Why the spongy moth outbreak has vanished in Québec

October 24 2022, by Emma Despland

This freshly emerged lab-reared female spongy moth is one of the few survivors of 2022. Credit: Victoria Yip, Author provided

Last year, forests across southern Québec and Ontario and much of New England turned eerily leafless. The air hummed with the sound of munching mandibles and tree trunks were covered with a writhing carpet of caterpillars, while showers of caterpillar poop fell softly on the heads of unsuspecting hikers and campers.

The population of the European spongy moth, which had been gradually increasing since 2019, reached a dramatic peak in 2021 and completely vanished this year.

In 2020, the hungry caterpillar damaged 583,157 hectares of forests in Ontario and this number is bound to go up when the 2021 numbers are revealed.

Insect outbreaks are one of the most important natural disturbances in Canadian forests. As a biologist who has been working on plant-insect interactions for over 20 years, I see that the frequency, intensity and range of insect outbreaks keeps changing. To protect trees in our forests and cities, we need tree diversity.

Insect outbreaks

An insect outbreak can be frightening. In deserts around the world, vast swarms of locusts can blot out the sun for hours as they fly overhead. In the Rocky Mountains, hillsides are covered with dead trees, killed by the inner-bark-eating mountain pine beetle.

However, insect outbreaks are not a new phenomenon. Chinese historical

records document locust outbreaks for almost 2,000 years, while paleo-ecological studies show that Québec's boreal forests have witnessed spruce budworm outbreaks for at least 8,000 years.

Such insect outbreaks are part of how temperate and boreal forests—as well as semi-arid grasslands and deserts—function. Insect outbreaks stimulate nutrient cycling, accelerate forest succession and can renew forests.

Female insects can produce hundreds of offspring and for the population to remain stable, only two of these need to survive. A small increase in survival, due to factors like favorable weather conditions, can lead to a population explosion and an outbreak.

In the case of the mountain pine beetle and the desert locust, warming temperatures, increased cyclone activity and other such effects of climate change are bringing these favorable conditions more frequently to new areas, thus dramatically increasing the extent of outbreaks.

However, these outbreaks always come to an end because of what ecologists call lagged-density dependent population dynamics. Here, density-dependent means that the insects' mortality rate depends on the density of its population. As the population increases, mortality also increases and survival rate decreases. Meanwhile, lagged means there is a delay in this process—the insect mortality increases more slowly than population growth, causing an outbreak.

The outbreak crashes when the insect mortality eventually catches up with its population size. This usually happens due to a combination of factors including low food supply and increase in predators, parasitoids—insects that lay their eggs inside other insects—and diseases.

Where did the spongy moth go?

Students in my laboratory have been rearing spongy moth caterpillars for the past three years and have found that the mortality of these caterpillars gradually increased as the population grew.

In 2019, one student, Pamela Yataco Marquez reared over 300 caterpillars and observed an 80 percent survival rate. However, this year, despite an extensive search, Marie-Eve Jarry, Geovana Demarchi and Victoria Yip were able to find and rear only 97 caterpillars and only six survived to adult.

Several mortality agents including a virus Lymantria dispar multiple nucleopolyhedrovirus, the fungal disease Entomophaga maimaiga and two tiny parasitoid wasps called Cotesia melanoscela and Ooencyrtus kuvanae finally caught up with the insect population.

When parasitoids eggs—laid inside either the eggs or the bodies of other insects—hatch, they devour their host from the inside and eventually emerge from the dead host, ready to start the life-cycle anew.

They are more like predators than parasites because they kill their host, and are efficient biocontrol agents that decrease pest insect populations.

Creeping across borders

While the spongy moth is native to Europe, it has been in eastern North America since the 1860s and is part of our fauna now.

It has not reached the western part of the continent yet and the best way to stop this is to inspect outdoor gear for caterpillars or egg masses before traveling and not to move firewood.

The Asian spongy moth population has not spread in North America yet, and entomologists are working hard to keep it out.

In the past 150 years, many of the European spongy moth's natural enemies, including the fungal disease mentioned above and several parasitoids, have also been introduced, either inadvertently or deliberately. Our findings show that these natural enemies are well established in our region and have been effective in collapsing the outbreak.

The current range of the spongy moth distribution in North America extends up to southern Canada. Here, the eggs that spend the winter on tree trunks suffer high mortality due to cold, knocking down the survival rate irrespective of population size.

Forest managers in Québec and Ontario are on the alert for increases in spongy moth outbreaks—including both more severe and longer duration outbreaks similar to those seen in the U.S.—and a possible northward shift of the distribution range.

Diverse forests

While a tree that is leafless in July may appear dead, many trees can survive a few years of defoliation, drawing on stored reserves to flush out new leaves.

The spongy moth outbreak in the Montréal area in the late 1970s slowed tree growth, but did not cause the widespread death of forest trees. However, tree mortality does occur further south in the U.S. and depends on the diversity of trees in the forest area. The death of tree species preferred by the caterpillar is lower in diverse forests that mix in less-vulnerable species.

Diverse forests are more resilient under various stresses than more homogeneous ones. We need to create and preserve such diverse forests to help prepare for new types of insect outbreaks in our changing world.

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