



# BELOW THE SNOW

The world of wildlife beneath  
the white surface of winter

BY ELLEN HOROWITZ

**I HEARD THAT** A red fox buries its head in snow powder to grab a mouse detected with its keen hearing. Foxes, coyotes, and owls regularly prey on small rodents in winter by listening for the faint scurrying of tiny feet below the snow surface. PHOTO BY DAWN WILSON

Last winter while snowshoeing through the woods with my pup Louie, I found a large mound of snow with an entrance and hollowed-out interior. The two colorful insulated pads left at the opening, and a few other pads inside, felt like an invitation.

It was a human-made quinzee hut. These domed structures are built by shoveling loose snow into an SUV-size mound, waiting a few hours for the snow to set and harden, then hollowing it out.

Louie entered the snow cave first. I removed my snowshoes, knelt down on a pad, and crawled inside. The interior was about 8 feet wide, and there was plenty of headroom for sitting. The air felt warm without the chill of the wind outside. Within this cozy space, I started thinking about snow as insulation, and the hidden world beneath a blanket of white. It's easy to forget what goes on below the snow because we're usually above it.

#### WINTER'S BASEMENT

Scientists divide the world of snow—the nivean environment—into three categories: the supranivean above the snowpack, the intranivean in the middle, and the sub-

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**SELF-SUBNIVEAN** Sometimes people create their own subnivean zone by building a quinzee hut. These temporary outdoor shelters make use of the snow's insulating qualities to provide protection from the cold and wind just like how the subnivean layer beneath the snowpack protects mice, voles, and other small creatures.

nivean in the space between the ground and the snowpack.

Most people are unaware of the subnivean zone because they assume the snowpack extends all the way to the ground, says Torrey Ritter, nongame wildlife biologist for Montana Fish, Wildlife & Parks in Missoula. "But in fact there's a space down there, like the basement of a house, that's mostly free of snow," he says. "With the first snowfalls of the season, the snow doesn't pack down and fill every crack and crevice. Instead, all the rocks and logs and dead plant material hold the snow up a bit, kind of like little umbrellas, creating all these rooms and passageways."

The snowpack above acts like a thermal blanket that holds the earth's heat. The warmth transforms some of the snow that makes it down into the subnivean zone into water vapor. As the vapor rises and hits the bottom of the snowpack, it freezes into a layer of ice, serving as a basement ceiling. As more snow accumulates during winter and becomes increasingly heavy, the ceiling protects the subnivean space below. What's

more, all that snow provides insulation, keeping the subnivean layer's temperature around 32 degrees F even when the outside air temperature drops far below zero.

It's not exactly balmy down there in the subnivean zone, but it's warm enough for small animals to survive.

#### LITTLE MAMMALS BELOW

What lives in the subnivean? Mostly mice and voles. These small rodents remain active during the day, feeding on seeds, leaves, roots, and bark. In some places they find pockets of green plants. In the squashed-down vegetation they build elaborate tunnels that connect sleeping and dining areas, food caches, and latrines—just as they do in summer. Multiple exits to the snow surface provide airflow and opportunities to find food above the snowpack in the supranivean zone.

Shrews, Montana's smallest mammals, also prowl the subnivean. Shrews have voracious appetites needed to sustain their hyper metabolism. To stay warm, they must eat one to two times their own body weight in food per day. Shrews mostly consume insect eggs and pupae, adult beetles, beetle larvae, spiders, and other invertebrates, as well as the occasional baby mouse or vole.

Two larger mammals that also use the subnivean are the American pika and the wolverine. Also known as a rock rabbit, the pika has dense fur and small, rounded ears that reduce heat loss. This fist-sized rabbit and hare relative lives in boulder fields

“There's a space down there, like the basement of a house, that's mostly free of snow.”

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**DANGER BELOW** A short-tailed weasel holds a vole caught in the space between the ground and the snowpack.

