



Montana Natural History Center

Spring/Summer 2022

MONTANA Naturalist

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



**Rocky Mountain Tailed Frogs,
Plains Spadefoot Toads, and
How Hydrology Connects Them**

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Cover – Nestled among the ferns, shooting stars (*Dodecatheon pulchellum*) will soon burst into full purple glory along Sweathouse Creek in the Bitterroot Mountains. Photo by Merle Ann Loman, amontanaview.com.

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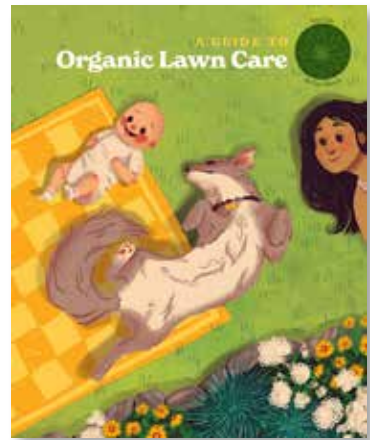
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tidings

March 2022: the spring equinox is nearly upon us,

a time of rebirth and renewal. I imagine we are all particularly ready for it this year, as we wrestle with what feels like unrelenting hard news: war, climate change, two full years of struggling through a global pandemic.

The weight of it all is both impossible and constant.

In the midst of all this heaviness, I've found myself buoyed up by stories from around the world: people working to combat climate change by listening, learning, and building community. Talented athletes from dozens of countries competing in the

winter Olympics, a testament to determination, overcoming challenges, and the incredible capacity of the human body. Riveting films from the Big Sky Documentary Film Festival, always a source of inspiration in the stories it brings in, stories that provide windows into lives entirely different from yet remarkably relatable to our own.

"In order to find your way you must become lost," says Nigerian writer and philosopher Bayo Akomolafe, and at a time when many of us are feeling lost, these stories give us hope that we can yet find our way. The stories that resonate most with me are the ones in which people find themselves, by choice or by circumstance, on a new path that connects them more deeply with the world around them.

How, then, do we forge a new path? Rooting ourselves in the natural world is so often a good place to start, and spring in Montana is a glorious time to do it. There is so much to celebrate, as many of the pieces in this issue show. Biologist Shane Morrison shares delightful stories of how—and why—young mammals play, and encourages us to go out and observe their playfulness for ourselves (page 4). Zoologist Paul Hendricks zooms in on some often-underlooked animals: Montana's slugs and snails, which are remarkably diverse and surprisingly satisfying to study (page 10). U.S. Forest Service park ranger Cortney Reedy revels in the amazing adaptations of water shrews, whose ancestors coexisted with the dinosaurs (page 24). And naturalist Alyssa Roggow writes of spadefoot toads and Rocky Mountain tailed frogs, the intricate relationship they have with Montana's complex water cycle, and how their story, and survival, affects ours (page 7).

Our stories are all interconnected. And letting ourselves "become lost" gives us greater opportunity to intersect the paths of others, whether that of a snail, water shrew, fox kit, or fellow human being with their own unique story.

Let's challenge ourselves to become lost, this year. Let's see what new paths may unroll before us, and what unexpected places they may take us. Let us know what you find, and learn. We'd love to hear your story.

Allison De Jong

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ALLISON DE JONG



At Play in the Wild

How Young Mammals Develop Skills and Have Fun Doing It

STORY AND PHOTOS BY SHANE MORRISON

Clockwise above:
Two-month-old red fox kit pounces
on its sister.

Swift fox kits pounce and nip
while playing.

Swift fox kits take turns pinning
each other.

Just like the big boys, young bison
calves romp and butt heads in mock
competition.

A pronghorn doe watches over a
playgroup of fawns.

One-year-old grizzly cubs play-fight
ferociously, wrestling, biting, swatting,
boxing, and testing each other's
strength—all without real injury.



One morning late in May, two young red fox kits were resting in the meadow grass near their

den under the old barn. The male fox rose in a crouch and snuck up on his sister where she lay with her back turned to him. He sprang into the air and pounced, his front feet landing on her head. She leapt up, pounced back, and off they raced, one after the other.

Few moments in nature are more entertaining to watch than young animals frolicking playfully. Montanans have the opportunity to find a variety of animal families simply by getting outside and spending some quality time in nature. In spring and early summer, you may get lucky and see young mammals at play. Squirrels are quite playful, engaging, and easy to find. They play chase, rushing up and down the tree trunks and leaping from branch to branch in an arboreal free-for-all. Or try sitting quietly by a riverbank and looking for river otters. One of the most playful species, they dash along the water's edge, slide down muddy riverbanks, and climb all over each other. Much of their play is spent swimming and chasing each other underwater. The adults seem to play almost as much as the kits.

In general, mammals seem to have an innate predisposition to play. However, play consumes a lot of time and energy, so there must be good reasons why play behavior evolved. Watching various animals over the years, I became curious about how and why they play. Behavioral ecologists have proposed various theories, several of which are reinforced by what we know about play in humans.

Play and Mammalian Development

Play seems to serve multiple roles in a species' physical and behavioral development. This apparently improved a mammal's survival and reproductive chances.

As play emulates adult behaviors, it develops the muscle strength, agility, and skills like hunting or eluding predators that animals need to become self-reliant adults. For example, bobcats, foxes, and coyotes largely hunt small prey such as mice and voles, so these predators also tend to employ similar hunting strategies. Young cubs and pups play hide and seek, stalk each other or lie in ambush, and then pounce, launching a surprise attack. They'll pounce on anything that moves including moths, grasshoppers, blowing leaves, and especially each other. Pouncing is an innate hunting strategy, likely

deeply rooted in the evolutionary history of carnivores as it is found in other predators like wolves and bears.

While play can be solitary, it is often social. Social play—play between two or more animals—can be particularly important in the social development of young mammals. They learn through play how to interact and cooperate in different social contexts. At least in theory, play tends to reduce friction between pack mates or family members and increases social bonding and trust.

Social play by its very nature involves cooperation between players, even when social play is competitive. Human play is often competitive: we compete in sports and while playing cards or board games. As with humans, as long as animals play fairly, play gives them a way to compete and test themselves against their playmates without risk of injury. Particularly for males, play-fighting hones their competitive drive and the abilities necessary to compete as adults for dominance, food, territory, and mates. Young animals that play fair tend to be appropriately competitive and cooperative as adults. Consequently, they're accepted into their social group and more successful in mating.

We can see the role of play by looking at examples from two different groups of highly social mammals. Socially, ungulates are herd animals. Pronghorn fawns gather in playgroups not long after birth to romp and race across the prairie, while a nanny—one of the does—watches over them. Bighorn sheep lambs and mountain goat kids spend much of their time climbing and jumping from rock to rock. Bison calves kick, buck, jump, and race about. But ungulates are also competitive, as young males will butt heads during play, preparing for the day they battle for the right to mate.

Probably the most social animals, next to humans and other primates, are wolves. They usually hunt cooperatively in packs, because they hunt game like elk and bison that are much larger than they. Wolves also engage in inter-pack warfare, much like human tribes. The development of a dominance/submissive hierarchy is important to the stability of such a large group as a pack. Play is very important in socialization, so adult or yearling wolves will often play with the puppies by *handicapping* themselves to match the puppies' abilities. They'll play-crouch and roll onto their backs, feigning submission. They'll let the pups jump all over them, nipping their legs and ears. Then they may take off in a chase—much to the delight of the pups. Puppies also wrestle amongst themselves. Such play fosters dominance, competitiveness, and cooperative behavior in the littlest pack members.

Differences in Play

For the most part, the basic ways mammals play are markedly similar, yet significant differences exist between very different groups. To get a glimpse into the origin of these differences requires comparing play and other behavior across different taxonomic groups. A major factor in how a species' behavior evolved is the cost/benefit tradeoff between behaviors. This tradeoff considers the benefits of play, the cost of play in terms of the time and energy expended, and the time and energy



Two red fox kits start a game of chase by first play-bowing.

One day I watched a grizzly sow who had recently lost one of her cubs play with her lone remaining cub. First she ran away while looking over her shoulder, and then, pivoting around behind him, she started to chase the cub in circles.



mountain goat kids.

In addition, young mammals have an intense curiosity about their new world. Play may seem like random activity because young animals often explore in an undirected manner, wandering, discovering, and experimenting. But this exploratory play stimulates brain development and is closely related to intelligent problem solving—which is key to learning and adapting to new situations. Exploratory play seems particularly important to opportunistic omnivores like bears.

Signals in Play

Most of the time it's obvious when animals are playing, but sometimes it's difficult to tell, because, as we've seen, play is not a single type of *purposeful* behavior. Rather, play can be complex and often highly varied, emulating *other purposeful behaviors* needed in adulthood such as competition, cooperation, hunting, etc. It can be particularly difficult to distinguish competitive play from rivalry or territorial aggression.

