Bruce Spanworm

Yukon Forest Health — Forest insect and disease

5

Yukon

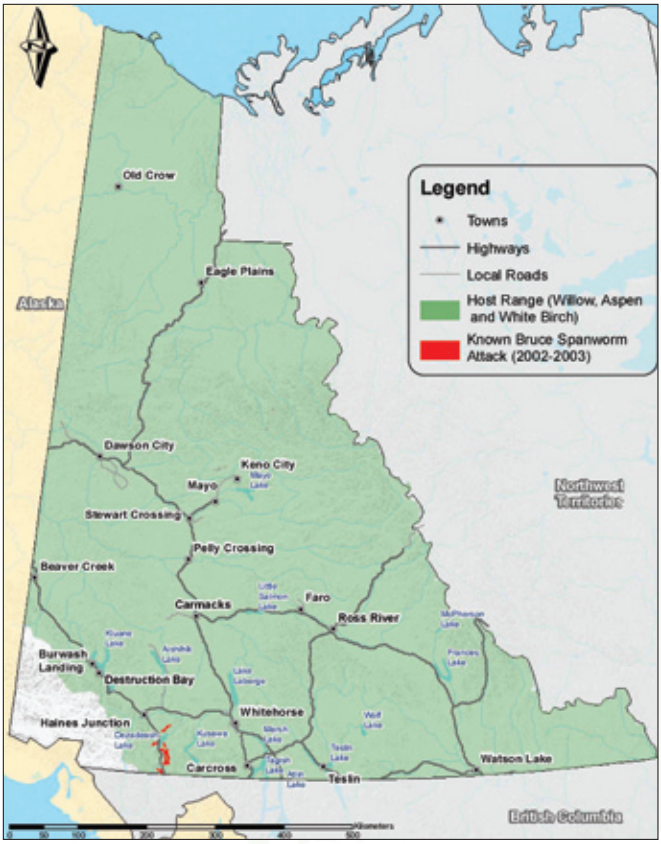
Energy, Mines and Resources

Forest Management Branch

Introduction

The Bruce spanworm (*Operophtera bruceata*) is a native North American hardwood defoliator. It infests maple (*Acer spp.*), aspen (*Populus spp.*), birch (*Betula spp.*) and other hardwoods throughout its natural range. In Yukon its impact on willow (*Salix spp.*) and aspen is of greatest concern. An outbreak south of Dezadeash Lake in 2002 and 2003 was mapped from the air over an area in excess of 10,000 ha. It was unique in that it occurred in willow in subalpine habitat. Although the Bruce spanworm is common throughout the north, damage of this magnitude had not previously been reported in Canada. The population collapsed in 2004; it is typical for infestations to subside after two years. Parasitized pupae were found in collected samples and this may have represented the mechanism of the collapse.

Host Range for Bruce Spanworm



(Source data: Yukon Government Forest Inventory Data [2008] and U.S. Geological Survey [1999] Digital representation of "Atlas of United States Trees" by Elbert L. Little, Jr. (http://esp.cr.usgs.gov/data/little/)
Disclaimer: The data set for historic incidence is likely incomplete and only extends from 1994–2008. Endemic or outbreak populations may have occurred or may currently exist in non-mapped locations within the host range.

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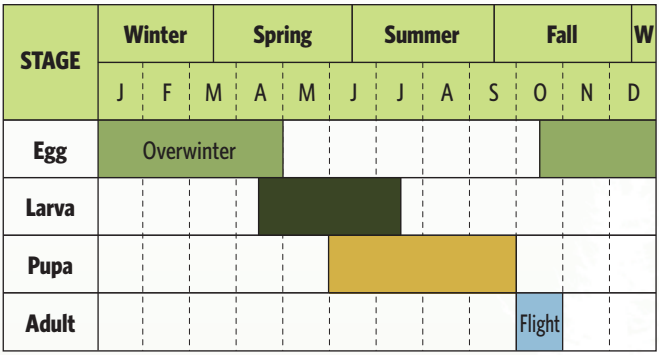
Life Cycle



The Bruce spanworm completes its life cycle in one year. Adult moths appear in October in Yukon. The females are wingless and crawl up the lower portion of the trunk (often late in the day), mate, then lay single eggs in bark crevices and protected openings. Larvae hatch the following spring, timed to correspond with bud-break. As the leaves develop, the larvae first consume the underside of the leaf, excluding the main ribs and veins. Often, larvae form the leaf into a protective sheath by folding it over and securing it with silk. They continue to feed within the leaf shelter. When leaf material is exhausted in one part of the tree, larvae produce a silk thread on which they travel to reach food supplies lower in the crown. This is also a means of dispersal as the silk sometimes becomes dislodged in the wind and larvae are blown to other trees. After five to seven weeks of feeding the larvae are mature and, in early to mid July, they drop from the tree onto the forest floor where they spin a cocoon in the leaf litter. The pupae **(photo 7)** will develop in the duff until late fall, when adult moths emerge.