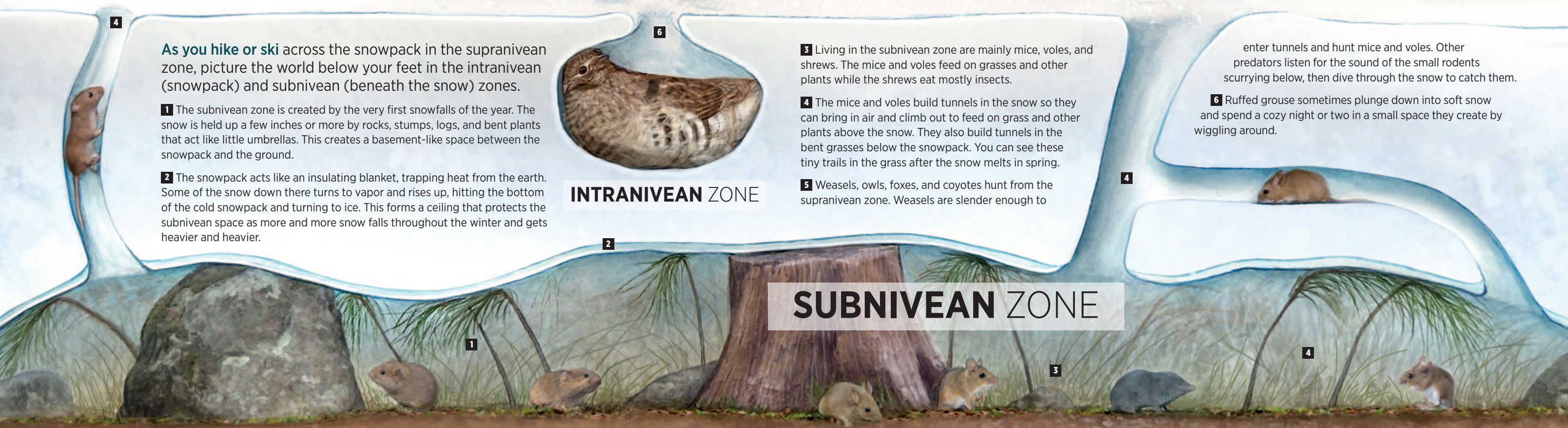
FROM LEFT: SHUTTERSTOCK; JIM EVANS/OUTDOOR CANADA; CONNIE FISKE & RON PAUL

# The Subnivean Zone

Illustration by Liz Bradford



## SUPRANIVEAN ZONE



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**As you hike or ski** across the snowpack in the supranivean zone, picture the world below your feet in the intranivean (snowpack) and subnivean (beneath the snow) zones.

**1** The subnivean zone is created by the very first snowfalls of the year. The snow is held up a few inches or more by rocks, stumps, logs, and bent plants that act like little umbrellas. This creates a basement-like space between the snowpack and the ground.

**2** The snowpack acts like an insulating blanket, trapping heat from the earth. Some of the snow down there turns to vapor and rises up, hitting the bottom of the cold snowpack and turning to ice. This forms a ceiling that protects the subnivean space as more and more snow falls throughout the winter and gets heavier and heavier.

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## INTRANIVEAN ZONE

**3** Living in the subnivean zone are mainly mice, voles, and shrews. The mice and voles feed on grasses and other plants while the shrews eat mostly insects.

**4** The mice and voles build tunnels in the snow so they can bring in air and climb out to feed on grass and other plants above the snow. They also build tunnels in the bent grasses below the snowpack. You can see these tiny trails in the grass after the snow melts in spring.

**5** Weasels, owls, foxes, and coyotes hunt from the supranivean zone. Weasels are slender enough to

enter tunnels and hunt mice and voles. Other predators listen for the sound of the small rodents scurrying below, then dive through the snow to catch them.

**6** Ruffed grouse sometimes plunge down into soft snow and spend a cozy night or two in a small space they create by wiggling around.

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## SUBNIVEAN ZONE

# Clues to subnivean activity

## Tracks and tunnels

Watch for holes in the snow where small animals enter or exit the subnivean zone. Evidence of weasels atop snow include small, paired tracks with five claws on each foot. Since they travel by bounding, their hind tracks fall directly on top of their front tracks, unlike those of mice, voles, and shrews.



Subnivean exit holes



Ruffed grouse wing prints at the exit of an overnight snow den



Vole tunnels in compacted grass

Voies are notorious for feeding on the tender bark of young trees and shrubs beneath the snow. Their teeth marks show up as light-colored gnaw marks on woody stems.

As snow begins to melt in early spring, look at the ground for the long, winding grooves in matted grasses that show where mice and voles traveled back and forth the previous few months.

## Wing prints

A ruffed grouse evacuates its snow roost by flushing with an explosion of wings and snow. By examining the exit hole, usually a foot or so from the entrance hole, you can see the hollowed cavern and grouse droppings. A few droppings likely indicate a single overnight stay, while a large pile signals a longer stay within the well-insulated, under-snow shelter.

## Snow Fleas/Springtails

The best opportunity to find these tiny (1/16-inch-long) insect-like creatures is when the air temperature warms to around 32 degrees F. That's when snow fleas migrate up to the snow surface. Their ability to "jump" comes from a tail-like appendage (called a furcula) attached beneath the abdomen and held in place with a clasp-like structure. When the furcula releases, the snow flea is catapulted several centimeters through the air, hence its other common name, springtail.

During winter thaws, snow fleas resemble specks of dirt or black pepper sprinkled on the snow. It's not unusual to find them around the base of trees or lining ski tracks or moose tracks, or appearing as tiny, dark jumping flecks.