But there are cues we can watch for. Mammals usually express their desire to play to others by various signals involving body posture, facial gestures, tail and ear position, and vocalization. If the other animal reciprocates with an accepting gesture, they begin to play. These play signals differ by species. One example common to dogs, wolves, coyotes, foxes, and bears is a *play bow* that, in my observations, usually precedes a game of chase. The front legs are outstretched, head low, expression excited. Wolves and dogs often wag their tails. The other player reciprocates with a bow, then a dodge, and off they run.

Over years of watching various animals in their natural habitat, I have learned a lot about how they behave, including how they play, yet today I have as many questions as answers. The more I learn, the more new questions arise. Lately, I've been interested in comparing how different carnivores communicate during play. What vocalizations do they make when play fighting? For example, bears do not vocalize during play fighting, but they do growl and roar during a real fight. What about other mammals?

Late one summer evening, while pondering such questions, I watched a bear family play hide and seek among the deep sagebrush. As the sun sank, hovering just above the western mountain range, the grizzly sow took off at an easy lope along a low rise. She glanced over her shoulder as one by one the cubs gave chase. And as I watched, I saw in the grizzly and her cubs a wild playfulness that seemed to transcend species. 🐾

—Shane Morrison is a retired computer scientist, systems engineer, and biologist with a long-standing interest in animal behavior and ecology. He is a certified Montana Master Naturalist.

FOR FURTHER READING

The Emotional Lives of Animals by Marc Bekoff (chapter 4 in particular)

The Rise of Wolf 8: Witnessing the Triumph of Yellowstone's Underdog (the Alpha Wolves of Yellowstone - 1) by Rick McIntyre

Becoming Wild by Carl Safina

demands of competing activities essential to survival, like foraging, sleeping, or finding shelter. These tradeoffs influenced how play behavior evolved in different species.

For example, ungulates are *precocial*, meaning their offspring are born in a fairly advanced state of maturity, able to move independently and feed themselves soon after birth. They can run within the first couple of days, as their survival depends on being able to elude predators. Although they are nursed for a period of time, they begin foraging soon after birth. However, grazing and browsing are time consuming, limiting time for play.

With *altricial* species, like carnivores, the offspring are born helpless and require significant parental care and feeding for an extended period. For example, before young wolves can hunt large game like elk, they must not only grow to adult size and strength, they must learn how to hunt. It takes a couple of years to develop the cognitive ability to detect and select the right prey and know how to inflict a kill. Since their food is provided to them when they're young, they can afford the playtime necessary for extended development.

Motivation for Play

The value of play to mammal development isn't the whole story behind why mammals play. What *motivates* them to play? The more you watch them play, the more you realize they're having fun! Research has shown that play produces endorphins in the brain that induce pleasure, further reinforcing play behavior. This seems to be true for most mammals.

Especially in the morning, young animals have so much pent-up energy they are compelled to play. Early each morning our retriever puppy, Scout, gets a bad case of what I call the "zoomies." He spins in circles, then leaps and races around the house. Similarly, numerous times I've watched fox kits get up from a nap with the *zoomies*. They start racing, chasing, leaping, and pouncing on each other non-stop for almost an hour. This is just as true for many other young animals like bison calves, bighorn lambs, and

FROG AND TOAD TOGETHER: HOW HYDROLOGY CONNECTS THE MOUNTAINS AND THE PLAINS

BY ALYSSA ROGGOW

Soon you'll hear them. As spring rains tame the dust of the Montana plains and rinse the grasses briefly to green, spadefoot toads (*Spea bombifrons*) will stir for the first time in a year and clamber from burrows beneath the soil's frostline to the surface. There they will congregate in pools of snowmelt and rainwater, and they will sing.

To our ears, "singing" may seem an over-generous description of this mating chorus. A pond well-populated with *bombifrons* sounds a bit like a classroom full of kindergartners with kazooes. For the toads, however, there are no accompanying giggles, because they are in a race for survival—a race against evaporation.

Water doesn't come often to the prairie east of the Rocky Mountain Front, and what little there is doesn't stick around long. This region has a semi-arid climate, which means the amount of precipitation that falls in a year is less than the rate at which moisture is returned to the atmosphere through plant action and evaporation, a combination of processes called evapotranspiration. For an amphibian like the spadefoot toad, this water scarcity defines every aspect of its life cycle.

Once the toads have mated, females will lay an unseemly number of eggs—up to nearly four thousand—in the temporary pools and ponds near their burrows. Surviving adults will feed on small insects and spiders, then use the keratinous "spades" on their hind legs to dig new burrows in which to wait out the coming heat. The babies, meanwhile, hatch into tadpoles within a single day and metamorphose into adults within a few weeks—one of the speediest toad childhoods on the North American continent. Many tadpoles are omnivorous, feeding on algae and small invertebrates. If there is an abundance of fairy shrimp, or if the water is drying up quickly, some tadpoles morph into carnivores (and sometimes cannibals) with large, serrated mouthparts. These tadpoles become adults faster than their omnivorous siblings, but will be indistinguishable from them once reaching adulthood. If their aqueous home lasts long enough, the newly grown spadefoots join their parents underground just in time to avoid a scorching.

Spea bombifrons burrow to depths of almost a meter, where traces of moisture remain in the soil—but little do they know their burrows act as a positive feedback switch, an action in which a community of organisms alters its environment to be more suitable to the community's needs.

As spring wanes and summer progresses, the sandy soils above the toads dry out, grasses and plants fall dormant, microbial life slows, and the soil compacts. Ironically, the drier soil becomes, the drier it wants to remain: compact soil becomes hydrophobic, so that sudden surges of water, like melting snow and spring rains, run off quickly instead of soaking in.

These same surges of water call *Spea bombifrons* from their burrows at just the right moment. As they scramble to the surface, they leave behind deep channels of loose soil: pathways for water to penetrate the hard ground and initiate a chain of reactions. As moisture returns to the deeper soil, hosts of microbes resume eating, pooping, and reproducing. They band

together to create teeny-tiny hydrophilic pockets, or pores, in the soil, which hold water and create space for further infiltration. All the while, *Spea bombifrons* sing and carry on with their reproductive blitz as the burrows they abandoned help sustain their habitat by allowing water to reach deeply into the soil.



The black, tough "spade" on their hind feet gives spadefoot toads their name, and helps them to dig burrows in the dry, sandy soil of their prairie habitat.



...but little do they know their burrows act as a positive feedback switch, an action in which a community of organisms alters its environment to be more suitable to the community's needs.

Spadefoot toads are not the only creatures who adapt to water scarcity by digging; humans dig, too. While *bombifrons* have learned to make the most of transient surface waters, humans dig wells to tap into a deeper resource: groundwater. Beneath the deepest burrow of a spadefoot toad, water saturates the substrate and flows through an ancient geologic formation known as the Madison Limestone Aquifer. Though this formation underlies large swathes of the plains in Montana, Wyoming, North Dakota, and South Dakota, the journey of the water it carries begins far away at the top of the world.



High above the plains, Rocky Mountain tailed frogs (*Ascaphus montanus*) live in almost complete antithesis to the plains spadefoot. Here, Engelmann spruce and subalpine fir flock the mountainsides, and the air is thin and spicy with resin. You can listen day and night, but you'll never hear a Rocky Mountain tailed frog; these frogs have no eardrums, and they do not call to each other. Instead, you'll hear a sound the spadefoot toad, buried in its barely damp burrow, can only dream of: fast-moving water, and lots of it.

Rocky Mountain tailed frogs live in the subalpine zone in quick, cold streams that flow all year. They're as uniquely adapted to this persistent water source as *Spea bombifrons* are to their intermittent watering holes. While a spadefoot toad reaches adulthood in three to four weeks, *Ascaphus montanus* lingers in the tadpole phase for three to four years. During this time, tadpoles cling to rocks and stream debris using an adhesive oral disc (aka

“mouth suction cup”) to prevent being swept downstream.

Swift currents also make it risky for adult Rocky Mountain tailed frogs to carry out the usual method of reproduction. In other frog and toad species (including *Spea bombifrons*), reproduction occurs externally when the male grabs the female in an embrace known as amplexus. This hug triggers the female to release her eggs into the surrounding water, which in turn triggers the male to release his sperm. In quiet waters, the chances of sperm and egg meeting are high. In a fast mountain stream, however, both sperm and egg would be washed away unfertilized. Rocky Mountain tailed frogs instead practice internal fertilization, and are the only known species of frog to do so. That “tail” isn't a tail—it's a cloaca. In



Before metamorphosing into their adult form, Rocky Mountain tailed frogs spend three to four years as tadpoles, living in cold mountain streams. Their mouths are located underneath (rather than at the front of) their heads and have a series of folds that essentially create a suction cup, allowing them to cling to underwater rocks.

the fall, a male uses the cloaca to deposit sperm inside the female. She then carries the sperm in her body through the long winter as she hibernates beneath a rock (*Ascaphus montanus* don't burrow into the streambed or substrate as *Spea bombifrons* do), and releases it to fertilize her eggs in spring when conditions are to her liking.

