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Canadian Forest Service – Great Lakes Forestry Centre

# Jack Pine Budworm

## INTRODUCTION

Jack pine budworm (*Choristoneura pinus pinus*) is the most destructive defoliator of jack pine (*Pinus banksiana*) in North America. Although the insect is widespread from the Maritime Provinces to Alberta and south into the Great Lakes region of the US, historically it has been particularly troublesome in the provinces of Ontario, Manitoba and Saskatchewan. Outbreaks in these provinces occur at intervals of around 10 years, with the peak defoliation lasting 3- 4 years. All age classes are at risk, however, mature and overmature jack pine stands (i.e., > 120 years old) are most vulnerable. Jack pine budworm has been observed causing severe defoliation in pure white pine stands in Ontario, Nova Scotia and New York State. When budworm populations are high they can quickly defoliate trees, causing top-kill and whole-tree mortality. Jack pine budworm can also defoliate red and Scots pine and black spruce growing near or with jack pine. In western North America, it will also defoliate lodgepole pine.

## LIFE CYCLE

The life cycle is similar to that of spruce budworm, to which it is closely related. In early August, female moths (adults) deposit clusters of approximately 40 lime green oval eggs on the top side of the needles in a pattern resembling fish scales. There are seven larval growth stages (instars). First instar larvae emerge from the eggs in about 10-14 days. They quickly seek out overwintering locations, usually under bark scales, and spin a silken shelter within which they moult to the second instar. The young larvae remain inactive in these sites over the winter, emerging in the spring prior to budburst.

The survival of the second instar budworm larvae in spring depends on the abundance of male jack pine flowers (pollen cones). As the shoots grow, larvae will feed on pollen until it is either consumed or released by the tree. As these flowers become unsuitable, larvae construct silken tunnels along the expanding shoot, where they feed on new needles. Larvae typically begin feeding at the base of the needle, often only consuming a portion of it. Larvae may also feed on new seed cones and old needles when the populations are high and the supply of new needles is exhausted.

The larvae continue to moult as they grow, until they reach the seventh and final instar.

Larvae are full grown by mid-July to early August, after about six weeks of feeding in the spring. They pupate on the shoot or inside their feeding tunnel and emerge as adults after about 10 days.

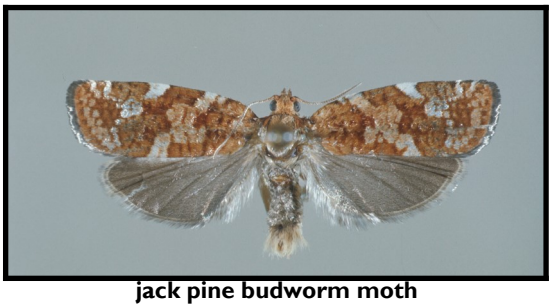
Jack pine budworm is a highly mobile species. The second instar larvae will spin down from the needles on silken strands, which they can use to 'balloon' long distances when caught in air currents. Moths can fly over 25 km on prevailing winds or during storms and can even be carried aloft by convective wind currents over thousands of kilometres. Because moths will only deposit approximately half of their eggs in their natal tree, these immigrants can contribute to new infestations by laying their remaining eggs after dispersing to a distant stand.

## APPEARANCE

Jack pine budworm larvae and adults look very similar to the spruce budworm and are often best distinguished by what host they are found on. Mature jack pine budworm larvae are 21 mm long with reddish-brown head capsules. Their dark, reddish-brown bodies have yellow sides and two rows of white dots along their backs. Jack pine budworm moths have a wingspan of 15–24 mm and their forewings have a rusty, reddish-brown colouration. For a definitive identification, a sample of a moth or larva can be submitted to experts. It is important to report the location and what tree species the insect was found on and to submit photos along with the specimen.

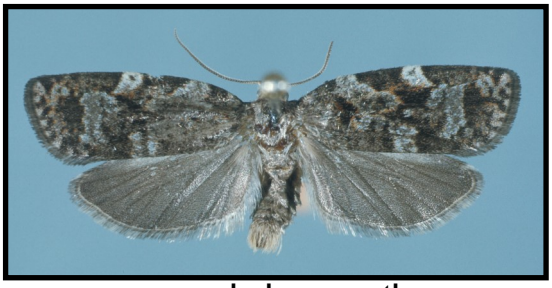
## DAMAGE

The last instar of jack pine budworm causes the most defoliation. Often the most serious damage to forests results from the first year of severe defoliation. High levels of defoliation can result in reduced pollen abundance the following year, which in turn can affect the survival of young larvae in spring. The impact of defoliation is more prevalent in stressed stands: those on thin soils or affected by drought or root disease. Moderate-to-severe defoliation gives trees and stands a scorched appearance which can be seen from aircraft and is used to map the size of outbreaks in the summer months. However, when late summer and fall rain storms wash away dead needles and budworm webbing, heavily defoliated stands will appear greyish-green to grey. For those trees that do not die immediately



jack pine budworm moth

jack pine budworm larva



spruce budworm moth

spruce budworm larva

following the outbreak, their survival or growth rates can be reduced for several years.

## NATURAL CONTROL

Numerous parasites and predators feed on jack pine budworm and diseases also take a significant toll. Together, these organisms keep populations in check most years. However, when weather, abundance of pollen cones and forest susceptibility are favourable, budworm are able to evade this suite of natural enemies and increase their survival. Within only a few years, populations can reach outbreak levels, although the exact causes are unknown.

When budworm populations affect forest values (e.g., timber supply, wildlife habitat, fire risk, carbon sequestration), forest managers can intervene with treatments designed to suppress populations or protect foliage until natural controls are able to reduce populations to the point where treatments are unnecessary. Unfavourable weather and natural reductions in the abundance of male flowers can also help reduce populations.

## WHAT CAN I DO?

For the forester, woodlot owner or Christmas tree grower, budworm outbreaks can represent a serious threat to pine. It is important to monitor budworm to forecast building populations. Provincial departments of natural resources typically conduct basic monitoring of such injurious forest pests. Often these surveys use pheromone traps to monitor moth populations in mid-summer; other surveys involve winter collection of branches to assess the population of overwintering second instar larvae or egg mass surveys in mid to late summer.

In some cases, the impact of jack pine budworm can be mitigated by increasing the diversity of tree species within a forest. A variety of stands (age, species composition) contain fewer vulnerable hosts, create natural barriers to budworm outbreaks and likely have higher numbers of budworm natural enemies. For pure jack pine stands, it is important to keep trees vigorous. This can be accomplished by reducing the rotation age of the stand, reducing the density of vulnerable trees, or both.

There are two active ingredients registered in Canada for forestry use and control of jack pine budworm: the biopesticide *Bacillus thuringiensis kurstaki* Berliner (B.t.k.) and the insect growth regulator tebufenozide, which mimics the insect's moulting hormone. These insecticides are used to protect foliage through the budworm outbreak. The success of this strategy is gauged by the reduction in defoliation with the treatment as compared to neighbouring untreated stands.

Homeowners and private land managers can check their pine trees each year for signs and symptoms of budworm attack. If an application of insecticide is warranted, a product registered for use against jack pine budworm can be applied to keep the trees alive and healthy.

## SUGGESTED READING

MacQuarrie, C. 2013. Predicting jack pine budworm defoliation. Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario. Frontline Express 72. 2 p.

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