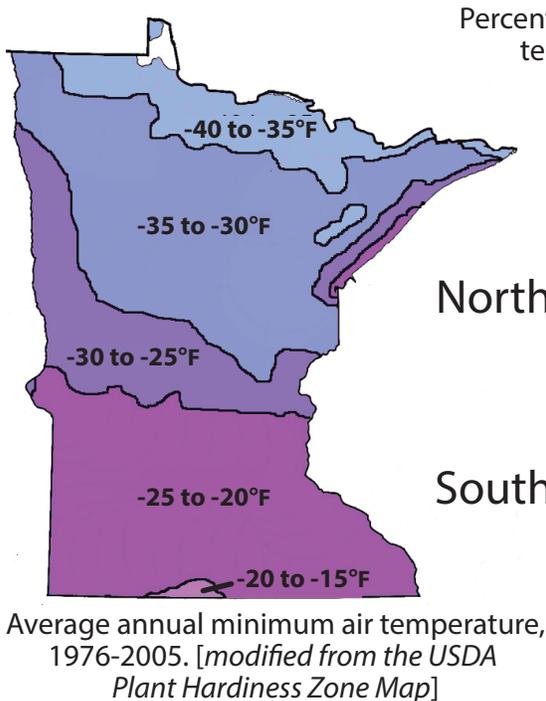


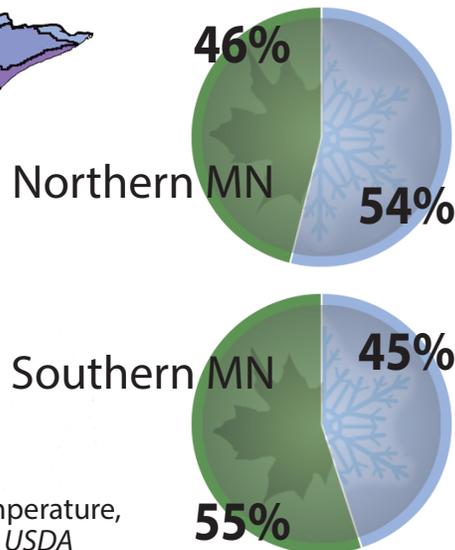
Tough Buggers:

Insect strategies to survive winter in Minnesota

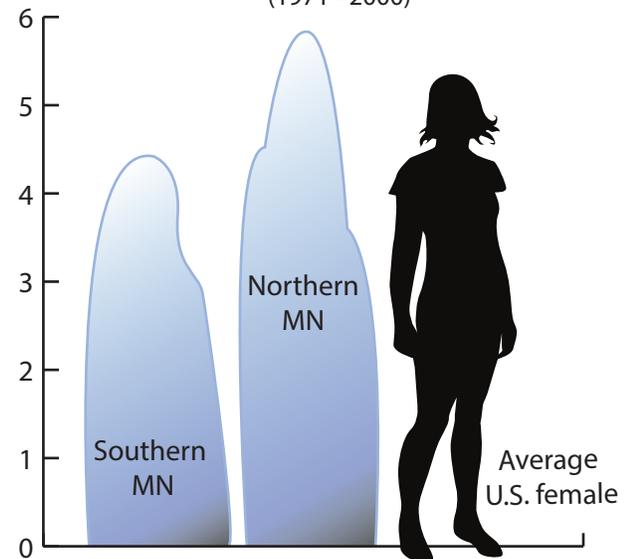
Minnesota winters are too cold for most insects to survive without special strategies and adaptations (see below). Learning how insects cope with cold temperatures is helpful in many ways. We can more accurately forecast when and where insects are active, and predict where invasive species may establish 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.



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.

Often, 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 freezing.



Strategy #1



Strategy #2

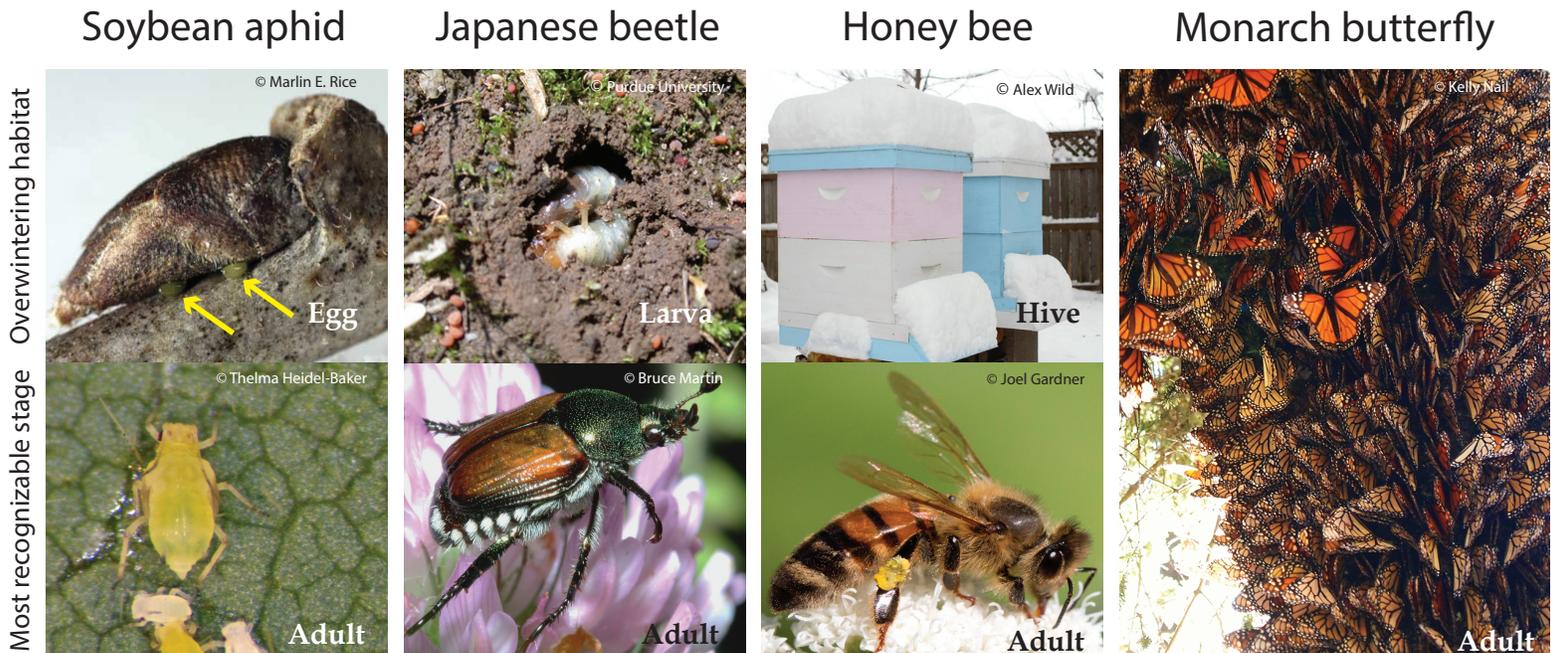


Strategy #3

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



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