Despite their many differences, Rocky Mountain tailed frogs rely just as heavily

The Madison Limestone Aquifer stretches more than 600 miles north and east of its Rocky Mountain sources into the eastern Dakotas and Manitoba, and belongs to a system of interconnected aquifers that underlie more than 300,000 square feet of the Northern Great Plains. Some of that water surfaces naturally: Giant Springs, located along the Missouri River in Great Falls, is one of the largest springs on the North American continent, and is fed by the aquifer about 400 feet below. Elsewhere, water is pumped to the surface for human use.



Don't be fooled—that's not a tail, it's the "copulatory organ" of a male Rocky Mountain tailed frog. This structure enables the males to internally fertilize the female frogs' eggs, keeping them from being washed away in the swiftly moving water.

and potentially frozen soils would cause spring meltwater to flood into streams and wash rapidly down the mountains, leaving behind dry streambeds and desiccated *Ascapthus montanus*.

The upper limit of the subalpine zone is the treeline, where conifer forests meet the exposed, rocky alpine zone. Here, trees act like a snow fence, abruptly slowing the scouring winds and collecting deep snowpack on their leeward sides. As a tree grows taller, it slows the wind more and more and accumulates a deeper snowpack. The more trees there are, the more the wind slows and the deeper the snowpack. But surely more snow means more water rushing away downhill in the springtime? In fact, when the snowpack is shallow or non-existent, forest soils freeze solid in extreme winter temperatures. Come spring,

though there is less snow, more of it runs off the hard ground directly into nearby streams, too quickly to be of use to the surrounding forest. Under a deep snowpack, soils are protected from the cold air and remain biologically active all winter—and, as is the case on the plains, microbial and vegetal activity makes the ground ready and able to receive more water. Water that seeps into the soil takes more time to reach a streambed, sustaining its flow far into the summer season. So, a tall stand of trees leads to deeper snowpack, which leads to better infiltration: a set of positive feedback switches that support the

Rocky Mountain tailed frog's habitat.

The canopy of a healthy subalpine forest is a patchwork of tree heights and foliar densities that also moderates the movement of spring meltwater. Snowpack in meadows and areas of light tree cover melts soonest, while shady regions may leak snowmelt all summer long. This graded melting process supports tree health by making moisture available to tree

roots throughout the dry growing season (positive feedback switch!), and it also sustains streamflow for *Ascapthus montanus*.

he lives and habitats of *Spea bombifrons* and *Ascapthus montanus* belie the "dog eat dog" world many of us were raised to see. When positive feedback switches are running smoothly, they create densely interconnected, collaborative ecosystems that sustain themselves over long periods of time—ecosystems that we humans are part of and depend on. The many water-slowing strategies of subalpine forests give time for some of that water to be pulled by gravity below thirsty roots and risk of evaporation into the saturation zone. Here, water fills all the pores and spaces between particulate matter. The upper boundary of the saturation zone is called the water table, and moisture continues to flow vertically downward until it encounters non-porous substrate, or bedrock. Once water can no longer be pulled towards the center of the earth, it flows across the bedrock until it reaches the Madison Limestone Aquifer under the plains below, where it sustains human life and activity.

Though few of us live in the subalpine zones where water enters the aquifer system, groundwater provides 94 percent of the rural domestic water supply and 39 percent of the public water supply in Montana. This means many of us are as directly dependent on healthy subalpine habitats as the Rocky Mountain tailed frog. And, like the spadefoot toad, we are adept in the arts of modifying our environments to suit our needs. Unlike the spadefoot toad, however, many of our current modifications interrupt the web of interconnected positive feedback switches around us. What might our lives and planet look like if we learned to modify our environments collaboratively, in ways that sustain ecosystems? The Rocky Mountain tailed frogs and spadefoot toads are depending on us to find out. 🦎

—Alyssa Roggow is the principal violist of the Great Falls Symphony and Cascade String Quartet, and facilitates multidisciplinary arts events throughout Montana. She also loves to learn about and experience nature, and is a certified Master Naturalist.

as spadefoot toads on an interconnected network of positive feedback switches to increase water infiltration in the soil and sustain their habitats. On the sunny, sandy, windy plains, evapotranspiration is the biggest threat to infiltration, but for the conifer forests of the subalpine zone, speed is the enemy. Were it not for an incredible array of strategies to slow the movement of water, steep mountainsides



Small and Slow: Wildlife You Can See and Touch

STORY AND PHOTOS BY PAUL HENDRICKS

A spring field trip. On the forest floor a decaying piece of moist wood is flipped over. There, now exposed to view, is a slow-moving animal, sort of earthworm-like but not a worm; it's some kind of slug. An excited fifth grader touches it, picks it up, and holds it in their open hand, then passes it on for others to hold before the animal is returned to the ground and the wood replaced. Everyone shares in the excitement of discovery.

Not all of Montana's wildlife is mega and charismatic. For the inquisitive naturalist, though, all wildlife is most interesting and wonderful, even the small and slow.

Of our diminutive animals, the slugs and land snails (more specifically, gastropods in the phylum Mollusca) suffer from an image problem. A common misperception is that they tend to be garden pests. And some certainly are. But it might

come as a surprise that the ones invading our Montana lawns and gardens are almost exclusively non-natives, introduced unintentionally by people. So, this leads to a question: does Montana even have native land snails and slugs? The answer is yes!

It is safe to assume that for most Montanans the thought of finding a smoky tailed dropper (*Prophysaon humile*, a slug that can, indeed, drop the tip of its tail) or a humped coin (*Polygyrella polygyrella*, a snail) wouldn't generate the same passion as the chance to spot a grizzly bear or a Trumpeter Swan, even though all four are on the Montana Animal Species of Concern list. Nevertheless, if your life's quest includes discovery and adventure, the search for Montana's native land mollusks may help provide what you desire. And if you wish to impart a sense of wonder about nature to a young (or older) naturalist, the native slugs and snails are animals that can be examined closely with little likelihood that they will



Distribution Map

Key: Images show approximate actual size of gastropod, with the exception of the brown hive, which is the size of the white dot.

- Magnum mantleslug
- Pale jumping-slug
- Banded tigersnail
- Idaho forestsnail
- Carinate mountainsnail
- Alpine mountainsnail
- Smoky taildropper
- Brown hive

Magnum mantleslug

Magnipelta mycophaga

Our largest native slug, first found on the Idaho side of Lolo Pass.

Pale jumping-slug

Hemphillia camelus

Jumping slugs have a visceral hump with a slit on the top, where you can glimpse the internal shell.

Banded tigersnail

Anguispira kochi

Our largest native snail, found only west of the Continental Divide in Montana.

Idaho forestsnail

Allogona ptychophora

One of the most commonly encountered large snails west of the Continental Divide, including Greenough Park in Missoula.

Carinate mountainsnail

Oreohelix elrodi

A Montana endemic, discovered in the Mission Mountains by Morton J. Elrod, the first biologist at the University of Montana and founder of the Flathead Lake Biological Station.

Alpine mountainsnail

Oreohelix alpina

A Montana endemic, discovered above tree line in the Mission Mountains and described in 1900 by Morton J. Elrod.

Smoky taildropper

Prophysaon humile

Taildroppers can autotomize (drop) their tails like lizards can.

Brown hive

Euconulus fulvus

One of our smaller and more widespread species across Montana.

suddenly escape from view.

That even includes the native jumping-slugs (of the genus *Hemphillia*) which, despite the imposing name, don't really jump but sometimes thrash rather vigorously when disturbed.

The number of our native land snails and slugs (basically snails whose shell is internal, if they have a shell at all) is larger than might be anticipated. About 11 species of slugs and 60 of land snails can claim Montana as their birthplace, first appearing here without the aid of human transport. One snail, the thinlip tightcoil (*Pristiloma idahoense*), and two slugs, the pygmy slug (*Kootenaia burkei*) and Skade's jumping-slug (*Hemphillia skadei*), were found in the state only during the last 17 years, the snail in 2015 and

the slugs in 2005 and 2010, respectively; both slugs were unknown to science until formally described in 2003 and 2018. [See *the Spring/Summer 2019 issue of Montana Naturalist for the story of the discovery of Skade's jumping-slug.*] More species "new" to Montana may yet be discovered, because few people pay them much attention.

As terrestrial native wildlife, this is a group whose members are smaller than three inches (76 millimeters) in size, and tend to remain under cover and out of sight. Snails range in shell diameter from the 1.5-millimeter aptly named small spot (*Punctum minutissimum*) to the 28-millimeter banded tigersnail (*Anguispira kochi*). Slugs range in extended length from the less-than-15-millimeter pygmy slug to the 80-millimeter magnum mantleslug (*Magnipelta mycophaga*). To

see most of these animals in the wild will require a bit of effort.

Ten of the native slugs live only west of the Continental Divide, with the other one found across the state. Of the native land snails, 21 live only west of or near the Divide, 17 are found exclusively east of the Divide, and the remaining 22 species live on both sides of the Divide. Taken together, the land mollusks of Montana west of the Divide have close affinities to those in northern Idaho and other forested portions of the Pacific Northwest, while those east of the Divide have affinities with other portions of the Rocky Mountains and Great Plains. A few snails live only in the prairie regions, usually near wetlands and in riparian areas and woody draws where moisture is more sustained; this portion of Montana has received even

less attention than the west and may provide new discoveries. As if that weren't motivation enough to spend more time looking for snails and slugs, the forested island mountain ranges of central Montana (Sweet Grass Hills, Highwoods, Bears Paw, Little Rockies, Judith, Crazies) are nearly virgin terrain when it comes to knowledge of their terrestrial mollusks.

