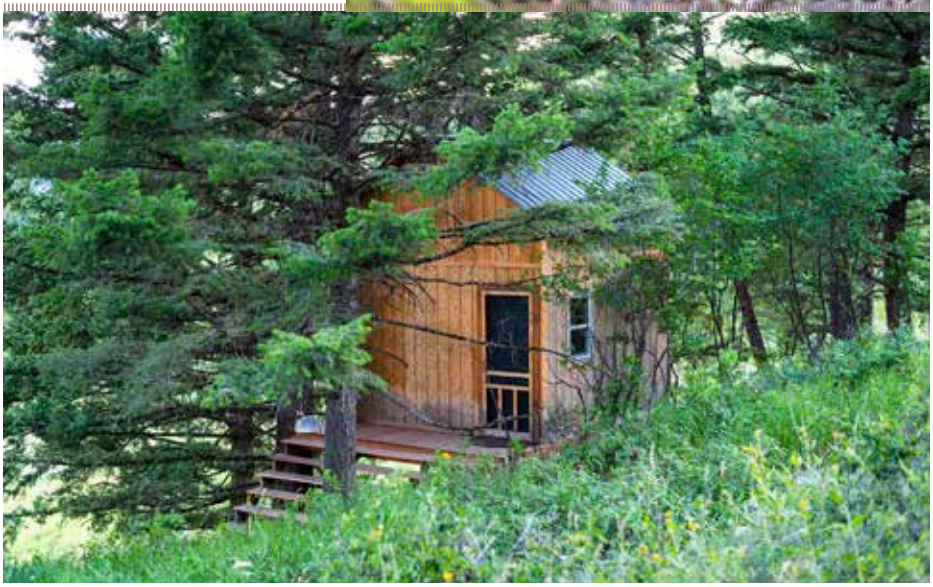
Treehouse living was simply a stopgap in housing for my family as we built our modest home on the same land. But it ended up being much more.

Despite living in an elevated treehouse, I'd never felt more connected with the earth. Every day there was a new flower to study. A bird family made a nest in the eaves. A mini-museum of rocks, shells, sticks, bark, lichen, bones, and plants sprang up on the stairs. Fairy houses magically appeared around trees whose trunks were surrounded with lush

Above: Our elk neighbors, bedding down in the meadow during an early snow.

Right: We quickly discovered that along with elk, moose, bears and so many different kinds of birds, that fairies also were our neighbors.

Below: Hawk House, nestled in the trees.



moss. Squirrels explored the Lego houses my kids built on the deck.

But it was the elk herd that gave me something majestic to set my sights upon—much needed long-term perspective when my days were filled with hauling water, preparing nourishing meals with only a cooler and camp stove, dashing into town for supplies from the hardware store, cleaning up after workers.

One morning, paralyzed by the day's to-do list, hot coffee in hand, I sat on the treehouse steps, flipping through one of my old journals when I found a handout about Zuni fetishes—small carvings made primarily from stone by the Zuni people—that I'd saved after visiting historical sites in the Southwest. According to the page, the elk teaches that pacing yourself will increase your stamina. I sat quietly with this wisdom.

From our perch in the treehouse, we watched the elk like some people watch television. Through binoculars we observed the elk as they moved through the distant aspen stands, visited the creek, moving closer to us as they slowly grazed their way uphill. A brief rainstorm would make it through the valley most afternoons, and the grasses and forbs grew to a rich blanket of emerald. The cows and calves fed on the abundant asters, daisies, dandelions, elk thistle, and grasses.

As the elk climbed, they'd eventually reach shelter in the mature Douglas-fir forest just to the east of our treehouse—entire herds disappearing into its deep, protective shadows. The mosaic of grasslands and forests seemed well-suited to provide what the elk herd needed most: food and shelter.

This habitat was well-suited for my family as well. Our lives were flensed to the essentials: food, shelter, sleep, love. And beauty.

In deep summer, I hiked the ridge to the west to see the wildflowers. I was engrossed in observing the new-to-me flowers when two large, dark animals exploded into my field of vision. I dropped to the ground, heart thudding like a bass drum. When I looked up, two Golden Eagles—with wingspans of more than six feet—were above me. I quickly abandoned my hike. Weeks later, I returned to the spot and discovered the picked-clean carcass of an elk calf.

Our lives and the lives of the elk became more interwoven as the days progressed.

At supper one evening, we all sat on the deck stairs, silver camp plates balanced on our knees. Mid-bite, my daughter spotted a group of six bachelor bulls in the gloaming, alert, belly-deep in grasses. We could sense their excitement, their energy. The seasons were shifting.

When the rut started that autumn, I kept the windows of the treehouse open so we could listen to the bulls' bugles ringing out. We had never heard anything so sonorous, urgent. Lying in our cots in the dark, I teased my kids that it wasn't elk living in our small valley of the Gallatin Mountains, it was a herd of elephants.

One day, we watched, rapt—two enormous bull elk, antlers locked, battling for control of a harem of females. Like the calls of the migrating Canada Geese in my childhood, the elk calls helped my body understand that autumn had arrived.

When an early autumn snowfall left 10 inches on the ground, the elk nestled in the fluffy snow on the south-facing slope amidst the stand of Douglas-fir trees where our treehouse stood. In the morning, we tromped through the snow, noting the oval-shaped depressions in the ground. We marked it as our first elk slumber party.

Two days before the permanent winter snow fell, we moved into our new home. After a week of steady unpacking, it dawned on me that the valley was quiet. The elk were absent. They had migrated downslope—across steep hillsides, through raging rivers, over rough terrain—to the valley grasslands where they wintered to seek shelter and new sources of food and to escape the deep, immobilizing snow of higher elevations.

