Wildlife and Winter

- modified from *Snow Activity Program* by John Pattimore

The ecology of wildlife and winter is an intricate web of seasonal changes and adaptations by animals to these changes. Temperature and snow are the two ecological factors that present problems to wildlife in winter. The degree to which animals can cope with these factors depends on behavioral, physiological, and morphological adaptations.

Many animals totally avoid cold winter temperatures by migrating, hibernating, or just sleeping. For some of these it is not the cold that directly causes this behavior. Birds have very adequate insulating feathers, but many birds migrate. A bear has thick fur, which is also a good insulator, but bears sleep in warm dens most of the winter. Still, many other animals remain completely active in winter. What dictates whether an animal will migrate or stay? What influences whether an animal will hibernate, sleep, or remain active?

It takes more than good insulation to keep animals warm. They must have fuel to produce body heat. Energy, which most obtain through food, is the dictator. Cold temperatures kill or drive off much of the animals' food, or snow (caused by cold temperatures) covers their food sources.

Adaptations to Cold

All animals must have a means of regulating body temperatures. Thermoregulation, as this is called, can be divided into three categories: poikilothermic, homeotherm, and heterotherms (as defined in Wildlife Document).

Many homeotherms use torpor as a way to conserve energy when the temperature changes. **Torpor** is a state of decreased physiological activity in an animal, usually by a reduced body temperature and metabolic rate. Torpor enables animals to survive periods of reduced food availability. A torpor bout can refer to the period of time a hibernator spends at low body temperature, lasting days to weeks, or it can refer to a period of low body temperature and metabolism lasting less than 24 hours, as in "daily torpor".

Hibernation

Hibernation is a state of inactivity and metabolic depression in animals characterized by lower body temperature, slower breathing, and lower metabolic rate

True hibernators reduce their body temperature to near that of the environment, possibly to a few degrees above 0°C. Their metabolic rate may be reduced more than fifty-fold. Small mammals, the largest group of hibernators, have a very low body-mass-to-surface ration so they lose heat very quickly. Hibernation, therefore, is an excellent energy economy for them. Hibernators need to wake up every few weeks o eat small amounts of stored food and pass wastes. True hibernators include ground squirrels, chipmunks, and other rodents.

Fatness seems to be related to hibernation because fat animals tend to start hibernating sooner than thin ones. However, fattening is not a necessity for thin animals of the same species may hibernate as well, although the onset may be delayed. Some hibernators do not fatten up in the fall but store quantities of food.

When entering hibernation the heart beat and metabolic rate decline before the body temperature starts to drop. This indicates that entering hibernation is an active process where vital functions are actually suppressed with the resulting decline in body temperature. The optimum environmental temperature for hibernation in most mammals is about 10°C. The body and environmental temperature are virtually the same in bats, while body temperature is two or three degrees warmer in ground squirrels. The respiratory rate drops to less than one cycle per minute, occurring in a series of two or three quick gasps followed by long rests. The heart rate may go as low as two or three beats a minute, but blood pressure remains quite high.

There are apparently limiting factors, which have prevented hibernation from becoming more widely established in the animal kingdom. The size-range of hibernators may be one such factor, from the smallest known hibernator, the bat, to the marmot, the largest known true hibernator. Within this size-range there seems to be a metabolic economy in the process of hibernation.

Daily Torpor

Many animals will lower their body temperature and metabolism for a shorter period of time (less than 24 hours) in order to save energy. Animals that undergo daily torpor include birds (even tiny hummingbirds) and some mammals, including many marsupial species, rodent species such as mice, and bats. During the active part of their day, such animals maintain normal body temperature and activity levels, but their metabolic rate and body temperature drops during a portion of the day (usually night) to conserve energy. Torpor is often used to help animals survive during periods of colder temperatures, as it allows them to save the energy that would normally be used to maintain a high body temperature.

Seasonal Lethargy

Seasonal lethargy defined as profound dormancy when animal remains at a body temperature only 2-5°C less during the winter.