Five land snails are considered endemics, meaning they are found nowhere else on the entire planet except in Big Sky Country. All five live west of, or astride, the Continental Divide. The bitterroot mountainsnail (*Oreohelix amariradix*) and keeled mountainsnail (*Oreohelix carinifera*) occur in the Missoula area, the first in a few locations near Lolo Creek and the second along the Clark Fork River drainage between Missoula and Garrison Junction on slopes overlooking the river and above creeks draining into it. The other three endemic snails, lake disc (*Discus brunsoni*), carinate mountainsnail (*Oreohelix elrodi*), and alpine mountainsnail (*Oreohelix alpina*) were first discovered in the Mission Mountains. The lake disc is still known only from the Missions, but the carinate mountainsnail has since been found above several creeks draining the west slope of the Swan Range; the shell of this snail is considered quite striking and beautiful by those drawn to land snails. The alpine mountainsnail, as the name implies, lives at and above tree line among the high limestone ridges and summits of the Bob Marshall and Scapegoat wildernesses, as well as in similar sites of the Mission Mountains. A possible undescribed species, like a small version of the carinate mountainsnail, was also found in 2007 above tree line on the Scapegoat Plateau. Imagine what it is like to be a small snail living year-round atop those alpine ridges and summits and surviving (thriving?) through no-one-knows-how many winters. What a life!

Favored habitats for native land snails and slugs include mature and old growth forests of all types, moister forest types dominated by western red cedar and grand fir, riparian areas with broadleaf deciduous trees such as cottonwood and birch, aspen stands anyplace including those surrounded by grassland, and rocky slopes, especially those composed of limestone which is a rich source of calcium needed for shell

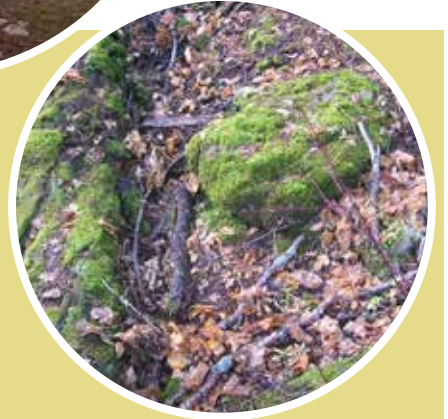
development. Always consider what a microsite offers in terms of moisture and shelter. Whether east or west of the Divide, the best sites include those with mosses and ferns, accumulations of leaves and/or woody debris, or patches of loose cobble to boulder-sized rocks (such as talus), especially when they provide cover or nooks where snails and slugs can seek refuge and avoid drying out. At any specific location, these are the first places to look for native land snails and slugs, and late spring and late autumn are the best times to search, the seasons when moisture is most often available and snails and slugs are most active. Given that these animals are relatively small, a hand lens is very useful to have with you for seeing details of small snail shells. A headlamp is also quite handy in dense forest for finding the small snails, especially on overcast days. And be ready to get your hands and knees dirty.

The number of Montana land mollusks, even including the non-natives, is less than that of other popular groups, such as Montana's wildflowers, birds, mammals, butterflies, or dragonflies and damselflies. Almost everyone is capable of learning all of the land snails and slugs known (so far!) in the state. This knowledge can be shared in the classroom and field with students of any age who like learning new things about nature, and who will get more than a fleeting glimpse of these live animals or their shells. This is especially satisfying for the novice naturalist. And for the really inspired, there is always the chance to make significant discoveries about the distributions and life histories of the terrestrial mollusks of the state. 🐌

—Paul Hendricks was a zoologist with the Montana Natural Heritage Program for many years, during which time he explored much of Montana. He is now semi-retired, serves on the boards of Montana Bird Advocacy and Rattlesnake Creek Watershed Group, and continues to follow his natural history muse.



Left: Scapegoat Plateau, with Scapegoat Mountain in the background. Two Montana endemic alpine snails live under limestone rocks in this view.



Below: Moss-covered woody debris and rocks with leaf litter. A good place to look for a variety of native snails and slugs.

Further reading for the curious naturalist:

BOOKS

Land Snails and Slugs of the Pacific

Northwest by Thomas E. Burke (2013).

(Technical, but with photographs of nearly all of the slugs and snails present in western Montana.)

The World of Slugs and Snails: Life in the

Very Slow Lane by David George Gordon

(2010). (An empathetic and readable introduction to the interesting lives and biology of slugs and land snails.)

A Guide to the Land Snails and Slugs of

Montana by Paul Hendricks (2012).

(Technical, but covers the entire state and all species known at that time, with dot distribution maps.) Available online at the Montana Natural Heritage Program website. <http://mtnhp.org/Reports.asp?key=6>

Life in the Soil: A Guide for Naturalists and

Gardeners by James B. Nardi (2007).

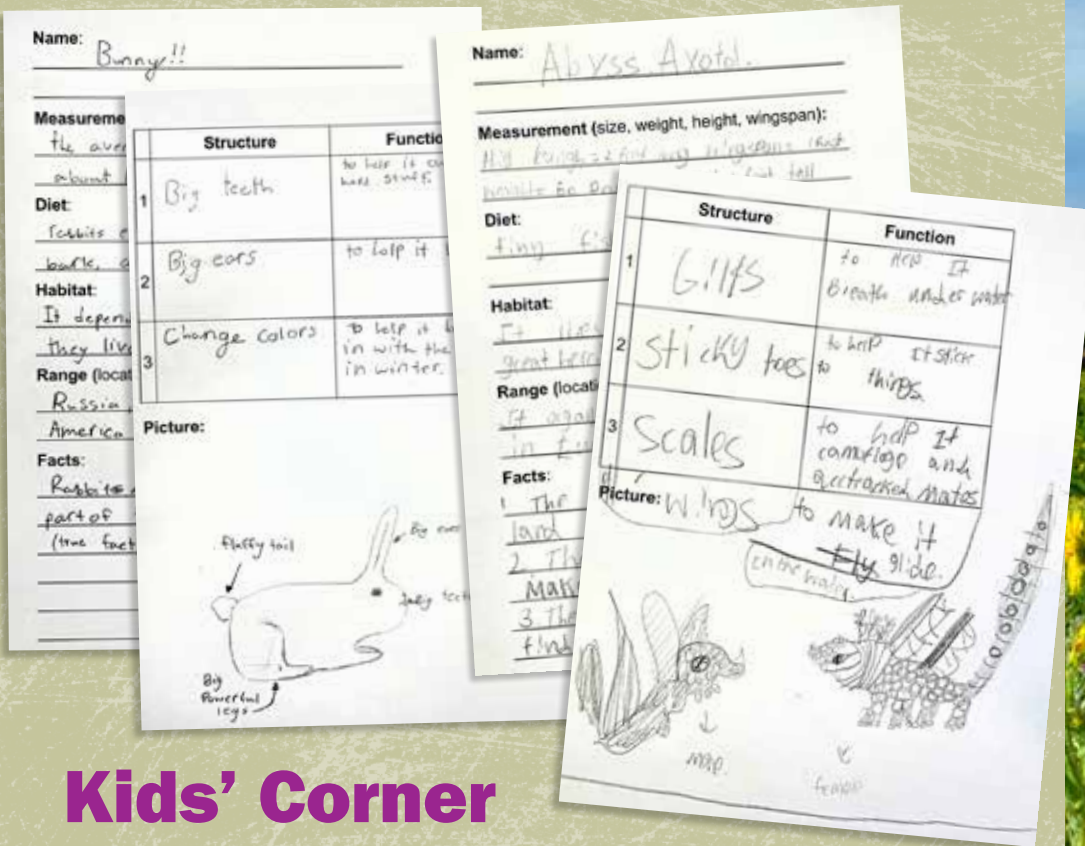
(An informative and user-friendly guide to the other life you might encounter on the ground under leaves, decaying wood, and rocks while searching for land snails and slugs.)

WEBSITE

Montana Natural Heritage Program Animal

Field Guide. <http://fieldguide.mt.gov/displayFamily.aspx?class=Gastropoda>

(Provides more comprehensive accounts than available in the 2012 Montana guide.)



Kids' Corner

Our February Visiting Naturalist in the Schools visit includes a field guide lesson that focuses on structure and function. Students can make up their own animals or draw real ones. Above are two creative entries from students in Mr. Baney's fourth-grade class at St. Joseph School.

Our Montana's Ancient Past exhibit also offers an opportunity for creativity! Visitors can draw a comic strip inspired by the exhibit. This one from an anonymous ten-year-old gave us a chuckle.

Want to draw your own? Come on by—we'd love to see what you come up with.



