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The Secret Lives of Creatures Under the Snow

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New England's native species have evolved remarkable ways to endure the harshest of winters, even when temperatures plunge below freezing, like we've seen recently. Cold-blooded creatures enter a state of dormancy called brumation, while some bird species migrate south to warmer climates. Meanwhile, certain mammals hibernate through the winter: an option I'm sure many of us wish we had! The more intrepid animals, and those that need to stay active, adapt in other fascinating ways: from changing the color of their coats to blend into the snow, to living and hunting in packs for added warmth and safety. The ways in which these animals modify their bodies to survive the brutal conditions are truly incredible, especially when we consider our reliance on space heaters and car seat warmers for comfort in winter months.

Bird migration down south. Photo Credit: Evalyn Bemis via Audubon Photography Awards

What many of us don't see are the subtle yet fascinating adaptations of small mammals like mice, voles, moles, and shrews. These critters create a hidden world beneath the snow known as the subnivean zone. The term comes from the Latin "sub," meaning beneath, and "niv," meaning snow. This secret refuge lies between the ground and the snow's surface and forms in two primary ways. One occurs when snow is prevented from directly contacting the ground by obstacles like rocks, logs, or plants. As snow falls, it accumulates, partially melts, then refreezes, forming a tough layer. There is often a gap that is created alongside or beneath the

obstacle where the snow has frozen. This open space is then preserved by the new layers of snowfall. As more snow continues to fall, it freezes and builds up more layers, but the gap remains undisturbed.

The other method of subnivean zone formation is through sublimation, where ice transforms directly into vapor. This is the process that happens when your food gets freezer burned. If food is left in the freezer too long or not properly sealed, the cold air will vaporize the water left in the food. You may notice some discolored areas of food and this is where the water was drawn out to create ice. In this context, snow melts and evaporates upon meeting Earth's heat radiating surface. Then it rises, refreezes creating a cozy zone just beneath it.

In order for the subnivean zone creatures to have a sturdy roof over their heads and comfortable living quarters, it only takes about six inches of snow. The cavity remains within a couple degrees of 32°F, regardless of the freezing temperatures and storms raging outside. It's similar to your childhood snow forts; it always felt warm inside, didn't it? For the animals in the subnivean zone, it's much the same: a snug, hidden haven where they can weather the winter (mostly) in peace.

Subnivean zone inhabitants. Illustration Credit: Bryce Michaels (Center for Wildlife Volunteer)

Mice, voles, and moles use this hideout for protection and shelter, but they also create elaborate tunnel systems through the snow to feed on plant seeds, shrubs, and tree bark. Voles have been found to actually construct entire underground homes complete with distinct rooms for eating, sleeping, and even using the bathroom. Red squirrels also burrow into the subnivean to stash food. Despite the added layer of security that the snow provides, these animals must remain vigilant, as predators are always on the prowl.

A meadow vole peeking out of its hideout. Photo Credit: Gerald Romanchuk via St. Albert Gazette

The primary threats within the subnivean zone are weasels and shrews, which can navigate the complex tunnels built by their prey to infiltrate their hidden homes. Coyotes and foxes, with their sharp senses of smell and hearing, can track these creatures through the snow. Similarly, owls use their extraordinary asymmetrical hearing to detect small mammals even if they're buried a foot beneath the surface. The hearing of owls is so precise they can actually detect the heartbeats of their prey from tens of feet away! In addition to these sensory advantages, predators can often spot their prey's dark bodies against the white snow or follow the tracks they leave behind, marking them as easy targets. Birds of prey will swoop in, sometimes leaving behind beautiful wing prints in the snow. I personally think the term "avian angels" is a fitting way to describe these impressions.

Owl wing print in snow. Photo Credit: Kent McFarland via Vermont Center for Ecostudies

Another (often forgotten) category of inhabitants in the subnivean zone is microbial life. Although invisible to the naked eye, they have proved to play an important role in the cycling of both carbon dioxide and nitrogen between the earth and its atmosphere. A substantial snowpack with an active subnivean zone encourages a healthy microbial population. Through respiration, microbes release a significant amount of carbon dioxide into the atmosphere. In fact, research suggests that as much as 50% of the carbon

taken up by plants in the summer is released back into the atmosphere by microbes during the winter. These microbes also fertilize the soil as snow melts by processing and storing nitrogen. With that said, if there was less healthy snowpack and, in turn, less of these microbes, plants wouldn't do as well come spring.

Evidence of these microbes at work are vents in snow pack. The released carbon dioxide in the subnivean zone would otherwise remain trapped in the subnivean zone until the snow melts if it weren't for these vents and the tunnel entrances that allow for degassing. This process is critical for the animals living in the subnivean, because they might otherwise suffocate.

Ventilation hole leading to subnivean zone.
Photo Credit: Mary Holland via Naturally Curious

The subnivean zone, though mostly hidden to us, is a vital habitat crucial for both those living below the snow and those above it. If you're looking to learn more about this mysterious world, winter wildlife tracking is the perfect activity! It's a great way to embrace the outdoors on those cold days when you might otherwise be curled up with tea by the fireplace or binge-watching the latest Netflix series. Winter tracking lets you tune into your senses and follow animal behavior, offering a chance to explore nature up close. And don't worry, the animals will probably be much happier to spot a curious predator with a camera in hand rather than one eyeing them as a snack!

We encourage you to join us for our two Introductory Winter Tracking Workshops here on our community campus on Saturday, Feb. 22nd and Saturday, March 22nd from 10AM-12:30PM. You'll have the chance to find animal tracks, discover tunnel entrances, and uncover clues about the secret lives of these winter residents beneath the snow!