That winter, my family had winding conversations about living in tandem with the elk. We considered what living in the Greater Yellowstone Ecosystem means and what responsibilities come with that gift. We studied maps created by Montana State University and learned that the land where we live was historically considered common hunting ground by Native American tribes. This knowledge helped us better understand our place in a deep, abiding culture of stewardship.

Top: The mini-museum's exhibit changed daily.

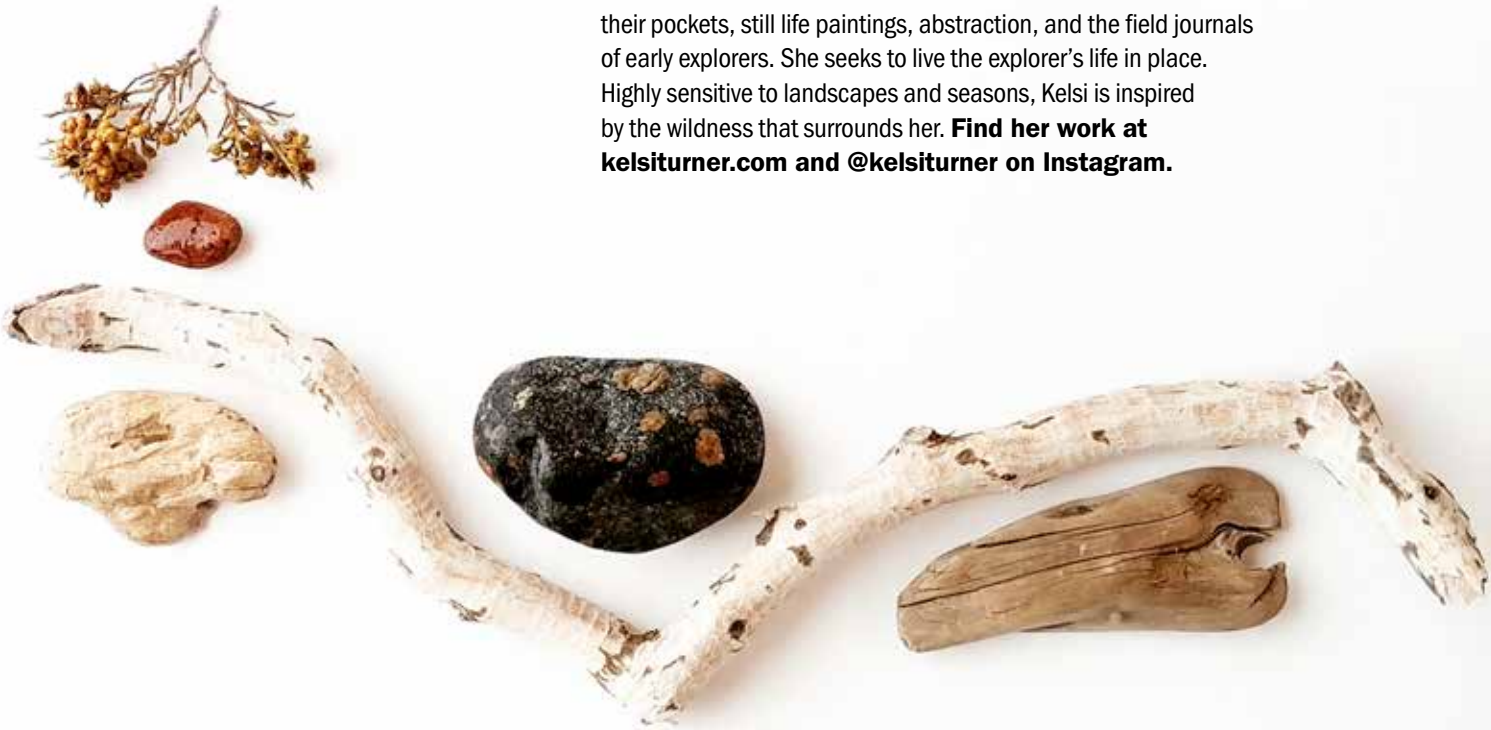
Above: One of the best parts of living in Hawk House was our epic pillow talk sessions. The kids slept in the loft, just above the cots.

Beeswax candles glowing, hot peppermint tea in hand, my family made plans. We talked about what modern stewardship looks like. We sketched plans to grow native plants where the soil surrounding our home had been disturbed by heavy machinery. We reached out to experts to find ways to make existing fencing in our area more wildlife-friendly. We read books. We asked questions. We decided not to raise fences, not to spray chemicals, not to get a dog.

And then early summer arrived and with it the heavily pregnant cows. Slowly, we began to recognize some individuals in the herd. We watched, through binoculars, as a cow elk gave birth. When the herd made their first run down the ridge and into the valley, we raised our arms over our heads in wonder and gratitude and welcomed them home.

—Kelsi Turner is a writer and visual artist whose work centers on connection to and stewardship of place. Find her at kelsiturner.com and kelsiturnerwrites@gmail.com.

Kelsi Turner is a writer and visual artist who makes art as a way to deeply observe, delight in, and steward place. Her work has its roots in the curious treasures with which her children fill their pockets, still life paintings, abstraction, and the field journals of early explorers. She seeks to live the explorer's life in place. Highly sensitive to landscapes and seasons, Kelsi is inspired by the wildness that surrounds her. **Find her work at kelsiturner.com and @kelsiturner on Instagram.**



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