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# State of resources reporting

December 2012

## Forest tent caterpillar in Ontario

*Outbreaks of forest tent caterpillar occur in Ontario approximately every 10 to 12 years and last anywhere from three to six years in a given location. The last forest tent caterpillar outbreak peaked in 2000/2001.*



### About forest tent caterpillar

The forest tent caterpillar (*Malacosoma disstria*) is native to North America and is the most widespread defoliator (leaf-eater) of deciduous trees on the continent. Outbreaks of this insect have been recorded in Canada since 1791. In northern Ontario, the forest tent caterpillar prefers to feed on the leaves of trembling aspen and large tooth aspen, but it can also be found on balsam poplar and white birch. In southern Ontario, the preferred tree hosts are oak and sugar maple. During a large outbreak, this insect will eat the leaves of many hardwood trees, with the exception of red maple.

Forest tent caterpillars are considered a forest pest because they impair the health of many hardwood trees and in some cases cause the tree to die. They are a nuisance to people because they appear

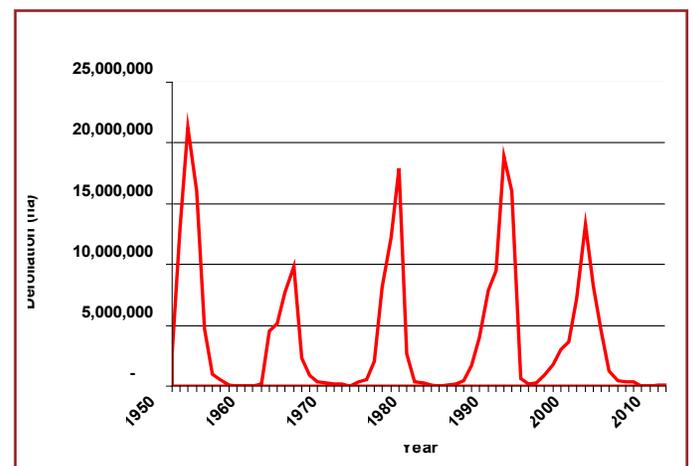


Figure 1: Moderate-to-severe forest tent caterpillar defoliation in Ontario, 1950 – 2011.

in large numbers and produce silk webbing and droppings (known as frass) that disrupt outdoor recreation activities. When disturbed they also emit a greenish-black fluid, which stains paint and clothing.

### Life cycle

Like many insects, forest tent caterpillars go through a life cycle, known as complete metamorphosis (Figure 2).

The young larvae (caterpillars) hatch in the spring from eggs that were laid on trees by the adults (moths) during the previous summer. The larvae emerge at the same time as buds start to expand on the host trees. The young larvae are black, hairy and about 0.2 to 0.3 centimetres long.

They crawl to the tips of branches to feed on the expanding buds. The larvae continue to feed in groups on expanding leaves and shed their skin (known as moulting) as they grow.

By mid-June, the larvae have matured and are about 4.5 to 5.5 centimetres long. Mature larvae have white keyhole-shaped markings down their backs with blue bands along the sides of their bodies, and brown hairs (Figure 3). When mature, the larvae migrate in groups, eating the leaves on one branch before moving to another. Once they have eaten all the leaves of the host tree, the mature larvae will crawl across roads, buildings, and poles in search of a new tree to feed on.

Mature larvae stop eating about five to six weeks after hatching, in mid to late June. Each larva then searches for a site in which to spin its cocoon. The larvae spin white silk cocoons intermixed with yellow powder in folded leaves, bark crevices, or sheltered places on structures, such as buildings, fences, or signs (Figure 4). Inside the cocoon the mature larva undergoes many physical changes (known as pupating). About ten days later an adult moth emerges.

The adult moth is beige to brown with a stout body and a wingspan of 2 to 4.5 centimetres (Figure 5). The wings are crossed by two diagonal lines. The moths only live for a few days, and during that time they mate. A single female moth will then lay 150 to 350 eggs in bands around twigs near the top of a tree. The eggs are held together by a protective layer of brown hardened foam.