Not all animals are able to lower their temperature and their heart rate as much as true hibernators. Many larger animals, like bears, become more lethargic and sleep through much of the winter. The heart rate of a bear also drops, though not as rapidly. During the early part of its seasonal lethargy, a bear's heart rate averages 50 beats per minute. After several months of uninterrupted sleep, the rate may drop to as low as 8 beats per minute. But a bear's body temperature remains nearly normal during this period. That's the reason a bear can wake relatively quickly -- a fact that's resulted in more than one hasty exit by from a bear den researchers. Pregnant females wake in mid-winter to give birth, then go back to sleep while their newborn cubs nurse. Still, most bears sleep all through the winter if left undisturbed.

Acclimatization

Homeotherms, that are not hibernators, precisely control their body temperatures. Many mammals control body temperature so well that there is barely any daily variation.

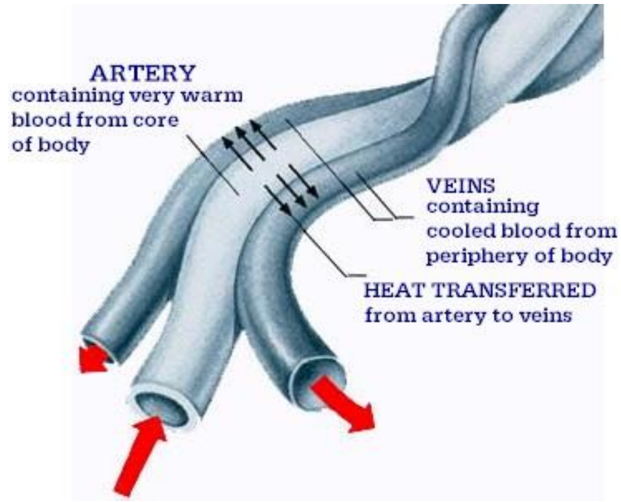
Many animals remain totally active during winter. They travel through or on top of the snow in search of food and to escape predators. What adaptations allow them to withstand cold winter temperatures? In the following discussion you will notice that some adaptations have evolved to cope with both cold temperatures and snow. Cold adaptations (acclimatization) occur in three categories: behavioral, physiological, and anatomical.

a. Behavioral adaptation – a large group of small mammals and many insects remain active under snow. These animals are known as chioneuphores, and their characteristics are discussed below in Table 1. The lifestyle that has evolved for them is called subnivean, and it affords them a constant temperature (rarely below 0°C) in which to move about in search of food. The beaver and the squirrel are both active in winter, one under the ice and one in the trees. However, these creatures have been busy during the fall storing food, which would otherwise be covered with snow or would be hard to obtain without wasting important energy (body heat). The beaver makes an underwater cache of leafy branches somewhere near the beaver lodge. At any time during winter a short swim under the ice to the cache to bring back a branch to the dry eating-platform in the lodge is all that is required. The squirrel has been busy during the fall collecting nuts and seeds and storing them underground or in hollows in trees within easy distance of its sleeping place.

   Beginning in the fall many animals increase their food intake, and many change their diets to food with higher energy content. Increased eating in fall is related to the occurrence of a physiological adaptation: an increase in the brown fat content of the tissues.

b. Physiological adaptation – More than other animals, mammals have been studied for their adaptations to cold temperatures. It is well known that shivering in mammals is not just an indication that an animal is cold but also a way of producing body heat. Muscle contractions in quick succession, as in shivering, produce body heat. However, with the full onset of cold temperatures shivering actually decreases and more effective heat mechanisms keep the animal warm.

A second marvelous mechanism for heat conservation has evolved in the legs and feet of animals that need to withstand winter temperatures.



