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Branching Out
from the Canadian Forest Service - Laurentian Forestry Centre

# Too Hot to Reproduce: How to Avoid the Worst for the Hemlock Looper

Because of global warming, warmer weather begins earlier in spring and continues later in the fall, thereby extending the season that is favourable to insect development. These seasonal changes will accelerate insect development and reproduction. Canadian Forest Service researchers observed that hemlock looper eggs laid earlier than normal are more likely to die prematurely due to prolonged exposure to warm temperatures. What about the adults? How will they react to warmer weather? Will they be more productive?

## The hemlock looper, you say?

Native to North America, the hemlock looper is considered a major defoliator in Canada. The wasteful feeding of this species and its rapid population growth make it a serious defoliator. It can be found from the Atlantic coast to the Pacific coast. In Eastern Canada, the hemlock looper is mainly found in balsam fir, while the hemlock is its preferred host in the Western provinces.

Hemlock looper outbreaks develop and subside very suddenly. They spread quickly and can cause the death of balsam firs in the first year that damage is detected. Hemlock looper damage is visible on conifers during epidemics in late July and early August. The trees turn a reddish colour, which is very characteristic of hemlock looper outbreaks. Needles damaged by feeding larvae dry out, turn red and drop in the fall.


The hemlock looper mates and lays its eggs only at night. The warmer the weather, the later mating occurs and the shorter the mating season.

## Disruptive heat

Using young couples (a male and a virgin female placed in a small breeding cage), researchers studied the effect of temperature on breeding. According to results, hemlock looper breeding is disrupted at 25°C. Mating success, which was high (approximately 85%) at 15 and 20°C, dropped to 38% at 25°C. It would seem that at that temperature, females have trouble emitting sexual pheromones or males do not detect them as well.

Young breeding couple in a cage.
Photo: NRCan

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Mature hemlock looper caterpillar.

## Quality production?

Contrary to mating success, egg production was not significantly disrupted by warmer temperatures. Female hemlock loopers are most productive at 15°C, i.e. the average temperature during the butterfly flight season spanning from mid-August to late September.

Eggs in an ovary.

Photos: NRCan

The eggs, which are green when laid, turn coppery brown when fertilized at which point they enter diapause, a necessary resting period.

However, the rising temperature did have considerable effects on the quality of the eggs laid. While the percentage of fertile eggs rose from 85% at 10°C to 93% at 20°C, it suddenly dropped to 51% at 25°C, which supports the premise that heat is damaging to hemlock looper reproduction. Moreover, regardless of temperature, the percentage of fertile eggs decreased particularly at the end of the egg-laying period, which suggests that either the quantity of sperm transferred to the female was not sufficient to fertilize all of her eggs, or the sperm became less viable over time. It is also possible that the temperature directly affected egg development. As the last eggs laid are smaller than the first ones, they are probably less predisposed to being fertilized.


Severe hemlock looper epidemic that occurred in the Réserve faunique des Laurentides in 2012. The insect eats everything it comes across.

## North or south?

Hemlock looper populations are divided into two groups. In the north, larvae development occurs in four stages, whereas it occurs in five stages in the south. As the growing season is shorter in the north, insect populations benefit from quicker development (fewer larval stages), so that the adults may have time to reproduce before the cold kills them. Conversely, since the growing season is longer in the south, having more larval stages delays reproduction and prevents the eggs from being killed by the heat. This strategy is also beneficial to adults who, by mating later in the season, increase their mating success and the probability of laying fertile eggs.

This information provides a clearer picture of this forest pest's biology, and helps to better predict its behaviour and thereby optimize its control in order to diminish its impact on the forest industry.

## Useful links

https://tidcf.nrcan.gc.ca/en/insects/factsheet/8846

http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/31713.pdf

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