Here are some of our favorite signs of spring in western Montana:

- [] Bitterroots blooming pink on rocky hillsides
- [] Mourning cloak butterflies fluttering
- [] Western Meadowlarks singing
- [] Western larches putting out their bright-green needles
- [] Osprey returning to their nests
- [] Rivers rising with snowmelt and rain
- [] Fluffy cottonwood seeds floating on the breeze
- [] The vivid blue of Mountain Bluebirds against a clear spring sky
- [] Arrowleaf balsamroot covering the hillsides in yellow
- [] All the wildflowers bursting forth: shooting stars, lupine, Missoula phlox, buttercups, prairie stars, douglasia, larkspur, prairie smoke, pasqueflower, yellowbells

What signs of spring do you love most?

Document your observations and submit them to editor@MontanaNaturalist.org for a chance to win a one-year family membership to MNHC!

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.

get outside calendar



Programs for Kids

Our Saturday Kids' Activities are back! On scheduled Saturdays families can drop in between 1:00 and 3:00 p.m. for a hands-on kids' activity. Free with membership or cost of admission.

MARCH

March 12, 26
Scavenger Hunt

APRIL

April 9, 16
Nature Poetry

MAY

May 7, 21
Seed Science

JUNE

June 11, 25
Fantastic Flowers

JULY

July 9, 23
Sink or Float?

AUGUST

August 6, 20
Insect Investigation

SEPTEMBER

August 10, 24
Building Beavers



Join us every Thursday morning at 10:00 a.m. for our **miniNaturalist program**—outdoors in the Nature Adventure Garden! Check our website for updates. Free with membership or cost of admission.

Explore Outdoors with Us This Summer!

Our 1st-5th grade Outdoor Discovery Day Camps feature daily field trips, skilled instructors, unique opportunities to connect with scientists and naturalists, and lots of time for exploration and play outdoors.

We're offering nine full weeks of camps this summer, including four camps in collaboration with the Missoula Butterfly House and Insectarium, nine half-day Pre-K family camps, and two STEEM (Science, Technology, Engineering, Environment, and Math) camps for 6th-8th graders who identify as girls. Learn more and register on our website: MontanaNaturalist.org/summer-camps/.

We can't wait to see you this summer!



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 APRIL-SEPTEMBER

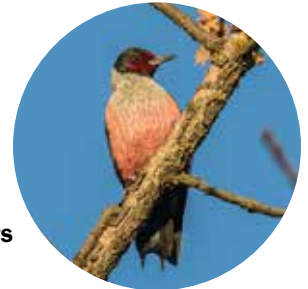
APRIL

Bears are awake
Shooting stars bloom purple on the hillsides
Listen for singing Song Sparrows



MAY

Yellow wildflowers bloom: arrowleaf balsamroot, heartleaf arnica, yellow violets
Lewis's Woodpeckers return



JUNE

Coyote pups are out of the den
Pronghorn fawns are born
Calliope Hummingbirds are incubating eggs



JULY

Young Ospreys are nearly ready to leave the nest
Young rodents become more abundant for predators



AUGUST

Cutthroat trout can be seen feeding at the top of the water on numerous insects
Perseid meteor shower peaks August 12-13



SEPTEMBER

Golden Eagles begin to migrate
Red squirrels cache seeds and create middens



MNHC PHOTOS

SQUIRREL: NPS.GOV; TROUT: JAY FLEMING; WIP: FLICKR.COM; OSPREY & COYOTE PUP: NPS.GOV; WOODPECKER: ION COX; FLICKR.COM; SHOOTING STARS: RICHARD DROKNER; FLICKR.COM

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



Adult Programs

Stay tuned for other spring and summer 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.

APRIL

April 9, 16, 23, 30

Nature Journaling 4-Part Club, Saturdays, 1:00-2:30 p.m. \$5. Registration required.

April 16

Surreal Naturalism with Artist Jessie Smith, 1:00-3:00 p.m.

\$35; \$30 MNHC members. Registration required.



JESSIE SMITH

April 19

Saunter with a Naturalist in the Evening, 5:00-7:00 p.m. \$10; \$5 MNHC members. Meet at Greenough Park. Registration required.

April 21

Saunter with a Naturalist in the Morning, 10:00 a.m.-12:00 p.m. \$10; \$5 MNHC members. Meet at Greenough Park. Registration required.

April 29

Glacial Lake Missoula: Evidence and Origins with Bruce Baty, 1:00-2:00 p.m. Free with admission. No registration required.

MAY

May 11, 14

Birding by Ear 2-Part Course, Wednesday 5:30-7:30 p.m. & Saturday 9:00-11:00 a.m. \$55; \$50 MNHC members. Registration required.

May 17

Saunter with a Naturalist in the Evening, 5:00-7:00 p.m. \$10; \$5 MNHC members. Meet at Council Grove State Park. Registration required.

May 19

Saunter with a Naturalist in the Morning, 10:00 a.m.-12:00 p.m. \$10; \$5 MNHC members. Meet at Council Grove State Park. Registration required.

May 20-22

Master Naturalist Rendezvous, 5:00 p.m. Friday-12:00 p.m. Sunday. \$40. Join your fellow Master Naturalists for a fun weekend of community, diverse nature programs, and naturalist hikes! Registration required.

JUNE



June 6-10

Summer Montana Master Naturalist Course - June. Monday-Friday, 9:00 a.m.-4:00 p.m. \$450; \$420 MNHC members. Registration required.

June 16

Saunter with a Naturalist in the Morning, 10:00 a.m.-12:00 p.m. \$10; \$5 MNHC members. Meet at the Native Plant Garden at Fort Missoula. Registration required.

June 21

Saunter with a Naturalist in the Evening, 5:00-7:00 p.m. \$10; \$5 MNHC members. Meet at the Native Plant Garden at Fort Missoula. Registration required.

JULY

July 19

Saunter with a Naturalist in the Evening, 5:00-7:00 p.m. \$10; \$5 MNHC members. Meet at Greenough Park. Registration required.

July 21

Saunter with a Naturalist in the Morning, 10:00 a.m.-12:00 p.m. \$10; \$5 MNHC members. Meet at Greenough Park. Registration required.

AUGUST

August 16

Saunter with a Naturalist in the Evening, 5:00-7:00 p.m. \$10; \$5 MNHC members. Meet at Maclay Flat. Registration required.

August 16

Saunter with a Naturalist in the Morning, 10:00 a.m.-12:00 p.m. \$10; \$5 MNHC members. Meet at Maclay Flat. Registration required.

August 22-26

Summer Montana Master Naturalist Course - August. Monday-Friday, 9:00 a.m.-4:00 p.m. \$450; \$420 MNHC members. Registration required.



JENAH MEAD DRAWINGS

SEPTEMBER

September 6-November 22

Fall Online Montana Master Naturalist Course, Tuesdays, 4:00-6:00 p.m., plus in-person field weekend, TBA. \$355; \$325 MNHC members. Registration required.



Volunteer Opportunities

Volunteers, we love getting to spend time with you again! Join us for trainings and/or get togethers this spring and summer:

Visiting Naturalist in the Schools Field Trip Training:

You are welcome to participate in our Staff Field Instructor training on **April 25 & 26**. We will have an overview from 9:00-10:30 a.m. on April 25 if you are unable to attend the full training.

Volunteer Garden Party:

Friday, June 3rd, 3:30-5:00 p.m. Join us at the Nature Adventure Garden at MNHC as we celebrate YOU!

Volunteer Meet & Greet:

Join us the **last week of August** (day and time TBD) to meet and mingle with MNHC staff and your fellow volunteers.

For other upcoming volunteer opportunities, check our website or sign up for our volunteer newsletter at MontanaNaturalist.org/volunteer/, and we hope to see you soon.

MNHC PHOTOS



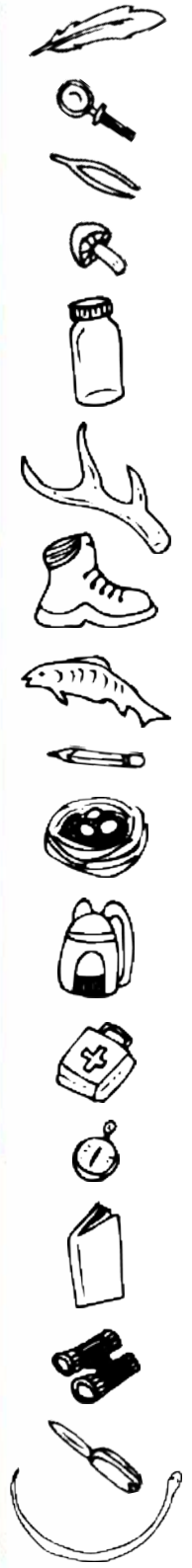
Join us on our monthly Saunters with a Naturalist!

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!

The Montana Natural History Center is located within the traditional homelands of the T'at'áyaqn (Bitterroot Salish) and Qlispélixw (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.



get outside guide



Can you find all of the hidden naturalist objects in this spring scene?

PUZZLE BY LIA MENDEZ,
SMALLFOXPRESS.COM

Download a coloring page of this puzzle at MontanaNaturalist.org/puzzle-page/
or pick one up at the Montana Natural History Center.