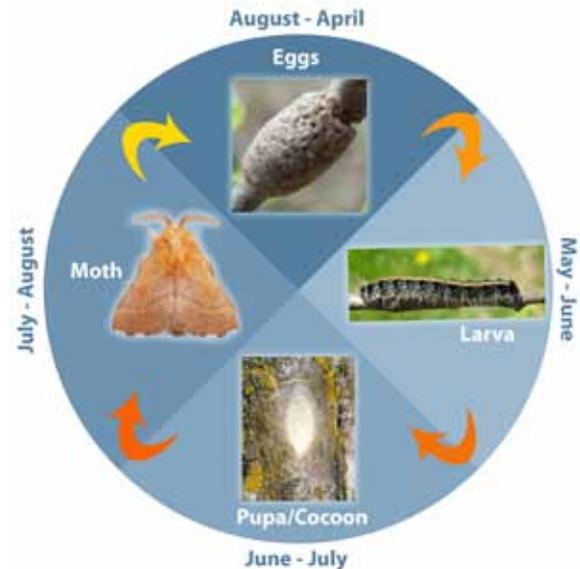


Figure 2: The annual life cycle of forest tent caterpillar. Photos: James B. Hanson, USDA Forest Service, Bugwood.org; Patrick Hodge, Ministry of Natural Resources and Mark Dreiling, Bugwood.org



Figure 3: Mature forest tent caterpillar larvae feeding. Photo: Dan Rowlinson, Ministry of Natural Resources.

## What is metamorphosis?

Metamorphosis is a process in which an organism goes through a physical change during its life cycle. This change in appearance is usually accompanied by a change in habitat or behaviour. Some organisms must go through metamorphosis to move from a non-reproductive to reproductive life stage. Examples include insects, such as butterflies and moths, and amphibians, such as frogs and toads.

Most metamorphosis in insects is described as either incomplete or complete. Incomplete metamorphosis consists of three distinct life stages: egg, nymph, and adult. A nymph is an immature insect that looks like an adult of the same species, but is smaller, lacks wings, and does not have mature sex organs.

Complete metamorphosis in insects involves four life stages: egg, larva, pupa, and adult. The insect looks very different at each stage. Larvae typically look worm-like, eat continually, grow rapidly, and moult as they grow larger. When the larva is mature it moults one more time and becomes a pupa. The pupa is typically covered in a hard outer case and cannot move on its own. In some insects, like moths, the pupa forms inside a silk shelter called a cocoon. Inside the pupal case the insect's body and tissues reform to take on the adult form with wings and sex organs. When the pupa stage is complete the adult emerges from the protective case looking very different from the larva.



Figure 4: Forest tent caterpillar cocoon on a sign post. Photo: Patrick Hodge, Ministry of Natural Resources.



Figure 5: Adult moth. Photo: Lacy L. Hyche, Auburn University, Bugwood.org



Figure 6: Forest tent caterpillar larvae resting on a tree. Photo: Patrick Hodge, Ministry of Natural Resources.

They appear as swellings that are about two centimetres wide. In three weeks, around the middle of August, a young larva forms in each egg. It remains dormant in the egg until the following spring, when it hatches.

### Symptoms and damage

To identify damage caused by forest tent caterpillars, look for large areas where hardwood trees are missing their leaves (Figure 8). During the early part of the season, the larvae eat leaves near the top of the tree. As the leaves are consumed, they move toward the inner and lower parts of the tree.

### Who is feasting on your trees?

Contrary to their name, forest tent caterpillars do not actually form tents. Instead, they spin silk mats on the trunks and branches of trees. The larvae gather together on these mats when moulting or to rest after feeding (Figure 6). Forest tent caterpillars are often confused with eastern tent caterpillars (*Malacosoma americanum*), which do actually create a tent and sometimes feed on the same trees as forest tent caterpillars. Eastern tent caterpillar larvae are black and hairy like the forest tent caterpillar, but have a cream coloured stripe down their back, with blue spots, and brown and yellow lines along their sides (Figure 7). Forest tent caterpillar larvae will often rest in the tents made by eastern tent caterpillars. During outbreaks, they can be so numerous that they outnumber the eastern tent caterpillars in their own tents.