Snow flea

FROM LEFT: STEVEN AKRE; NATURE GUEPH TRACKING CLUB; SHUTTERSTOCK; NATIONAL PARK SERVICE

From page 28.

and rocky talus slopes next to alpine and sub-alpine meadows. Active all winter, the pika spends most of its time in dens and tunnels in the subnivean zone, sometimes under 40 or more feet of snow, where it is protected from frigid temperatures and blizzard conditions. Much of the pika's winter food comes from the plants it harvests, dries, and caches in "hay piles" during summer.

With their wide, snowshoe-like paws, wolverines travel easily over snow. But they also move under the snowpack into spaces that form beneath fallen trees and boulders.

This seasonal refuge offers insulated resting places, hiding cover, food caches, and dens for wolverines to give birth and raise their kits.

White-tailed ptarmigans, dusky grouse, and ruffed grouse also spend time under the snowpack. During rugged winter weather when the mercury plummets and winds howl, a ruffed grouse will dive headfirst from a tree perch into soft, deep snow and disappear completely from sight. The bird then wiggles a bit to create a little snow cave, where it can spend one or more nights in relative comfort, insulated by the surrounding snow. In the morning, the grouse bursts out of the roost and flies off.

## DINNER BENEATH THE SNOW

As they do the rest of the year, many predators hunt the mice and voles that live in the subnivean. Three weasel species live in Montana. Each has fur that turns white in winter to camouflage it from other predators while moving across snow. Their thin coats, however, aren't adequate to keep the sleek predators warm. Weasels "can't deposit fat on their frames nor produce thick, bulky coats during winter because they have to fit through tight vole tunnels," writes Dr. Kerry Foresman, author of *Mammals of Montana*. After capturing and eating a vole or mouse, short-tailed and least weasels are known to curl up and nap in the

tunnel of their victim before moving on to the next meal. Due to their high metabolism, weasels must feed five to ten times per day to stay warm enough to survive.

Though tree squirrels up above are their main prey, American martens also hunt voles and mice in the larger spaces of the subnivean zone under windblown trees, branches, and logs. These snow-covered shelters also provide a warm place to rest and digest.

The sound of scabbling little rodent feet in subnivean tunnels catches the attention of foxes and coyotes. They listen intently, cocking their head from side to side to determine the location of potential prey. When ready, they leap into the air and then plunge into the snow. If their timing is right, they catch something to eat.

Owls are even more skilled at pinpointing sounds below the snowpack. From up to 90 feet away, a great gray owl can detect voles digging tunnels in snow that's more than 16 inches deep. Once the sound is located, the bird glides into position on silent wings and plunges into the snow talons first. Imprints from the raptor's large wings often appear at capture sites.

## OTHER LIFE IN THE SUBNIVEAN

In addition to animals, snow cover protects soils and vegetation from freezing temperatures and drying winds. Most of Montana's herbaceous (non-woody) plants lie dormant as seeds or root stock during winter. In late winter and early spring, enough low-level



**ZEROED IN** Great gray owls have remarkable hearing aided by a dish-like face, which directs sound waves into their ears. The owls can detect an under-snow mouse or vole from 90 feet away.

photosynthesis can take place to trigger blooms on glacier lilies and pasqueflowers pushing up through melting snow.

The subnivean is also home to even smaller forms of life. Cold-tolerant fungi, commonly called snow mold, grow in and under deep snowpack. While some types of snow mold are pathogens on dormant vegetation, others decompose leaf litter and other organic matter.

In a study published in the journal *Soil Organisms*, researchers looked at microarthropods—small insects, spiders, and insect-like organisms such as springtails and mites—that fed on fungi below the snow.

They found that many of these species "feed continuously on gray mats of fungal hyphae and spores mixed with decaying plant matter."

In other words, snow molds are the foundation of the subnivean food chain. They are eaten by snow fleas and beetles, which are consumed by predatory mites and spiders, which then get devoured by shrews and other small mammals.

Snowpack is not always a benevolent blanket of warmth. After rapid melting or rain, small animals can get wet and die from hypothermia, or drown as water rushes through a tunnel like a flash flood. A grouse can get trapped under a crust of snow and freeze to death. Or it can try to plunge into a seemingly soft snowdrift that in fact is covered by a hard crust and be wounded or killed upon impact. Then there's the fact that Montana winters are warming and producing less snowfall, fewer days of snow on the ground, and snow that is melting faster in the spring.

Montana may have less of the white stuff than in decades past, but there's still enough to create subnivean zones across the state. When my pup Louie and I emerged from that abandoned quince hut last winter, we reentered the outer world of sun and light. But as we walked home across the snow, I thought of the dark snow basement below our feet and all the living creatures scurrying and scrambling to survive down there. 🦉



**SNOW SLEEPING BAG** Like ruffed grouse and dusky grouse, Montana's white-tailed ptarmigan will burrow into the intranivean zone for a night or two to stay warm during especially harsh weather.

FROM TOP: DONALD M. JONES; DAWN WILSON