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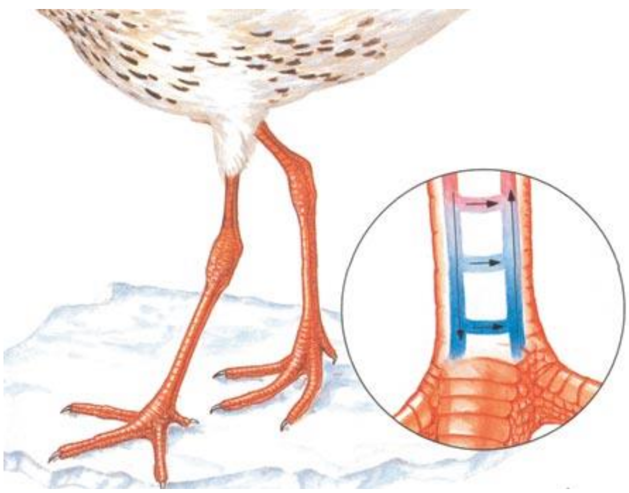
Counter current heat exchange - Ever notice a duck standing on ice and wonder how there feet do not freeze while they spend the night sleeping on ice in sub-zero temperatures? The short answer is that it is about heat exchange. The smaller the temperature difference between two objects, the more slowly heat will be exchanged. Ducks, as well as many other birds, have a counter current heat exchange system between the arteries and veins in their legs. As blood flows through the blood vessel =, and gets closer to the cold surface of the body, the warm blood loses heat to the surrounding tissues. The blood of the animal becomes cooler as it loses heat to the tissues. Enough heat is lost to the tissues such that when the blood gets very close to the surface of the body, there is a small temperature gradient. This smaller temperature gradient means that less heat is lost from the blood and tissues. When the blood leaves the body surface, it has a low temperature. However, the vessels carrying blood to, and away from the surface are very close to each other (see above). These vessels are close enough that when warm blood loses heat, the returning cold blood picks up the heat and increases in temperature. As cool blood moves further into the body, at each stage, the warm blood losing heat is always warmer then the cold blood, and so heat is constantly transferred to the cool blood, increasing its temperature. This exchange of heat works because the warm blood is always slightly warmer than the cold blood, and heat will travel down this gradient. Counter current heat exchange prevents the loss of a large amount of heat by causing the transfer of heat from warm blood, to cool blood reentering the core of the body. This prevents a large loss of heat across the body surface, and prevents extremely cold



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blood from entering the core of the body, and dropping the core body temperature.

c. Anatomical adaptation – The change for winter that you are most likely to be familiar with is the thickening of insulation, the fur. Many mammals grow a thick soft under fur covered by the normal, longer coarse over fur. Many mammals grow a thick soft under fur covered by the normal, longer coarse over fur. If you can, watch and inspect this cycle of change in a dog such as a Siberian husky and you will see this happening. Birds experience an increased thickness or loft of feathers, which they can lift away from their bodies to increase their insulation.

   Some mammals have evolved more compact smaller ears and feet so that less heat is needed to keep these extremities warm. A general higher tolerance to cold stress-which is difficult to measure- also occurs in water-active animals.

Adaptations to Snow

The depth, the density (compactness) and the hardness (moisture content/temperature relationship) of snow on the ground are factors that influence wildlife. Shelter, travel, food and escape from predators are the essential requirements for wildlife in winter. Snow presents problems to wildlife in their pursuit to satisfy these requirements.

Some biologists use an ecological classification to indicate how animals have adapted to cope with these problems. Adaptations may again be behavioral, physiological, or anatomical, as were adaptations to temperature. The classification is intended only as a set of guidelines. Certain animals overlap the lines of this classification and cannot be rigidly classified. Only a study of the specific adaptations to snow will provide a relative classification for the animal.

Table 1: The ecological classification of animals' adaptations to snow.

Class/adaptation	Behavioral
Chionophores: Avoid snow Venture out infrequently	**Migration**: birds, insects, small mammals **Hibernation/Dormancy:** insects, snakes, frogs, ground squirrels **Store Food/Sleep:** tree squirrels, beaver, bears, skunk, porcupine

Class/adaptation	Anatomical

Chionophiles: Snow lovers Do not avoid snow Have adaptations	**Floaters**: increased surface area under each foot (ptarmigan, hare, lynx) Floaters are elevated to new supplies of food every snowfall This adaptation relies on density and hardness of snow Ptarmigan grows compact flexible feathers around each toe (also grouse) Hare and lynx grow dense hair on feet Gait (type of movement) aids travel over snow If snow is not dense and hard, even a snowshoe hare may sink slightly and experience some difficulty in travelling This adaptation would be essential to escape from predators or in pursuit of prey. **Pelage changes**: white hair grows in and dark hair is shed due to little understood influences of light intensity and temperature (snowshoe hare, ermine, ptarmigan). Camouflage is important to both predator and prey