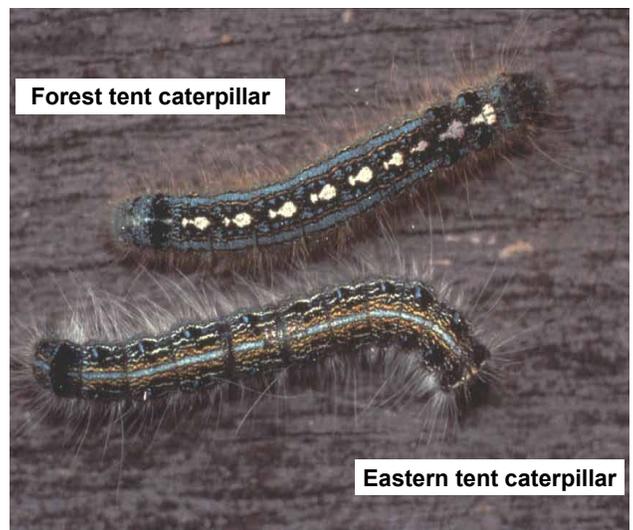


Figure 7: Forest tent caterpillar and Eastern tent caterpillar. Photo: Ministry of Natural Resources.

## Impacts of forest tent caterpillar outbreaks on tree health

The damage caused by feeding larvae can range from relatively little leaf loss to complete defoliation of trees, depending on the abundance of the insect. During severe outbreaks, large areas of susceptible forests can be completely defoliated by early summer (Figure 9).

In most cases, if a tree loses more than 50 per cent of its leaves, it will grow a second crop of leaves in about four to six weeks. However, these leaves are usually less nutritious and higher in fibre. The new leaves help the tree carry out photosynthesis, but growing these new leaves can stress the tree because it uses up starch reserves (a tree's energy stores) from the root system. Trees that are repeatedly stripped of their leaves year after year may become weakened, branches and twigs may die, and the overall growth of the tree may be reduced. In some cases of severe defoliation, whole trees may be killed, especially when the outbreak lasts several years. Trees that survive are left in a weakened state and become more susceptible to other insect infestations, disease, and drought. In sugar maple stands, even one season of severe damage from larvae will reduce the quantity and quality of sap, which can reduce the production of maple syrup.



Figure 8: The leaves of these trees have been eaten by forest tent caterpillar. Photo: Patrick Hodge, Ministry of Natural Resources.



Figure 9: Severe defoliation of a woodlot caused by forest tent caterpillar infestation. Photo: Patrick Hodge, Ministry of Natural Resources.

### The good and the bad...

Forest tent caterpillars are native to Ontario and a natural part of the forest ecosystem. Outbreaks of forest tent caterpillars can provide benefits to some plants and animals. Many insects, birds, and mammals rely on forest tent caterpillars as a source of food and are able to increase their populations during forest tent caterpillar outbreaks. Forest tent caterpillars also provide nutrients for forest plant life. Caterpillar droppings (frass) are rich in nutrients - especially nitrogen, which fertilizes the forest soil. Forest tent caterpillar outbreaks also help drive forest succession. Removing leaves from the overstory (larger, taller trees that shade the forest floor), allows more sunlight to reach the understory (smaller trees that grow beneath the overstory). This promotes the growth of the smaller tree species. For example, in northern forests, trembling aspen often forms an overstory above conifers like balsam fir and white spruce. Each successive forest tent caterpillar outbreak encourages the growth of understory conifers, which eventually grow up and take over the canopy of the forest stand. In general, natural disturbances such as strong winds, fires, and insect infestations promote new forest growth, which creates desirable habitat for many forest-dwelling creatures.

Forest tent caterpillar outbreaks can also have negative effects on other parts of the ecosystem. Severe forest leaf loss alone can drastically change the entire ecosystem. Leaves provide shade and excessive leaf loss allows sunlight to penetrate down to the forest floor. This can cause the understory temperature to rise, warming streams, and reducing habitat for some organisms. Soil temperatures can also rise, causing drought stress to the understory plants and trees, and increasing the risk of forest fires.

Most healthy hardwood trees can withstand two to three years of a forest tent caterpillar outbreak. If other stresses occur, such as drought or attacks by other insects, trees may not be able to recover and may eventually die.

## Status of forest tent caterpillar in Ontario

In Ontario, the last major forest tent caterpillar outbreak began in the late 1990s and peaked in 2001. It covered more than 13 million hectares (Figure 10). Back-to-back outbreaks in northeastern Ontario resulted in severe and widespread aspen mortality affecting more than 618,379 hectares of forest. Aspen trees in the northeast were still relatively weak because of the short recovery time between outbreaks.