In this issue, we wanted to spread the love a little and acknowledge a number of volunteers who have worked with us over the past few months and more. There are too many to list—we are fortunate to have an incredible group of volunteers!—but here are a few of the many people we’re grateful for:

Visiting Naturalist in the Schools volunteers:

Lisa Bickell
Kai Blanco
Wayne Chamberlain
Sydney Driver
Judy Dundas
Julie Ellison
Sue Furey
Carolyn Gard
Sam Getty
Maja Holmquist
Len Johnson
Madeline Jordan
Claudia LaRance
Becky LaTray
Summer Nelson
Linda Pilsworth
Chris Rowe
Rod Snyder
Sue Snyder
Zoe Transtrum

Naturalist Book Club managers:

Annie Bernhauer
Caspern Black
Deborah Drain
Suzanne Hendrich
Sherry Staub

Adult programs volunteers and interns:

Roy Curet
Kelly Dix
Michele Esser
Penny Hegyi
Maja Holmquist
Len Johnson
Lisa Robertson

Front desk volunteers:

Madeline Jordan
Ellen Knight
Candice Mancini
Sherry McLaughlan
Anka Rashed

Auction committee:

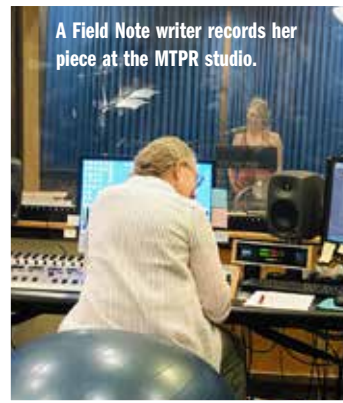
Rachael Cheff
Suzanne Elfstrom
Hank Fischer
Sue Furey
Anne Guess
Steph Lambert
Ed Monnig
Rick Oncken
Caitlin Thompson
Jackie Wedell

We deeply appreciate you all, as well as all those we couldn't list here.

Thank you for all you do!



Volunteers both lead and assist with our adult programs.



A Field Note writer records her piece at the MTPR studio.



Many of our volunteers love spending time outside with kids on our VNS field trips.



There's always plenty to do in our gardens in spring and summer!

Did you know there are dozens of ways to volunteer with MNHC? While many of our volunteers assist with our children’s programs, from Visiting Naturalist in the Schools to miniNaturalists to summer camps, there are many other opportunities, especially as our in-person programming is ramping up again:

Do you enjoy...

- **plants, gardening, and being outdoors?**
Help weed, water, and maintain our native plant gardens at MNHC and Fort Missoula!
- **working with adults?**
Assist with our adult programming (and get a free ticket!) at evening lectures, field days, sip & sketches, and more.
- **fundraising and events?**
Join our auction committee (always a fun group!) and help us plan, solicit donations, and prepare for our biggest fundraiser of the year. Spring and summer are the perfect time to get involved!

- **writing and research?**
Write a Field Note to be aired on Montana Public Radio, or an educational post for our naturalist blog and social media!
- **talking to people?**
We occasionally need volunteers to hang out at our front desk and greet visitors - always a fun way to spend a couple of hours.
- **working with kids?**
Help lead school field trips in May and October, teach a lesson or three for summer camp, or help out with our Saturday Kids’ Activities and miniNaturalist programs!

Want to learn more? Interested in getting involved? Visit MontanaNaturalist.org/volunteer/ or contact Drew Lefebvre at dlefebvre@MontanaNaturalist.org.



Grow Safe: Non-Toxic Missoula

Making Missoula Healthier, One Lawn at a Time

BY ANNE GREENE

ILLUSTRATIONS BY ISABEL QUIRAM

After a long, cold winter, I am looking forward to summer—the sight of green trees and meadows, the sound of birdsong, and the sweet perfume of flowering plants. What I'm *not* looking forward to is another lawn care season. I dread the appearance of little flags on my neighbor's lawn telling me to "keep off treated areas until dry." I hate the smell of chemical fertilizer and pesticides wafting off athletic fields, and I shudder when landscaping trucks pass me carrying drums of liquid fertilizer and lawn spray.

There are now about 63,000 square miles of lawns in the U.S., an area the size of Texas. Every year, we fertilize them with 45,000 tons of chemical fertilizers and protect them with nearly 90,000 tons of pesticides. We irrigate them with 9 billion gallons of water every day. We do this mostly for cosmetic reasons, so our lawns look as much like putting greens as we can make them.

"Pesticide" is an umbrella term. It includes herbicides, insecticides, fungicides, and many others. The Latin suffix "-cide" means "killer."

The consequences are dire indeed. The most widely used pesticide in the world is Monsanto's Roundup. It contains, among other chemical ingredients, the herbicide glyphosate. In addition to being toxic to birds, bees, and aquatic organisms including

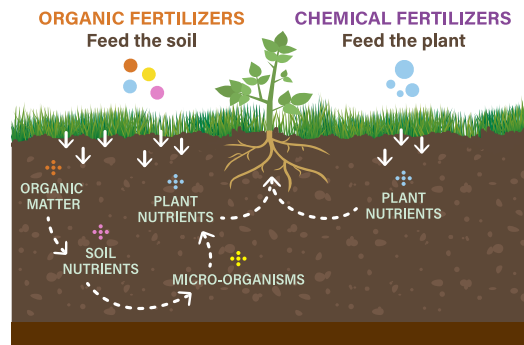
fish, glyphosate is an endocrine disrupter and has been declared a probable human carcinogen by the World Health Organization. Thousands of people have filed lawsuits blaming Roundup for causing a type of cancer called non-Hodgkin lymphoma, which has cost Monsanto \$11 billion in settlement fees.

Glyphosate is also an active ingredient in TruGreen, a deceptively cheerful-sounding product that misleads homeowners into thinking they do no harm by spraying it on their lawns.

Another toxic product homeowners often use is Weed and Feed, which conveniently combines a herbicide and a chemical fertilizer—all in one. An active ingredient in the herbicide is 2,4-D, a key component of Agent Orange, which was used to defoliate the forests of Vietnam and has been linked with hormone disruption, neurotoxicity, and reproductive problems. Some studies have linked it to cancers in dogs. It has a habit of drifting far from the place it was applied and finding its way into homes, where it can remain for up to a year.

These chemicals are regularly mixed with other herbicides as well as inert (and often dangerous) ingredients that make them much more toxic than they are alone. Hundreds of products for sale in the U.S. contain glyphosate and over 1,000 contain 2,4-D.

Chemical Fertilizers
Another danger to people and the environment is chemical fertilizers. They are rapidly taken up by plants, but the excess usually runs off after watering or rain. The runoff ends up in our rivers and creeks where it plays havoc with the delicate balance of nutrients. Often, the result is algae blooms. As the algae die, their decomposition robs the water of oxygen, killing fish and other aquatic organisms. Manufacturing chemical fertilizers requires burning fossil fuels and contributes to climate change.



How do these chemicals end up in our bodies? We either breathe them in as vapor, absorb them through our skin, or ingest them. Children are particularly at risk when they play on the ground and put their hands and toys in their mouths.

If we are exposed, most of us aren't aware of

it. However, some people are hyper-sensitive and immediately react in ways that cause loss of taste, trouble breathing, irritability, dizziness, and worse. One of these people is Alison Reintjes, an





Healthy soil is full of roots, but roots don't grow in the soil itself. They grow in tiny air pockets between soil particles that contain oxygen, microorganisms, and water. These air pockets disappear when the soil is compacted, slowing root growth and causing bare patches in your lawn. The best thing you can do to grow a healthy lawn is to aerate your soil.

Find physical copies of the guide at the Montana Natural History Center, Currents Aquatic Center, County Extension, and Caras Nursery, and the digital version on the Grow Safe website.

Interested in learning more? Join us for a combined virtual and in-person training session with Beyond Pesticides later this spring (date & time TBD). For more information, visit growsafemissoula.org or contact Missoula Parks & Rec at 406.552.6268.



artist in Missoula. She was tired of being forced to stay inside during the summers because of her reaction to herbicides sprayed nearby. In 2021, she helped form the non-profit Grow Safe: Non-Toxic Missoula. “I was waiting for someone else to take the lead, but finally realized that I needed to step up and start the conversation about reducing pesticides,” she said. Through community partnerships and education, the group strives to reduce toxic pesticides used in Missoula.



Grow Safe presents an alternative to the traditional Weed and Feed approach to lawn care. Called organic lawn care, it's a way to grow beautiful lawns by building healthy soils. These soils contain countless living organisms that support the growth of vigorous grass that crowds out weeds and discourages pests and disease. Organic lawn care works with nature, using compost and organic fertilizers such as alfalfa meal, earthworm castings, and fish meal, as well as effective mowing, aeration, and seeding. With time, and some work, you can be the proud owner of a safe and beautiful lawn. An extra bonus is reduced water bills, because healthy soil and grass are more efficient at absorbing water and need less to thrive.

