How Wildlife Stays Warm

Ben Kruser, *The Leader*, *December 1992.*

Most of us are familiar with the basic ways in which wildlife avoid freezing in winter. Hibernation, high fat or "Hi, Florida!" are common methods. Researchers have now revealed some new facts about these methods as well as other cold survival strategies among winter-hardy animals and plants.

Winter creates severe stress on animals, especially smaller species. Birds weighing less than 30 g have particulary intense problems staying warm. They have a large surface area relative to volume and therefore lose more heat than larger, bulkier birds. Smaller birds are relatively less insulated than larger birds, as well, since their size limits the amount of feathers they can pack on the body.

Let's compare a 600 g willow ptarmigan and a 10 g chickadee. The ptarmigan produces two types of feathers, on for summer and one for winter. The insulating value of its winter feathers means that the body heat production required for the ptarmigan to maintain its high body temperature is the same at 32 degrees C in summer as it is at -13 degrees C in winter.

The ptarmigan also burrows into the snow to protect itself against winter weather. Studies have shown that, under several feet of snow, the temperature hovers around -5 degrees C, even when it is ~40 degrees C on the ground. For the ptarmigan, this produces a heat surplus that allows it to stretch its meagre fat and food reserves.

Because the chickadee is not equipped to burrow or grow into a fluff ball, it has to be able to cope with severe weather. One of its methods is to let its body temperature drop at night from 40 degrees C to around 26 degrees C. By becoming hypothermic, the chickadee can save up to 23% of the estimated energy it needs to maintain its normal temperature.

The chickadee also withstands the cold by shivering. During shivering, antagonistic muscles contract simultaneously, which means no external work is done and all the energy produced appears as heat inside the body. In severe cold weather, shivering can create five times the energy needed to maintain a chickadee's body temperature. (The next time you're shivering your teeth out, tell yourself that you just think you're cold.)

What about mammals? New studies of the blood composition of hibernators provide insight and potential medical benefits. Studies on ground squirrels show that hibernation is controlled by a blood substance known as HIT, or "hibernation inhibition trigger". When HIT is produced, it lets ground squirrels basically shut down body functions. Their heart rate drops from 350 beats per minute to a mere three or four. Their body temperature drops to about one degree higher than the surrounding air of their burrow. Because HIT also suppresses appetite, the squirrel can spend the winter living off its layer of fat.

HIT can produce some aspects of hibernation in non-hibernators as well. Medical studies have shown that injections of HIT in lab animals led to a marked lowering of pulse rate and body temperature. Potential applications have been mentioned by leading medical researchers involved in heart surgery and other low temperature operations.

We've all been taught that frogs, salamanders, and bugs bury themselves under leaves or dirt to escape winter. The reality is that these creatures do not dig below the frost line, which means they are imprisoned in an icy tomb where, in many cases, the temperature drops below freezing.

But amphibians, reptiles, and insects are "cold blooded"; they can't regulate their body temperatures. How then do they prevent the water in their blood from crystallizing, expanding, and rupturing all their vital organs when temperatures fall below freezing?

Researchers studied three cold-resistant species, the spring peeper, grey tree frog, and wood frog. They found that, with the onset of cold weather, the frogs began producing glycerol, a glycol alcohol compound commonly used in auto antifreeze products. This compound in the frogs' blood enables them to freeze solid for short periods with no harm.

Plants that live in the high arctic face the particular challenge of trying to grow and produce seeds in a very short growing season. Researchers looked at how plants might use solar energy not only for photosynthesis, but also for heating flowering parts.

They found that a number of plants produce flower shapes resembling parabolic discs. The flowers not only absorbed heat, but also focused the reflection onto stamens and carpels, possibly accelerating the development of pollen and seeds. Temperature readings done with a thermo probe found, for instance, that the air inside the cup-shaped blossoms of the pusque flower could be as much as 8 degrees C warmer than the surrounding early spring air.

One of the interesting side benefits is that pollinating insects are attracted to the flower as a source of warmth. This increases the plant's chances of being pollinated early, thus speeding along the production of seeds.

For many people, winter is a time to fall asleep and let the world go on. Nature offers some of its best stories at this time of year, but only for those who are hard enough to go out and hear them.

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