In the southeastern part of the province, just north of Kingston, 8,912 hectares of hardwood trees were defoliated by forest tent caterpillars in 2009. The following years, scattered pockets of hardwood forests across southern Ontario were severely defoliated because of major increases in forest tent caterpillar populations. The 2010 infestation occurred from just north of Belleville, west to Goderich and totalled 60,424 hectares. Defoliation was most severe in the Bancroft area, where 30,074 hectares were affected, and in the Midhurst area, where 20,755 hectares were affected. This pattern was repeated in 2011, when scattered pockets of

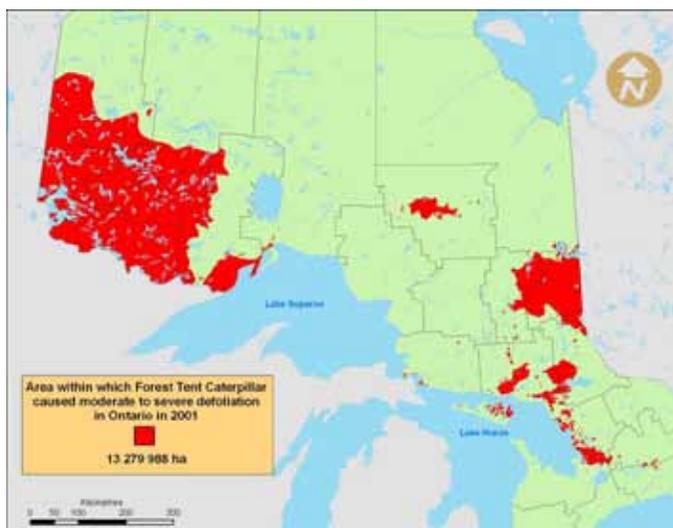


Figure 10: Ontario forest tent caterpillar outbreak during its cyclic peak in 2001.

hardwood forest totalling 66,938 hectares were attacked by forest tent caterpillars in the same area (Figure 11). The main tree species affected were sugar maple, trembling aspen, red oak, American beech, white birch, and white ash. The southern Ontario forest tent caterpillar population declined in 2012 before it could erupt into a full outbreak. However, in the northern part of the province the insect was widely present in 2012, and a new outbreak in the north is expected to begin in the next one to two years.

## What factors affect forest tent caterpillar populations?

Forest tent caterpillar populations increase rapidly in the first few years of an outbreak. Once the outbreak peaks, the population collapses just as quickly. Although we don't know what causes outbreaks of this native insect to occur, there are several natural factors that contribute to their collapse.

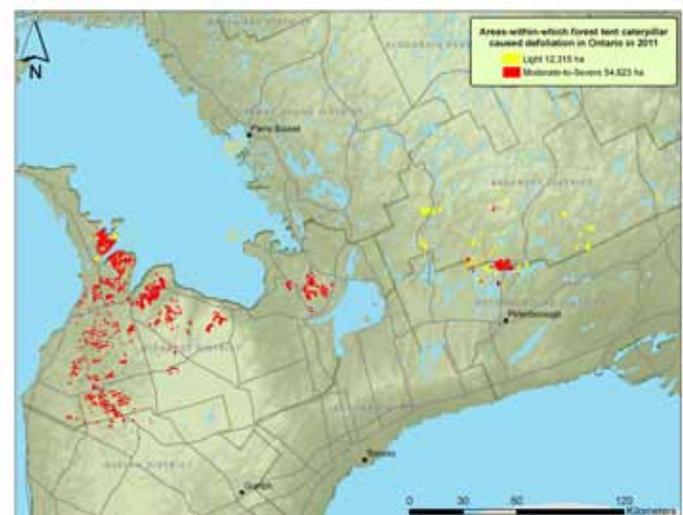


Figure 11: Outbreak of forest tent caterpillar in 2011.

## Food availability

During an outbreak, populations of forest tent caterpillars can eat all the available leaves on the preferred host trees causing starvation. This can result in poor reproduction or even death. Larvae weakened by starvation are also more susceptible to disease and predation.