The time may be right for a transition to more organic lawn care in Missoula. The City's 2020-2023 strategic plan includes a goal of working “to reduce, or when possible eliminate, the use of toxins when managing green spaces.” Thanks to a recent grant from an alliance of non-profit organizations called Healthy Babies Bright Futures, Missoula Parks and Recreation was able to hire a consultant on organic turf care, which included a partnership with the national organization Beyond Pesticides. Through this collaboration, the City is creating a pilot park for organic turf management at McCormick Park and offering a training session on organic lawn care. (See details in sidebar at left.)

Grow Safe is working with many community partners and supporters to publish a guide for Missoula homeowners about transitioning to organic lawn care, due out this March (see sneak preview). In the future, the organization hopes to convince City Council to adopt an official policy for organic land management and is collecting hundreds of signatures from Missoulians who want safe, non-toxic parks, playgrounds, and athletic fields.

Adopting a policy to use organic land management isn't new. At least 150 cities, towns, and universities across the U.S. have committed to using organic products on their public spaces as much as possible. The benefits are many and lasting: less toxic exposure for their citizens; healthier soil; less demand for water; healthier and more numerous pollinators, birds, and other wildlife; thriving aquatic ecosystems; and more carbon dioxide sequestered to offset climate change.



Grow Safe envisions such a future for Missoula—where everyone can enjoy our parks and fields without fearing for their health or the health of their children and pets, where those who are sensitive to toxins are free to enjoy their surroundings, and where people like me can look forward to summer with unfettered enthusiasm.

For more information, visit the Grow Safe website: growsafemissoula.org.

—Anne Greene is a biologist and author of *Writing Science* in Plain English. She is a volunteer at *Grow Safe: Non-Toxic Missoula*.

imprints

Exploring Nature with Missoula Christian Montessori

Last fall, our teaching naturalists explored nature's cycles with the Missoula Christian Montessori School. Each week focused on a new natural cycle such as weather, decomposition, weathering and erosion, and more! We also dedicated class time to work on our nature journaling skills through scientific accounts, storytelling, and studying phenology. The students at the Montessori School were inquisitive, dedicated to our nature studies, and a blast to hang out with!



One of the students, Timo, holds up the liquid remnants of an inky cap mushroom from an experiment on decomposition.

THANK YOU, KELLEY AND IAN!

In late 2021 we said goodbye to two wonderful board members who each served as president during their six-year tenures: Kelley Willett and Ian Foster. We so appreciate their wisdom, leadership, and passion for MNHC over the past several years. We miss them, and wish them the best in their future adventures!



Kelley Willett



Ian Foster



MNHC PHOTO

New Naturalist Field Station: Penny Hegyi, Conservation Photographer

Ready for a brand-new exhibit? This spring and summer we're excited to feature a new guest in the Naturalist Field Station, our rotating exhibit. Please join us in welcoming wildlife photographer and children's book author Penny Hegyi! Penny specializes in up-close portraits of some of Montana's most charismatic wild creatures, and her work looks amazing in our exhibit hall, surrounded by natural history specimens.

Our Naturalist Field Station showcases naturalists at work with a rotating focus of the naturalist as an artist, scientist, or writer. The exhibit also reminds visitors that you don't need special training to be a naturalist—anyone can practice the study of nature through observation. In this latest exhibit, Penny shows her love of and respect for the natural world through her beautiful photos. Stop by this spring or summer to see Penny's work up close!

Are you or someone you know a good candidate for a future Naturalist Field Station? Email Drew at dlefbvre@MontanaNaturalist.org if you'd like to discuss the possibility of a future exhibit.

MNHC PHOTO

Science & Nature Buddies: MNHC's New Partnership with spectrUM

Beginning this year, MNHC and spectrUM are partnering on camps programs! The two organizations have collaboratively hired Camps Coordinator Alyssa Giffin to organize and lead camps for both MNHC and spectrUM throughout the year—summer camps, school's out camps, spring break camps, and more. This exciting partnership will also allow us to offer more programming where participants can engage in activities and programs at both facilities. Stay tuned!



Alyssa Giffin

COURTESY ALYSSA GIFFIN

As To The Mission

John & Sherry Bremer: A Legacy of Generosity

We at MNHC are fortunate to have the generous support of many wonderful people in our community—and beyond. In this issue, we'd like to acknowledge and remember two special individuals in particular: John and Sherry Bremer.

John and Sherry were unfailingly generous to MNHC from the beginning. Life-long naturalists and avid gardeners, their passion for the natural world was contagious, and volunteering at MNHC was one of the ways they chose to give back to their community. They stepped in as volunteer librarians in 2011, just as long-time library volunteer Minie Smith moved on to new adventures. For two years they spent several hours each week inventorying our (3000+) book collection, organizing the library space, and processing new books, their wry humor, kind smiles, and infectious laughter always a bright spot at MNHC. The staff loved hearing their gardening tips and stories of building their passive-solar home in Michigan, and some of us still have the plants John carefully transplanted and gifted to us.

After Sherry passed away from cancer in 2013, John continued to work as volunteer librarian for two more years, while also spending time at our native plant garden at Fort Missoula. After passing on library duties to wonderful volunteer Marian McKenna, John continued to spend hours of hard work during many summers maintaining and improving our native plant garden. He pulled quack grass for days, transplanted native plants he had grown at his own home, and assisted with every task from fence repair to pruning. He was a steadfast, loyal volunteer and an essential piece of the garden crew camaraderie. His positive, curious, and kind nature enhanced everyone's experience working at the garden.

John passed away in late 2020; we learned then that his and Sherry's generosity was not limited to their time. They left MNHC a generous and unexpected bequest which allowed us to expand our programming in several exciting ways:

- An ongoing renovation of the library and associated exhibits intended to keep the collections vibrant and accessible.
- Inspiring the next generation of nature stewards by expanding our programming for middle and high school teachers and students.
- Investing in our staff with expanded positions and benefits so we can continue to offer the highest-quality environmental education and best provide for the amazing staff that delivers it.

Through these projects and investments we hope to honor two wonderful and amazing people and their generous legacy gift. We are infinitely thankful for John and Sherry, and miss them immensely.

Thank you, Sherry and John.

Allison De Jong,
Montana Naturalist Editor

Christine Morris,
Community Programs Coordinator
and

Thurston Elfstrom,
Executive Director



John and Sherry Bremer

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



A blustery beginning led to dramatic skies, a gorgeous sunset, and a wonderful event.

We are so grateful that we got to celebrate with so many of you in person last September at our Annual Banquet and Auction. We had a wonderful (if wild and windy) evening outdoors at the PaddleHeads stadium, and it was so good to come together again as a community. Thank you for the laughter, the camaraderie, and the support! 281 generous friends helped us raise more than \$153,000 to support us in inspiring curiosity, passion, and stewardship of the natural world. And, of course, we couldn't have done it without the following businesses and individuals whose generosity and hard work made this event possible. (Please accept our apologies for any missed names.) **Thank you!**

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And a Montana-sized THANK YOU to our auction committee—we couldn't have done this without you:

- Rachael Cheff
- Suzanne Elfstrom (committee chair)
- Hank Fischer
- Sue Furey
- Anne Guess
- Stephanie Lambert
- Edward Monnig
- Rick Oncken
- Caitlin Thompson
- Jackie Wedell

Stay tuned...

For the date and venue of our fall Banquet & Auction! We look forward to celebrating with you this fall.

MNHC PHOTO

SPOTLIGHT:

We've welcomed several new staff in the past few months. We're excited to introduce them to you!

Kellen Beck joined MNHC in spring 2021 as our Front Desk Associate, and this past winter moved into the role of Marketing & Events Coordinator. Kellen grew up in the Northwoods of Bemidji, Minnesota, where she cultivated her love of the outdoors, fishing, camping, and hiking among the beautiful paper birch trees and melodic love songs of the Common Loon. She moved to Missoula fourteen years ago and completed her B.A. in Print Journalism at the University of Montana. Over her years in Missoula, Kellen has worked in the service industry, wearing many hats, most recently working at Conflux Brewing Company as a manager and event coordinator. Always passionate about conservation work, Kellen began as a field volunteer with the Owl Research Institute four years ago. Her volunteering involved catching and banding countless owls throughout western Montana. After years of persistence and dedication, she was hired as ORI's social media coordinator. In Kellen's spare time she can be found hiking through the mountains with her two dogs, Sage and Theo, and her husband, Dean. She loves reading, writing, birding, and, above all, gardening.



Our other new Teaching Naturalist is **Stephanie Parker**, who is a familiar face at MNHC. Stephanie's fascination for the natural world brought her to Missoula in 2013 to pursue a degree in biology. During this time, she assisted with research on nesting bird behavior and butterfly morphology. She became enthralled with museum collections as a curatorial assistant at the Philip L. Wright Zoological Museum. She first started with MNHC in 2016, spending her summers exploring with campers. Stephanie then completed her M.S. in Biology from California State University, Chico, while exploring creeks and woodlands of the Sierra Nevada foothills. In addition to researching insect and plant interactions, she was a biology lecturer at the university and served as curator and STEM educator for Gateway Science Museum. She is thrilled to be back with MNHC and in Missoula with her fiancé, Colter, and their cat, Josh. In her free time, you can find Stephanie reading, hunting for wildflowers, and attempting to perfect the chocolate chip cookie.