Class/adaptation	Anatomical
Chioneuphores Do not avoid snow Do not have specific adaptations for snow but carry on as normal	**Ploughers**: moose, deer, elk, wolf, fox These animals travel where snow is shallower or along trails packed by game Hard and dense snow allows easier travel for some on top of snow (wolf) If there is a crust deer and moose may punch through continually, making them easier prey for wolves **Burrowers**: shrews, moles, voles Could not withstand cold temperatures They remain completely active under snow where the temperature remains warm and moist relative to snow surface temperatures Because of carbon dioxide build up under snow, these animals must dig ventilator shafts to the surface Snow that is too hard or dense may cause a problem for ventilation

Behavior in Winter

1. Reptiles

   Reptiles, such as snakes and lizards, are poikilotherms that produce relatively less metabolic heat than homeotherms. With no effective surface insulation such as hair or feathers, and little subdermal fat, their body temperature depends on the temperature of their immediate surroundings and what heat they can absorb from the sun's rays. Unless there is an external source of heat such as sunlight, temperatures below that at which ice forms in their tissues can quickly kill most poikilotherms. Thus all poikilotherms in this area must hibernate or find an alternative coping mechanism and they must doe this in a sheltered place. The red-sided garter snak is particularly interesting. Not only is it the most common reptile in Manitoba, but also it lives farther north than any other reptile on this continent.

Despite the various mechanisms this snake has evolved to survive the winter, there still appears to be a high degree of overwintering mortality. Perhaps many of the snakes don't get deep enough underground to avoid freezing. Or perhaps many die from lack of oxygen. We may never know.

2. Insects and Invertebrates

Insects employ four main ways to survive winter. Firstly, some, such as the monarch butterfly, migrate. Secondly, some enter diapause, which is dormancy deeper than sleep. This may happen at any stage of the insect's life cycle. Adults may seek shelter in crevices in trees, rocks, and buildings. These adults in diapause secrete glycerol, a biochemical that acts as an anti-freeze and prevents damage to tissues from freezing.

Thirdly, on branches you may find galls and cocoons in each of which an insect is changing from one stage in its life cycle to the next. Many insects lay eggs in late summer. These can be found on twigs or in pond water, and can over-winter without freezing until they hatch in spring. Fourthly, many insects remain active under the snow in winter. In warm moist conditions these invertebrates are active in obtaining food from the leaf litter. Snow cover in Manitoba creates a subnivean microenvironment at the ground surface, which is very different from the above-snow macroenvironment. Temperatures under the snow may hover between 0°C and -6°C in spite of the coldest above-snow temperature.

3. Birds

Many people regard winter as a time of year when there are few birds in Manitoba. This is not necessarily true, however, as at least 30 species are regularly found in the province, but many of these are localized within restricted ranges.

The Goshawk is the only hawk regularly found in southern Manitoba in the winter. It feeds on whatever mammals or birds are available and which it can catch. Ruffed Grouse and Snowshoe Hare are amongst its favored foods and are readily taken despite their large size. The Goshawk is associated with dense woods and can frequently be seen winging its way down narrow valleys and along shorelines.

The Ruffed Grouse – a bird of the thick woods – feeds in the early morning and at dusk, and at these times can be observed perched in a tree eating buds of poplar, birch, willow, or spruce. During the remainder of the day, they roost in dense thickets or under snow. At night, if there is little snow, they roost next to the trunk on the lower branches of a tree. If the snow is deep, they fly into the soft snow and form a cavity as much as two feet below the surface. Here they are insulated from drifting snow, icy winds, or sub-zero temperatures. In agricultural areas, Sharp-tailed grouse can best be seen during the morning, feeding in stubble fields. Sharp-tails spend the night sleeping in tall grass until the snow becomes deep, then they are forced to bury into snowdrifts along the edges of woods.

The White-breasted Nuthatch is regularly found at many feeding stations where suet, acorns, and sunflower seeds are the favored foods. This bird roosts overnight in a sheltered cavity, which is the center of its winter territory.