## Weather

Weather events, such as a heavy frost shortly after the larvae emerge in the spring, can cause local populations to collapse. Cooler spring temperatures or late spring frosts can also delay leaf development or damage host tree leaves, causing the larvae to starve. This is likely what started the collapse of the last outbreak in 2002. The larvae emerged in early spring during a period of warm weather, which was followed by several weeks of very cold weather. The larvae either starved or froze to death.

## Parasites, predators, and pathogens

There are many different parasites that will attack forest tent caterpillar throughout the different stages of their life cycle. The large flesh fly (*Sarcophaga aldrichi*) is native to Ontario and is one of the most common parasites of forest tent caterpillars. Often called the friendly fly because of its habit of landing on people, this fly lays maggots (fly larvae) on forest tent caterpillar cocoons. The maggots burrow through the silk cocoon and feed on the pupa inside. Over 80 per cent of forest tent caterpillar pupae may be killed by the large flesh fly each year.

Many insects, birds, and even small mammals also feed on forest tent caterpillars at different life stages. While these predators may not cause the collapse of a forest tent caterpillar population, intense predation can reduce their overall numbers.

Bacterial, fungal, and viral diseases can thrive when caterpillar population densities peak. Infection by a naturally-occurring virus called NPV (nucleopolyhedrosis virus) is one of the primary causes of the collapse of outbreaks (Figure 12). Like the parasitic fly, the occurrence of NPV rises as the forest tent caterpillar population increases. When an infected larva dies, viral bodies are released that spread and infect other larvae.

### The real story behind the friendly fly

Many people believe that in the past the Ontario government released friendly (large flesh) flies to combat forest tent caterpillar outbreaks. This myth dates back to the 1930s when friendly flies were actually called “Hepburn” flies after Mitchell Hepburn who was the premier of Ontario from 1934 to 1942. Several other provinces and American states have been blamed for friendly fly outbreaks. However, increases in friendly flies are actually the result of biological and ecological factors.

Friendly fly populations increase when forest tent caterpillar populations increase, because there are more pupae for the flies to feed on. High numbers of flies are actually a sign that the forest tent caterpillar outbreak is likely to collapse soon. Typically, friendly flies are most abundant the year after the forest tent caterpillar population has collapsed.

Following the end of the forest tent caterpillar outbreak, people are usually pleased the caterpillars are no longer a problem, but the large number of flies can be quite a nuisance. The good news is that friendly fly populations will also collapse because there are now fewer forest tent caterpillars for them to feed on.



Friendly flies. Photo: Ministry of Natural Resources.



Figure 12: Larvae with NPV (see far left) are often found hanging from their midsection, like an upside down "V". Photo: Patrick Hodge, Ministry of Natural Resources.

## How are forest tent caterpillar outbreaks managed in Ontario?

Insect populations in Ontario are monitored each year through ground and aerial surveys as part of the province's Forest Health Monitoring Program. Forest health technical staff record and report on forest health conditions and the occurrence of events related to living things, such as insects and diseases, and non-biological events, such as severe weather conditions.

When an insect outbreak occurs in Crown forests, the Ontario Ministry of Natural Resources forms a planning committee of ministry staff, representatives from the forest industry, and local citizens committees. The committee examines management options to address the problem, which can include:

- taking no action
- implementing a control program (e.g., application of an insecticide), and/or
- carrying out salvage, accelerated, or redirected tree harvesting.

The committee makes recommendations to the ministry's regional director, and the resulting program is implemented by the ministry, the forest industry, or both.

When an insect is affecting private or municipal land, ministry staff provide information to landowners and managers to help them make informed decisions regarding management options during forest pest outbreaks.

Because forest tent caterpillars are native to Ontario, natural control factors will typically reduce population densities. Outbreaks are therefore usually allowed to run their course. However, management programs can reduce the impacts of this forest pest on high-value hardwood forests.

If an outbreak is severe and insecticide spraying is warranted, the Ministry of Natural Resources' policy is to use biological insecticides rather than chemical insecticides. Biological insecticides have less impact on non-target species than traditional chemical pesticides. The biological insecticide used by the ministry is *Bacillus thuringiensis* subspecies *kurstaki* (Btk). Btk is a naturally occurring bacterium that kills feeding larvae. This insecticide can also be used on gypsy moth (*Lymantria dispar*), spruce budworm (*Choristoneura fumiferana*), and other forest pests. In recent years there has been progress in the development of chemical insecticides that, like Btk, are more environmentally friendly and have limited impacts on non-target insects. Examples include products that mimic or act as growth regulators that disrupt the insect's growth.

