Willow Blotch Miner

Yukon Forest Health — Forest insect and disease

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Yukon

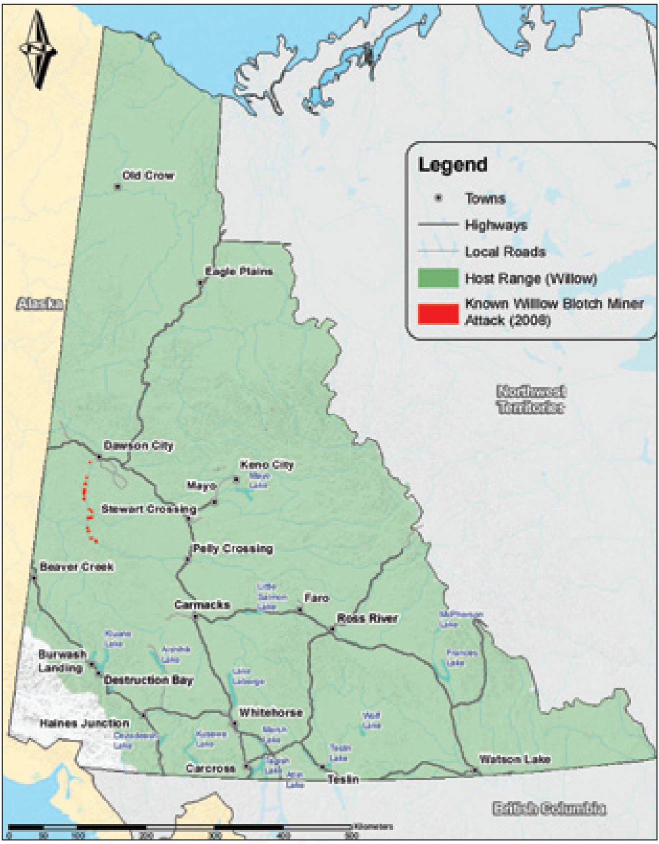
Energy, Mines and Resources
Forest Management Branch

Introduction

One of the most destructive defoliators of willow in North America, the willow blotch miner (*Micrurapteryx salicifoliella*) is common throughout its host's range. Severe defoliation by the blotch miner was first recorded in Yukon in 2007 adjacent to the Stewart River at Stewart Crossing. In 2008, larger (38 ha) localized outbreaks were mapped during an aerial survey on islands in the Yukon River between its confluence with the Stewart River and Dawson City. As with the previous infestations, the outbreaks have occurred where willow is predominant: in marshes and along the edges of watercourses. Alaskan forest health surveys found extensive areas of blotch miner damage in the early 1990s along the Yukon and Kushkokwim Rivers. The 2007 Alaskan survey showed over 91,000 ha of willow blotch miner activity — the 15th consecutive year of attack.

Damage caused by the willow blotch miner is most noticeable as reddening foliage in willow thickets. Upon closer inspection, leaf damage appears as necrotic patches on the upper side. This results from the larval mining of the epidermal layers of the leaves. Because of the vigorous growth of willow shrubs and their ability to coppice, shrub mortality and long-term damage rarely occur.

Host Range for Willow Blotch Miner



(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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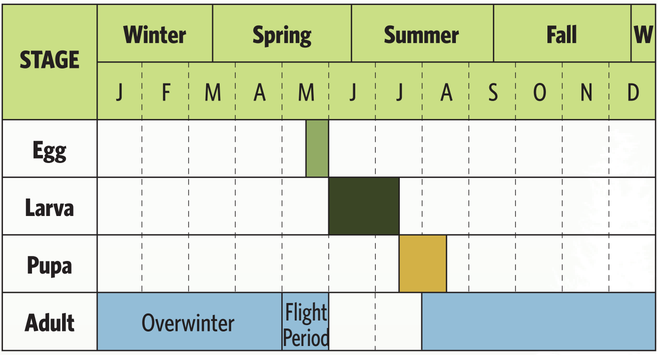
Life Cycle



The blotch miner overwinters as an adult. The exact location of the overwintering site is unknown, but adults mate and lay eggs in late May. The viscous eggs are laid singly on the undersides of leaves, and are cemented in place with an excretion from the female. First instar larvae hatch two weeks later directly into the leaf and commence mining. The larvae go through five instars over the following four weeks. Early instars mine alongside the larger leaf veins, while later instars mine the mesophyll just below the upper epidermis crossing through the major leaf veins. This produces the signature necrotic, reddish "blotches" on the leaf's surface.

By mid-July, larvae emerge through slits on the underside of the leaf. These late instar larvae do not feed but seek out a favourable location for pupation. The mature larvae spin a cellophane-like dome (cocoon) on the leaf surface within which they pupate. The upper leaf surface is most frequently used; however, some larvae spin their cocoon on the under surface. Adults emerge from the cocoons in August and seek out sheltered locations in which to overwinter.

Definitions:

Necrotic: *death of cells or tissues of a tree such as needles, twigs or branches.*

Instar: *the stages in the growth of a larva before it pupates.*

Frass: *a mixture of fecal matter and chewed plant debris.*

Host Species Attacked and Damage

Tree species attacked in Yukon: Most species of willow are susceptible to blotch miner activity. The felt-leaf willow (*Salix alexensis*) is resistant to infestation because the densely packed, wooly hairs on the leaves prevent oviposition. Dwarf willows (e.g., *S. arctica* and *S. polaris*) that occur in the alpine are also immune to the blotch miner. This is probably due to climatic factors rather than physiological differences from lowland species.