Host Species Attacked and Damage

Tree species attacked in Yukon: Bruce spanworm most commonly attack willow and sometimes trembling aspen (*Populus tremuloides*) and white (paper) birch (*Betula papyrifera*). Other broadleaf tree species can also be attacked. Trees of all sizes and ages are susceptible.

Bruce spanworm larvae mine emerging buds, causing holes in the developing leaves which become obvious as the leaves expand. Later, feeding occurs in the open on the underside of leaves or in the leaf shelters and the entire leaf is consumed, less the main ribs and veins. When an infestation is severe, fine silk webbing will cover large areas of the tree or shrub.

Larval feeding begins early in the spring but does not continue throughout the growing season. As a result, trees and shrubs have the ability to recover by producing new leaves. Consecutive years of infestation (generally 2–3 years) can result in reduced radial growth and although rare, tree mortality **(photo 8)**.

The 2002 Yukon infestation caused willow die-back but the willow's ability to coppice from epicormic buds on the stem enabled them to re-sprout the following year.

Key features for identification:

- The egg is light green **(photo 1)**, turning to bright orange later **(photo 2)**.
- Larvae are a stout bodied hairless looper, light green with light green to dark brown head (2–20 mm), though some individuals can have darker grey bodies and blackish heads **(photo 3 and photo 4)**.
- Larvae have one prominent and 2 lesser distinct yellow-white lines along their sides.
- Larvae have 3 pairs of front legs and 2 pairs of hind legs (unlike leafrollers) **(photo 4)**.
- Adult females are small (60 to 80 mm) and have only vestigial wings (flightless). They vary in color with some being dull brown with white patches, and others having bluish gray scales on their abdomens **(photo 5)**.
- The adult male is a light brown slender moth with bluish grey wings up to 3 cm wingspan and a small dot on the hind wing **(photo 6)**.

Photo number:

1. **Egg (green).** Citation: Ronald S. Kelley, Vermont Department of Forests, Parks and Recreation, Bugwood.org
2. **Egg (orange).** Citation: Ronald S. Kelley, Vermont Department of Forests, Parks and Recreation, Bugwood.org
3. **Dark looper.** Citation: Jean-Paul Laplante, Natural Resources Canada, Canadian Forest Service.
4. **Looper.** Citation: Thérèse Arcand, Natural Resources Canada, Canadian Forest Service.
5. **Adult female laying eggs.** Citation: Thérèse Arcand, Natural Resources Canada, Canadian Forest Service.
6. **Adult male moth.** Citation: Thérèse Arcand, Natural Resources Canada, Canadian Forest Service.
7. **Pupa.** Citation: Thérèse Arcand, Natural Resources Canada, Canadian Forest Service.
8. **Stand damage.** Citation: Claude Monnier, Natural Resources Canada, Canadian Forest Service.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Similar damage

Defoliation caused by the Bruce spanworm is similar to that caused by other deciduous defoliators. In particular, the large aspen tortrix (*Choristoneura conflictana*) appears to share similar timing and feeding habits. Damage by Bruce spanworm can be distinguished by the absence of pupal cases and egg masses on the foliage and no overwintering shelters on the stem and branches.

Larvae can be confused with larvae of other hardwood pest species. The fall cankerworm (*Alsophila pometaria*) and the spring cankerworm (*Paleacrita vernata*) also have looping larvae with two pairs of fleshy legs near the end of the abdomen. Both of these species are only present in urban settings on ornamental trees — oak (*Quercus spp*), elm (*Ulmus spp.*) and apple (*Prunus spp*) and lay eggs in masses as opposed to singularly.

Risk Assessment

The following table and text summarize the likelihood of occurrence and magnitude of impact of an outbreak at the stand level. The table and text are a coarse guide for estimating the risk of an outbreak when populations are at endemic levels.

Likelihood of Occurrence

Defoliator outbreaks can be cyclical and, beyond the presence of the host species, are not necessarily linked to specific environmental, climatic or stand conditions that enable an approximation of the likelihood of occurrence. However, physiological stress in host trees influences susceptibility and defoliator populations can be negatively or positively impacted by environmental, climatic or stand conditions. For example, late spring frosts may kill large numbers of larvae and their food source while warm, dry weather helps improve population survival. Though it is not known what triggered the outbreak of the Bruce spanworm it is assumed to have been related to the recent climatic conditions that favoured survival and successful reproduction of the insect. It's success was likely also fostered by severe drought stress that limited the host's ability to defend against attack.

