SURVIVING MONTANA

bugs below zero

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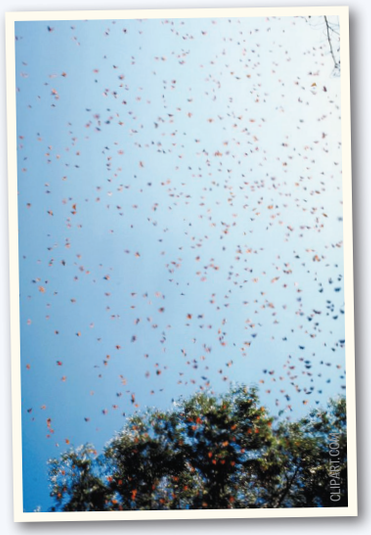
How do insects survive the winter? During the summer, insects regulate their body temperatures mainly by exchanging heat with their surroundings. Summertime insects are free to move around and raise or cool their body temperatures by seeking out suitable micro-environments. However, when the first hard frosts hit Montana, often as early as September, insects run out of leeway. They must then fall back upon some other mechanism that allows them to cope with extreme cold.

Migration

Migration is one strategy for escaping the killing freeze. The monarch butterfly is the best-known example of large-scale migration, these insects moving as far south as central Mexico for the winter. Another impressive migratory butterfly is the painted lady, *Vanessa cardui*, a species common to Montana and widely distributed throughout the world. Periodically, enormous numbers of these bright orange, speckled butterflies migrate back and forth from northern North America to the deserts of the southwestern U.S. and northern Mexico. These migrations are sporadic, often bursting forth after profitable rainy seasons in the deserts where the butterflies spend the winter. A similar species, the west coast lady *(Vanessa annabella)* is a western species that reaches as far inland as Montana, where it is occasionally collected. Both species favor open fields, vacant lots, and gardens. They fuel flight by feeding on flowers of many plant types, especially thistles, hollyhocks, forget-me-nots, mallows, nettles, and various legumes. Thus, an avid flower gardener in Montana can furnish valuable re-fueling stations for migrating butterflies.



Chemical Freeze Avoidance Strategies

Many insects prepare for extreme cold while staying at home in Montana by changing their body chemistry. During fall, insects commonly produce glycerol for use in the fluids between the cells. Like anti-freeze in our cars, glycerol gives insects the ability to *supercool* by lowering the freezing point of their body fluids to temperatures well below normal, preventing damaging ice crystal formation. Glycerol is an added expense for insects to produce, in terms of currency in calories that need to be eaten in preparation for the cold. So, in the spring the animals dispense with glycerol production and levels drop accordingly.

Mountain pine beetles *(Dendroctonus ponderosae)*, like many insect species, cannot tolerate freezing of body tissues while they winter as larvae beneath the bark of their host trees — lodgepoles and other pines. The bark provides little barrier from the cold, where temperatures within can drop to below minus 30 degrees Fahrenheit during the bitter cold winters that are so prevalent in the western region. Winter cold mortality is a key factor affecting pine bark beetle numbers, and sudden cold is best. If temperatures drop gradually throughout the fall, mountain pine beetles are able to achieve supercooling freezing points that are 36 degrees Fahrenheit or more below the ordinary (summertime) freezing point of their body fluids. Early and severe freezes prevent mountain pine beetle larvae from building up glycerol levels, ordinarily a progressive process stimulated by gradually decreasing temperatures.

However, very warm winter temperatures can also cause mortality in *D. ponderosae*. In preparation for winter, larvae stop feeding and void their bodies of "ice-nucleating agents" such as food in the gut and certain stored proteins, which allows more efficient supercooling. This seasonal response may not be optimal when winters are unusually warm.

Behavioral Freeze Avoidance

Various micro-environments can furnish protection from winter cold. Female grasshoppers probe deeply into the soil to deposit eggs. Some adult beetles hibernate underground during winter, and many flies overwinter in the soil as pupae. Other methods of hibernation include nestling under flakes of bark on trunks and branches of trees, or underneath leaves and other detritus on the ground. Ladybugs often hibernate by piling together under stumps and rocks or within outbuildings to share heat and buffer temperature extremes. Ants and termites head below the frost line, where their large numbers and stored food sustain them through the cold. Most aphid eggs are laid on exposed branches to overwinter. However, many ants stash aphid eggs in protected underground chambers. The eggs are not eaten. Rather, they are maintained in neat piles where they are frequently cleaned and re-stacked to keep fungi and molds away. In the spring, the newly-hatched aphids will be carried up into the canopies of trees and bushes where they are tended like miniature cattle and milked for their sugary honeydew.

Freezing Solid

A few insects forego these fancier tactics and tough it out by actually freezing solid. They can subsequently resume normal activity when they thaw out. In Montana, the northern rock-crawler *(Grylloblatta campodeiformis)*, a pale brown cricket-like insect, survives best high in the mountains above treeline. They prefer somewhat balmy temperatures above the freezing point of water, in moss and decaying wood, where they actively forage on snowfields in the winter, hunting for dead insects and other detritus. But, for brief periods of time, they can freeze solid and survive. These tough insects are well-adapted to the northwest region, and occur nowhere else. ■