During periods of severe infestation, entire stands of willow are affected. From the air these stands appear reddish-grey **(photo 1)**. Conversely, endemic populations of willow blotch miner cause damage to single leaves or branches **(photo 2)**. The upper epidermal layer of the leaf is mined, creating necrotic patches that initially appear lobed but become diffuse through later larval instars **(photo 3)**. The majority of the leaf mines are made in midsummer; however, if the attack occurs earlier in the spring then a gall can form. This localized area of cancer-like growth appears as small conspicuous bumps on the leaf surface.

Larval tears on the underside of the leaf are symptoms unique to the willow blotch miner. These small openings appear mid- to late summer when the late larval instars have completed their feeding. As with other leaf miners, blotch miners have the problem of removal of frass from the feeding chamber. Blotch miners will either pack the frass within sections of the feeding chamber or push the frass away from the mine through small holes.

Key features for identification:

- Eggs are pale green when viewed against the leaf surface. The eggs are satiny, finely veined and dome-shaped.
- Larvae (1st and 2nd instar) are 0.5–1.6 mm long with brown heads. Bodies are yellowish and sharply tapered to the posterior **(photo 4)**.
- Larvae (3rd and 5th instar) are 1.3–6.5 mm long. Legs are present and the larvae are translucent yellow.
- Pupae (4.8–5.5 mm) are dark brown and slender. Their legs and antennae extend to the end of their abdomen. They are found on the leaf surface under a cellophane-like dome.

- Adults are grey, mottled moths with a wingspan of 10.6–11.2 mm.
- Necrotic, reddish patches appear on the upper leaf surface.
- Larvae emerge through characteristic tears along the underside of the leaf.

Photo number:

1. **Severe damage to sapling.** Citation: Rod Garbutt, Canadian Forest Service.
2. **Leaf damage.** Citation: Rod Garbutt, Canadian Forest Service.
3. **Larva.** Citation: Rod Garbutt, Canadian Forest Service.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Similar damage

Damage caused by the blotch miner can be confused with other willow leaf miners such as leaf beetle larvae (*Phratora spp*). The necrotic patches created by the blotch miner differ from the leaf skeletonization caused by the beetle larvae. Other species of sawfly and leaf beetle damage may also be confused with the blotch miner.

Risk Assessment

The following sections summarize the likelihood of occurrence and magnitude of impact of an outbreak at the stand level. These sections 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 their food source, while warm, dry weather helps improve population survival. In the case of the blotch miner it is likely that a combination of breeding success coupled with drought stress on the host has resulted in the damage.

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:	Moose and ptarmigan feeding (-)							
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 as the attacked leaves turn brown. Fall colours are muted from their usual vibrant yellow.
3. There is no commercial harvesting of willow in Yukon and timber productivity is not considered applicable.
4. Given that willow can coppice from the stem and that mortality is rare, no impact on wildfire hazard is anticipated.
5. Given that willow blotch miner 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 frost events at critical life stages
- longer summer season for growth and reproduction
- climate induced stress on the host

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. Ongoing warmer winters may enable the blotch miner to inhabit willow in subalpine environments that would generally have been inhospitable due to low winter temperatures and spring frost events.

Management Options

Monitoring

Willow blotch miner activity can be viewed from both aerial and ground surveys. Because willow is so prevalent across the landscape, aerial surveys are more efficient than ground-based surveys. The best time of year for monitoring is mid- to late summer prior to pupation when the larval mining has reached a maximum. Considering the duration and spatial distribution of historic outbreaks in the region, yearly aerial surveys will help to monitor the incidence of blotch miner activity. For aerial survey standards, refer to 'BC Aerial Survey Standards' (MoF, 2000).

Direct Control

There are no known effective means of control for willow blotch miner outbreaks. Individual high value trees can be treated with systemic pesticides. Ensuring that willow trees/shrubs are healthy is the most important silvicultural consideration. During periods of light infestation, individual branches can be pruned and destroyed.

References

B.C. Ministry of Forests. 2000. *Forest health aerial overview survey standards for British Columbia.* B.C. Forest Service. 46 pp.

Byers, J. 2006. *Leaf Mining Insects.* Chemical Ecology of Insects: http://www.chemical-ecology.net/insects/leafmine.htm

Collet, D.M. 2004. *Willows of Interior Alaska.* US Fish and Wildlife Service: http://alaska.fws.gov/nwr/yukonflats/pdf/WillowsFinal.pdf

Furniss, M.F.; Holsten, E.H.; Foote, J. and Bertram, M. 2001. *Biology of a Willow Leafblotch Miner,* Micrurapteryx salicifoliella*, (*Lepidoptera: Gracillariidae*) in Alaska.* Environmental Entomology 30(4): 736–741.

Garbutt, R. 1998–2001. *Yukon Forest Health Reports*. Unpublished reports prepared for the Department of Indian Affairs and Northern Development.

Garbutt, R. 2002–2009. *Yukon Forest Health Reports.* www.emr.gov.yk.ca/forestry/foresthealth.html

Holsten, E.; Hennon, P.; Trummer, L., andSchultz, M. 2001. *Insects and Diseases of Alaskan Forests (eBook).* USDA Forest Service, R10-TP-87. 207 pp: http://www.fs.fed.us/r10/spf/fhp/idbook/

Ott, R.A. 2008. *Trip Report for the Yukon Forest Health Survey.* Unpublished report prepared for Yukon Government.

Ott, R.A. 2009. RAO Ecological Consulting Services. *Development of a Risk-Based Forest Health Monitoring Program for the Yukon*. 33 pp.

Snyder, C., M.E. Schultz, and J. Lundquist (Compilers). 2008. *Forest health conditions in Alaska — 2007.* USDA Forest Service, Alaska Region, and State of Alaska, Department of Natural Resources, Division of Forestry. Forest Health Protection Report R10-PR-18. 96 pp.

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