Keri Geiser, one of our new Teaching Naturalists, grew up in southwestern Pennsylvania, where she spent much of her childhood outdoors, from searching for salamanders and crayfish during the summer months to following animal tracks in the snow during winter months. She continued to immerse herself in the outdoors as she pursued a B.S. in Geoscience at Hobart and

William Smith Colleges. With a deep love of the mountains and all things winter she found herself moving out to Montana once she'd completed her degree. As she gained a deeper respect for and understanding of mountains blanketed in snow, she took a leap and headed to Glacier National Park for the summer to work with the Glacier Institute. Now, after spending four years watching the seasonal changes in GNP, she is excited to join the MNHC team to continue sharing her passion and curiosity for the outdoors with others.



Ashley Sinclair is our new Museum Associate, and hers is the first face you'll see when you walk in our doors! Ashley was born in Billings, but was raised for most of her life in Bozeman, Montana. She has gained a lot of her knowledge and experiences not only growing up in Montana's beautiful habitats, but also through volunteering and work with

organizations and businesses such as the National Parks Conservation Association, Montana Cooperative Wildlife Research Unit, and more. Her passion for the outdoors, science, and education led her to pursue a B.S. in Wildlife Biology and certificate in Global Leadership at the University of Montana, which she received in the spring of 2021. While living in Missoula, she has been involved with Missoula's youth and the community, educating them about wildlife conservation and natural history through MNHC as well as the Boys and Girls Club of Missoula County. Her favorite ways to pass the time include snowshoeing, backpacking, river floating, hiking, gardening, crafting, watching tv/movies, and cooking. She is excited to help the Missoula community through MNHC and continue learning how to be a natural steward.



Stay tuned for the return of **MNHC's Spring Luncheon** benefiting camp scholarships. We're excited to welcome you back to our luncheon tradition later this spring! Join our email list or follow us on Facebook or Instagram to learn more.

The Tiny, Yet Mighty, Water Shrew

Water shrews are mouse doppelgangers of the mammal world. Or at least, that is what I thought when I first encountered one over a decade ago. I was a student at the University of Wisconsin in Stevens Point and working through a summer program called Treehaven. It was essentially a natural resources boot camp where students spent half the summer working as water, wildlife, survey, and forestry biologists complete with having to produce 25-page reports on our findings. It was grueling at times, like learning how to be a forester in the morning and then writing a manual about it in the afternoon.

I loved it.

I didn't love the frequent raspberry patches I had to scratch through or the fatalities in our mammal surveys, but I loved just about everything else. And this experience introduced me to water shrews. In the middle of what we called "wildlife week," my group set up live traps to catalog the many mini mammals that lived in a nearby boggy haven. There were oodles of voles, a few mice, and one shrew: the water shrew.

At first, I was giddy with excitement to see something other than a vole, until I realized it wasn't moving. Our professor explained that, trapped and unable to meet the demands of its high metabolism, the furry creature had died.

That summer feels like another lifetime, but I'm still fascinated by the tiny, high-energy animal that once shared the landscape with dinosaurs and today walks on water and bares iron-coated teeth.

Shrews are ancient mammals. During the Cretaceous (145 to 65 million years ago), when *T. rex*, *Triceratops*, and raptors roamed the land, so did shrews. When dinosaurs went extinct, shrews continued to survive and thrive long after the age of reptile giants had passed. Today there are 385 species of shrew, including more than a dozen species of water shrew, the world's smallest diving mammal.

It was likely their small size and their ability to shelter underground or in the water that allowed small mammals to survive a mass extinction event that the dinosaurs couldn't. And water shrews are very small. They're roughly five to six inches long—including two to three inches of tail—and weigh a quarter to half an ounce, or about as much as a AAA battery. Shrews are frequently mistaken for mice, but these creatures are not rodents. Generally smaller than a mouse and with long, pointy snouts, these voracious predators

BY CORTNEY REEDY

Above: With enzymes that function well in the cold and thick fur that traps air, water shrews are well adapted to swimming and hunting in frigid water. They have been observed swimming in ice-lined water and even, in some instances, beneath the ice.

Opposite page: Quick-flowing mountain streams, with exposed rocks and surrounded by vegetation, are excellent water shrew habitat.



Water shrews' fur is dark on their back and light on their front, an adaptation called countershading that helps them camouflage while swimming. From above, the dark fur on their back blends into the murky depths of the water; from beneath, the lighter fur on their belly blends into the sky.

APRIL HENDERSON, NPS

KRISTI DUBOIS



also increases flotation, meaning water shrews must paddle with the intensity of an Olympic swimmer to keep from being buoyed to the surface. Stiff hairs on their hind feet, known as fibrillae, help them to move through water and comb off droplets once they emerge. Their hairy feet can also trap air bubbles, allowing them to walk as far as several feet on the surface of the water!

With so many unique adaptations, water shrews inspire admiration in many people. Shannon Hilty, a wildlife biologist with Montana Fish, Wildlife, and Parks, is also an admirer, and I'm envious of her close encounter with a live water shrew. While conducting Harlequin Duck surveys on the Boulder River outside of Big Timber, she and her husband were struggling to walk upstream in the fast-flowing water. In the middle of the river, her husband suddenly exclaimed, "There's a mouse swimming at me!" When Shannon looked closer, she saw that it was a western water shrew, climbing out of the river with a stonefly larva in its mouth. It gobbled

are insectivores—though they'll eat almost anything they can catch. A water shrew will feast mostly on aquatic insects, which can make up 80 percent of its diet, as well as other small aquatic invertebrates (such as mollusks and leeches) and small vertebrates (including frogs, salamanders, and fish).

It's a good thing water shrews are good at finding food, because they need to eat almost constantly to survive. They have a high metabolic rate—converting their food to fuel extremely quickly—and lose heat rapidly because of their tiny size. To overcome heat loss, these furry furnaces use energy at a nuclear rate, eating one to two times their weight in food each day. That's like a 150-pound human eating up to 1200 hamburgers! When they can't get enough food they can starve in a matter of hours, like the one I found in Wisconsin. Since shrews don't hibernate, they're feeding that furry furnace year-round. They eat intensely for 30 to 45 minutes, then sleep for an hour when their body temperature drops.


North America's water shrews reside in mountainous regions and boreal forests. They were recently divided into three distinct species by scientists (thanks to newly sequenced DNA); the water shrew found in Montana is the western water shrew, *Sorex navigator*. As their common name implies, they prefer aquatic habitats, including streams, ponds, and lakes—ideally with ample vegetation, logs, rocks, and humidity. This type of habitat is necessary for shrews to engage in their most common feeding behavior: diving.

Water shrews are specially adapted to hunting in aquatic environments. They dive to search for food beneath the water year-round, even during winter, and can hold their breath for more than 30 seconds. Their water-repellent fur can trap air, like a dry suit for scuba divers, which lessens heat loss by half. It



the stonefly and rested on a rock in the middle of the stream, fur dripping, while Shannon and her husband watched in delight.

Shannon also told me about one of her favorite of the water shrew's adaptations: iron-coated teeth. "I'm obsessed with shrew teeth," she told me. Unlike rodent teeth, which continue to grow throughout the animal's life, shrew teeth remain the same size from birth to death. And the shrew's diet of insects, Shannon informed me, with their tough exoskeletons made of chitin, are incredibly hard on teeth. So the tips are coated with iron—they're actually red!—to protect them and prevent them from wearing down.

The water shrew's long list of exceptional features seems to break from the standard guidelines for most mammals. This tiny titan has managed to defy the odds to outlast the dinosaurs, thrive on land and water, and scurry its way straight into this mammal's heart. 

—Cortney Reedy is a Master Naturalist and a park ranger with the U.S. Forest Service.



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Donald Anthony S. Johnson

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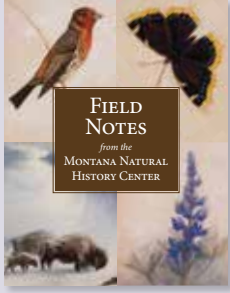
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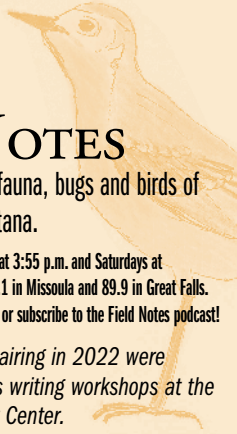
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Many of the Field Notes airing in 2022 were written in the Field Notes writing workshops at the Montana Natural History Center.



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Contact Kellen at
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Lone Wolf

Penny Hegyi's stunning conservation photography is the focus of our latest Naturalist Field Station exhibit (please stop by and check it out!). Penny's mission is to inspire appreciation and protection of wildlife through visual storytelling. She captures wildlife in their natural environment rather than game farms or zoos. Penny patiently waits for those special moments, and strives not to disrupt or invade an animal's space. Her love, respect, and admiration for wildlife has led her to tell their story through photographs and words.

Find her work online at pennyhegyi.com, @Penny Hegyi on Instagram, and Penny Hegyi Photography on Facebook.



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