Magnitude of Consequence

The magnitude of consequence is a subjective assessment of the potential consequences of an outbreak. This list is not exhaustive and is intended to stimulate thought on potential impacts to consider over time.

Value	Impact							
	-							+
Traditional Use[1]				■				
Comment:	Limited summer food source for wildlife (-)							
Visual Quality[2]				■				
Comment:	Dead foliage period (-)							
Timber Productivity[3]								
Comment:	Not applicable							
Wildfire Hazard[4]								
Comment:	No impact anticipated							
Public Safety[5]								
Comment:	No impact anticipated							
Hydrology[6]								
Comment:	No impact anticipated							
Time Scale (years)	20+	15	10	0-5	0-5	10	15	20+
Comment:	Impact refers to a predicted, substantial positive (+) or negative (-) impact on a value for an estimated time period							

Notes:

1. In this context, traditional use values considered are hunting, trapping and understory shrub/plant use. Given that willow leaves are the primary food source for moose (*Alces alces*) and willow ptarmigan (*Lagopus lagopus*), negative impacts are expected to traditional hunting values.
2. Visual quality is negatively impacted for a brief period during the current year's attack but willow and other broadleaf species can refoliate within several weeks so visual impact is likely to be fleeting unless mortality occurs.
3. There is no commercial harvesting of willow and other broadleaf species in Yukon and timber productivity is not considered applicable.
4. Given that willow and other broadleaf species can refoliate within several weeks and that mortality is rare, no impact on wildfire hazard is anticipated.
5. Given that Bruce spanworm outbreaks rarely cause mortality, no impact is anticipated.
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Implications of Climate Change

General Circulation Model (GCM) results in the 2007 Intergovernmental Panel on Climate Change (IPCC) report indicate that warming in northern Canada is likely to be greatest in winter (up to 10°C) and warmer by 3–5°C in summer. Mean annual precipitation is also predicted to increase (particularly in fall and winter). More rainfall is expected on windward slopes of the mountains in the west, therefore the rain shadow effect of the St. Elias Mountains may mean that southern Yukon will not experience increased rainfall. Higher temperatures will increase levels of evaporation and transpiration, and ultimately lower

soil moisture levels. Therefore, even if summer rainfall is maintained at current average levels, higher temperatures would result in limited soil water availability and cause moisture stress in trees. Temperature and precipitation are likely to be the dominant drivers of change in insect populations, pathogen abundance and tree responses as it influences insect/pathogen development, dispersal, survival, distribution and abundance. Defoliator species may benefit from warmer temperatures because of:

- higher rates of overwinter survival
- fewer late spring frost events
- longer summer season for growth and reproduction
- increased drought stress on the host species

Alternatively, if the timing of critical stages in the host (e.g., spring budburst) changes so that it is no longer in sync with key life stages of the defoliator (e.g., spring larval emergence), the defoliator population may be negatively impacted. Elevated carbon dioxide levels would likely reduce the nitrogen content in host needles/leaves, which may have either a positive or negative impact on defoliators depending on their nutritional requirements.

A short life cycle, mobility, reproductive potential and physiological sensitivity to temperature (i.e., insects are cold blooded) will mean that the distribution and diversity of defoliators at higher latitudes could change in a relatively short period of time as they take advantage of new climatically suitable habitats. Under a warming scenario, defoliator outbreaks could become more frequent and more severe, which could increase tree mortality, particularly if trees are drought stressed. The recent Bruce spanworm outbreak was unique in that it occurred in subalpine habitat; recent warmer winters may have enabled the spanworm population to flourish in the subalpine environment, which would generally be inhospitable due to low winter temperatures and spring frost events.

Management Options

Monitoring

Bruce spanworm activity can be viewed from both aerial and ground surveys. However, because of the variety of hardwood defoliators in Yukon forests, ground level species confirmation would be necessary. The best time of year for monitoring is early July when defoliation is at its height. This allows identification of the larvae before they pupate and enter the duff layer. Trapping of male spanworm moths can be done in October if the specific pheromone is available. For aerial survey standards, refer to 'BC Aerial Survey Standards' (MoF, 2000).

Direct Control

Control is rarely necessary for Bruce spanworm infestations because they are short-lived and rarely cause mortality. In general, populations are controlled by inhospitable climatic conditions, natural predators, parasites and diseases. In urban settings where damage is a concern for high value trees and shrubs, an effective control method is to band the tree with commercially available materials that entangle the adult female moth as she ascends the stem. These materials are applied in the fall when adults are emerging from the duff layer.

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