Tough Buggers:

Insect strategies to survive winter in Minnesota

University of Minnesota
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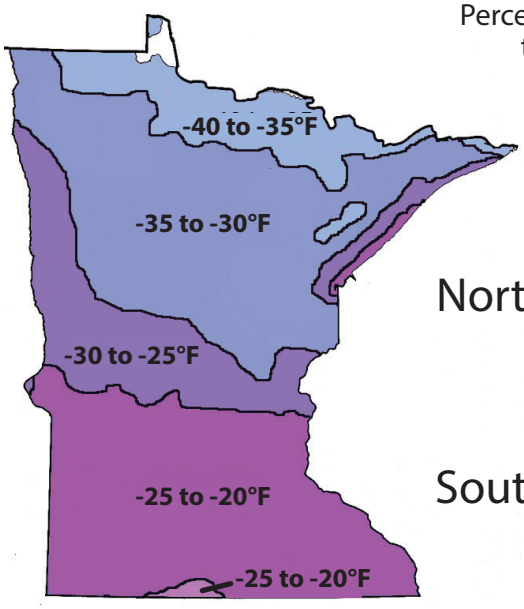
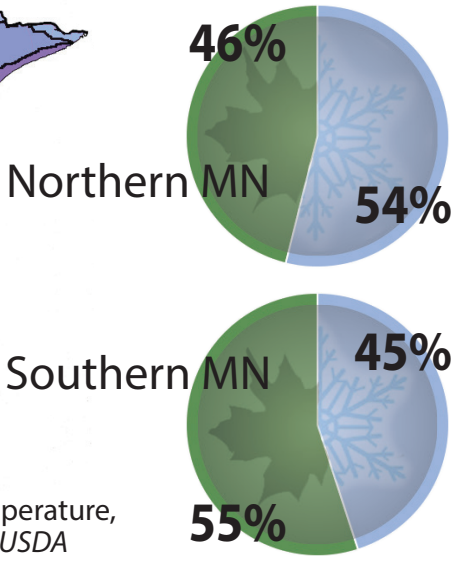
Minnesota winters are too cold for most insects to survive without special strategies and adaptations (see below). Learning how insects cope with cold temperatures is helpful in many ways. We can more accurately forecast when and where insects are active, and predict where invasive species may establish in the future. We can also better understand the different ways in which pest and beneficial insects will be impacted by climate change. Warmer winters could allow more insects to survive, expanding or shifting their habitats to new areas. Other insects may be less likely to survive because of reduced snow cover, which can serve as an insulative layer. Below, you see just how cold Minnesota is, for how long, and how much snow falls.

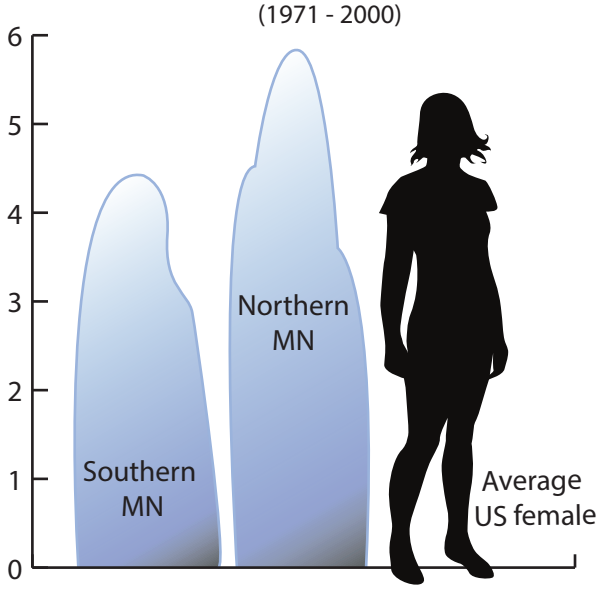


Average annual minimum air temperature, 1976-2005. [*modified from the USDA Plant Hardiness Zone Map*]

Percentage of the year with a daily minimum temperature above freezing (green) and below freezing (blue)



Average feet of snow per year
(1971 - 2000)



Strategy #1
Avoid the cold

Many insects find *shelter*, often in *aggregations* with insects of the same species. Other insects will *migrate* to warmer climates.

Strategy #2
Don't let yourself freeze

Most insects die when they freeze. But some *supercool* by making chemicals to prevent freezing until temperatures below the freezing point of water.

Strategy #3
Let yourself freeze

Some insects can survive freezing. They survive by using special *proteins* to regulate the way their body freezes and to minimize damage to cells.

Some insects will use more than one strategy to battle the cold. For example, the woollybear caterpillar (below right) avoids the cold by finding shelter under leaf litter and snow, produces chemicals to supercool, and can also survive

Strategy #1 Strategy #2 Strategy #3

The table below lists brief facts about the overwintering strategies of common insects that are, or might one day be, found in Minnesota. Overwintering notes include what physiological (e.g. lowering supercooling point) and/or behavioral adaptations (e.g. burrowing under the soil and snow) they use, and the lifestage in which they spend the winter.

Strategy		Species	Overwintering Habitat	Winter Lifestage
	----	Striped cucumber beetles	**Die** in MN, spring migrants from southern states	Adult
	----	Corn earworms	**Die** in MN, spring migrants from southern states	Pupa
Avoid cold	1	Monarch butterflies	**Migrate** to Mexico	Adult
	1	Common green darners	**Migrate** to the Southern US and Mexico	Adult
	1	European honey bees	**Aggregate** in hives	All stages
	1 & 2	Multicolored Asian lady beetles	**Aggregate** in sheltered areas	Adult
	1 & 2	Northern house mosquitoes	Find **protected** sites with high humidity	Adult
	1 & 2	Bean leaf beetles	As **individuals** under leaf litter and snow	Larva
	1 & 2	Japanese beetles	As **individuals** under soil and snow	Larva
Don't freeze	2	Codling moths	As individuals under bark; **supercool** to -10°F	Larva
	2	Emerald ash borers	As individuals under bark; **supercool** to -26°F	Larva
	2	Mountain pine beetles*	As individuals under bark; **supercool** to -31°F	Larva
	2	Gypsy moths	On bark; **supercool** to -17°F	Egg mass
	2	Forest tent caterpillars	On bark; **supercool** to -22°F	Egg mass
	2	Soybean aphids	On buckthorn near leaf buds; **supercool** to -29°F	Egg
Freeze	2 & 3	Asian long-horned beetles*	As individuals under bark	Larva
	2 & 3	Goldenrod gall flies	As individuals in goldenrod stem	Larva
	1, 2 & 3	Woollybear caterpillars	As individuals under leaf litter and snow	Larva

Species not yet found in Minnesota

	Soybean aphid	Japanese beetle	Honey bee	Monarch butterfly
Overwintering habitat				
Most recognizable stage				

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