## Outlook for forest tent caterpillar infestations

Periodic outbreaks of forest tent caterpillars will likely continue in Ontario. Historical outbreak patterns and the increasing occurrence of larvae in northern Ontario suggest that a full outbreak can be expected in the north in the next few years.

## What can you do?

Forest tent caterpillars are a natural part of the ecosystem and are not a threat to human health. Natural control factors will usually take care of forest tent caterpillar outbreaks. However, high numbers of caterpillars during outbreaks can be very annoying to homeowners especially when they migrate and cluster in large numbers along sidewalks, buildings, and lawns. Ornamental trees, hedgerows, and woodlots can also be affected during outbreaks, particularly when other events such as drought occur. Urban and ornamental trees may be more likely to die when attacked by the insect because these trees are often growing in highly stressed environments. Some preventative and active measures you can take to control forest tent caterpillars include:

### Egg Removal

After leaf drop in the fall, forest tent caterpillar egg bands can be clipped from trees and disposed of to reduce populations the following year. It is much easier to remove egg bands when there are no leaves on the trees because they are more visible. Egg bands appear as shiny dark brown cases that encircle twigs (Figure 13).

### Larvae Control

When caterpillars appear in the spring they can be physically removed from small trees or squashed. This is most easily done in the evening or on cool days when the caterpillars are resting in large clusters on tree trunks or branches.

There are several insecticides that will control caterpillar infestations. Insecticides should be applied in late May or early June when the larvae are actively feeding, since most insecticides must be eaten by the larvae to be effective. It is also important to apply them before they have a chance to eat too many leaves. Ensure you follow the directions found on the label and only use insecticides that have been registered by the Pest Management Regulatory Agency and classified by the Ontario Ministry of the Environment. Contact your local Ministry of the Environment office to find out more about insecticides that are approved for use against forest tent caterpillars. For large forest areas and woodlots, the only practical way to apply an insecticide is through aerial application using a helicopter or fixed-wing aircraft.

On trees that are free of larvae, you can take preventative measures to reduce the likelihood of infestation. Applying a sticky band around the trunk of the tree can stop migrating larvae from reaching the leaves of the tree. This simple trap can be created by placing a band of broad tape around the trunk at chest height and coating it with a sticky material such as Tanglefoot®. Do not apply the sticky material directly to the tree, because it may kill the bark. Traps can be removed in July once the larval stage is complete.

### Cocoon Removal

Cocoons can be removed and destroyed before the moths emerge in July. Cocoons are yellowish-white and can be found on tree trunks, fences, buildings, and leaves. Wear gloves when removing cocoons, because the yellow powder on the cocoons can trigger an allergic reaction in some people.



Figure 13: Egg band. Photo: Patrick Hodge, Ministry of Natural Resources.

## Information Sources

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Scarr, T.A., K.L. Ryall and P. Hodge. 2012. Forest Health Conditions in Ontario, 2011. Ontario Ministry of Natural Resources and Canadian Forest Service.

## Related Information

- Agriculture and Agri-Food Canada - Forest Tent Caterpillar
- Canadian Forest Services
- Ontario Ministry of Natural Resources
- Ontario Forest Research Institute
- Contact the Health Canada Pest Management Regulatory Agency (PMRA) for more information on insecticides that can be used.  
toll-free: 1-800-267-6315  
e-mail: pmra.infoserv@hc-sc.gc.ca  
web: <http://www.hc-sc.gc.ca/cps-spc/pest/index-eng.php>
- Visit the Ontario Pesticides Advisory Committee website at [www.opac.gov.on.ca](http://www.opac.gov.on.ca) to see which pesticides are classified for use in Ontario.

## More information

For more information on the status of forest tent caterpillar in Ontario, please contact:

State of Resources Reporting  
Ontario Ministry of Natural Resources  
Inventory, Monitoring and Assessment Section  
300 Water Street  
Peterborough ON K9J 8M5

Email: [SORR@ontario.ca](mailto:SORR@ontario.ca)

[www.ontario.ca/stateofresources](http://www.ontario.ca/stateofresources)