

Subject: How They Survive

Summary: How do plants, birds and mammals survive the harshness of the winter,
and what activities could you have on this theme -- localized to north-
american
fauna and flora

How They Survive

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The absence of concealing foliage during winter presents the opportunity to discover wildlife habits and happenings that occurred during warmer months. Bird and insect nests appear where we were sure no animal could hide.

Winter also opens the door to discovering how wildlife copes with extreme cold. By studying different survival schemes, we learn some good lessons about environmental adaptations.

Plants

Do plants migrate? Why is sap stored in the roots? How do plants avoid drying out when they are exposed to cold, arctic winds?

Once a plant is rooted, it must contend with changing environmental factors. Plants do migrate, in a sense, by dispersing seeds that, given the right conditions, will germinate in far-away areas.

Plants that overwinter in the mature stage face moisture-related

problems. The cactus is adapted to desert conditions that are similar to the winter environment. To conserve precious water, it has a small surface area that cuts the number of pores exposed to moisture-wicking wind. Cactus leaves are tightly rolled into spines that serve double-duty as armament. A waxy coating covers the cactus body to seal in moisture as well.

The life-preserving water inside the cactus becomes life threatening in winter. Stored sap expands as it freezes and can burst cells and damage the plant. To prevent this, the cactus expels its water and overwinters as a limp deflated pincushion.

Deciduous trees also reduce their pore surface area for winter by shedding their leaves. Evergreen needles with their small size and waxy coating enable the tree to grow on poor soil and in colder habitat zones. To prevent damage from the freezing of the stored water, tree sap flows away from extreme freezing temperatures into deep roots.

Rhododendrons are evergreens that retain broad leaves throughout winter. On cold, windy days, the leaves will droop and furl to cut exposure to the wind, an adaptation similar to that of the cactus in winter.

Insects

Where do insects live in winter? Some insects, such as monarch butterflies and dragonflies, migrate south. Most insects only live until fall and pass on their legacy by laying eggs that will hatch the following spring.

Examine the branches of fruit trees such as cherry and apple for the small, thick, bubbled band of the tent caterpillar's egg case.

Although the case is coated with an impervious chemical-resistant shellac, you can easily prune or peel it off to prevent infestation.

Some moths and wasps overwinter in the larval stage. Look under the bark of dead trees or logs. Silky cocoons protect the pupae from the elements, but not from the prying beaks of hungry chickadees, woodpeckers and titmice.

Midges, sawflies and certain wasps have adapted to letting plants build cocoons for them. The adult injects an egg and some body fluid into a host plant. The fluid activates woody tissue around the egg to grow rapidly. The result is a thick, bulbous gall. In spring, the now mature insect chews a hole through the plant tissue and begins the cycle anew.

There are numerous types of galls. Open and examine for larvae small "oak apples" attached to oak leaves. Pine-cone-like growths on willows are aptly called pine cone willow galls. Tumors on goldenrod stems are goldenrod ball galls. A goldenrod bunch gall results when a gall midge lays its egg on the tip of the plant's stem. Although the stem stops growing, the plant continues to produce leaves and the result is a rosette.

Tumors on elm, oak and pine trunks, called burls, are signs of a bacteria or virus infection.

A gall has some advantages over a cocoon. It offers more camouflage and resistance to predators than some cocoons. Red squirrels, however, favour white pine blister-rust cankers and cottonwood leaf galls.

Amphibians

How do cold-blooded animals keep from freezing solid? How can they

breathe when they're buried in mud? Researchers looking for answers to these questions ran experiments on three cold-resistant frog species; the spring peeper, wood frog and gray tree frog. They froze the frogs at -6 degrees C to -12 degrees C for a week, then exposed them to temperatures between 8 degrees and 10 degrees C. After three days, the frogs had fully revived.

Insects and amphibians are able to survive freezing because their bodies produce glycerol, a glyxol alcohol compound we use in the form of car antifreeze. The substance circulates through their blood and prevents their vital organs from freezing up. As the body temperature drops, their metabolism slows and they need less oxygen to maintain body functions. Wintering frogs require only a fraction of their normal oxygen intake and are able to absorb sufficient quantities through the skin.

Animals without glycerol, such as snakes and turtles, have limited northern ranges because of their low tolerance to sub-zero temperatures and inability to reproduce quickly in a short breeding season.

Mammals

Why do animals hibernate? What special traits do hibernating mammals exhibit? Do they use glycerol too?

Hibernation is a specialized adaptation which allows animals to survive in times of extreme environmental conditions or food shortages. Some species of desert ground squirrels will enter into a state of torpor during hot dry months. This is called estivation.

Hibernating mammals do not use glycerol. Instead, they build up a dense layer of brown fat and rely on a body-produced chemical called

HIT, the hibernation induction trigger.

White fat does not burn off readily and acts as an insulator. But, when a hibernator's body temperature drops too low, stored brown fat does "burn" to create body heat.

As the days grow shorter and colder, the hibernator's brain begins to produce HIT. The chemical induces a deep sleep and regulates the lowering of body temperature, heart beat and breathing. HIT also guards against infections and diseases during hibernation.

In the golden-mantled ground squirrel, the heart slows from 350 beats per minute to three or four. Body temperature drops from 37 degrees C to just above 0 degrees C. Contrary to popular belief, ground squirrels, woodchucks, bats and dormice do not sleep for five months straight, but wake periodically to nibble on stored food. During hibernation, there is virtually no body-waste build up.

Bears, skunks, raccoons and tree squirrels are not true hibernators. Black bears enter into a hibernation-like state of lethargy where the body temperature drops from 38 degrees C to 31-34 degrees C and their breathing rate to only three or four times a minute. But they are easily awakened from their sleep.

How do non-hibernators adapt to winter conditions? Food caches are handy, but heavy snows can bury them out of sight. Many winter mammals have an excellent sense of smell. Caribou can scent lichens under a heavy snow crust and use their broad hooves to dig feeding craters. The word caribou means "the one that paws". Researchers have found that gray squirrels can smell their buried acorns through 100 cm of snow.

Specialized hair helps some animals to repel cold. Deer hair is hollow and the dead air space retains body heat. The long guard hairs of a

wolverine protrude well above the dense underfur to shed any ice or frost buildup. Oily hairs on the foot pad prevent snow from balling around hooves and paws.

A white fur coat has obvious camouflage benefits and, now, biologists who study polar bears believe it offers an added solar radiation advantage as well. The lack of pigmentation allows the hair to perform like fibre optics to carry sunlight to the polar bear's black hide by internal refraction. In this way, the skin is provided extra warmth.

Birds

Birds migrate for the same reasons mammals hibernate - to escape environmental pressures. Some species of swifts hibernate when cold weather kills off their insect food. The poor-will of the southwestern U.S. lowers its body temperature to 6 degrees C and can endure almost 90 days without food.

Winter birds use similar schemes to those of winter mammals to cope with frigid weather. Stiff feathers around the toes of the sharp-tailed grouse act as snowshoes. To accommodate an increased demand for oxygen as the temperature drops, the rock ptarmigan has a heart four times bigger, compared to body size, than that of a ruffed grouse.

Before winter sets in, birds grow an added layer of air-trapping adult down. This fluffy long-john suits the arctic dwelling willow ptarmigan. Its winter plumage is so effective against cold that, at -13 degrees C it needs only the same amount of energy to maintain body heat that it uses at 32 degrees C. By digging a burrow into an insulating snow bank, the ptarmigan can conserve its precious layer of body fat.

Winter foods are very important.

High energy berries such as highbush cranberries, and rosehips are rich in carbohydrates and vitamins. Insects are almost total protein.

Activities

Collect and make a display of insect galls. Put some in a glass jar to capture the emerging adult. Look for old white-faced hornet (paper wasp) nests in trees or on buildings. Examine them for dead wasps and note their characteristics. Can you find any coloured flakes in the nest material? Wasps will sometimes take paint flakes from nearby houses for building material.

Bird nests also give clues to wildlife behaviour. Can you find evidence of food and eggshells? What was the favourite nest building material? Do not remove the nest, since it is protected by law as are the birds. One of the reasons for this protection is that returning migrants can re-use the nest. This means birds can begin breeding sooner and the young have longer to develop before having to begin the fall migration.

Discuss the similarity and differences between how various animals survive and how man survives. Why are wool and down coats better insulators than nylon? What hardships did frontier explorers face when travelling in Canada's high arctic? A study of nature's adaptations to cold will give us insight on how we can live in harmony with the natural world.

Resources

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