Pine Engraver Beetle

Yukon Forest Health — Forest insect and disease

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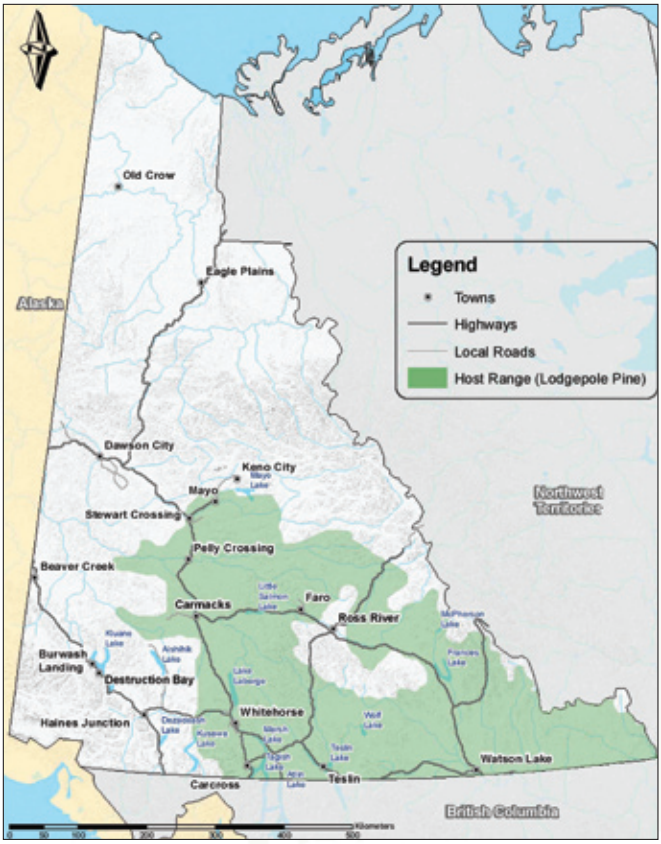
Yukon
Energy, Mines and Resources
Forest Management Branch

Introduction

The pine engraver beetle (*Ips pini*) is a natural disturbance agent of lodgepole pine (*Pinus contorta*) stands in Yukon. Its range coincides with the distribution of the host. Engraver beetles (often referred to as Ips beetles) commonly infest logging slash and damaged, stressed or recently felled trees. At epidemic population levels, pine engravers can also cause top-mortality or single and group tree mortality. Historically, pine engraver infestations have been associated with major disturbances such as fire, flooding, clear-cut logging and infestations of other pests such as the mountain pine beetle (*Dendroctonus ponderosae*). In Yukon, pine engraver activity is often associated with porcupine feeding damage. However the main instances of single and group tree mortality in Yukon have been associated with weakened trees on the fringes of wildfires. Pine engraver beetles attack all age-classes and diameter classes of pine. No significant outbreaks have been recorded in Yukon since forest health reporting began in the early 1950s.

Host Range for Pine Engraver Beetle



(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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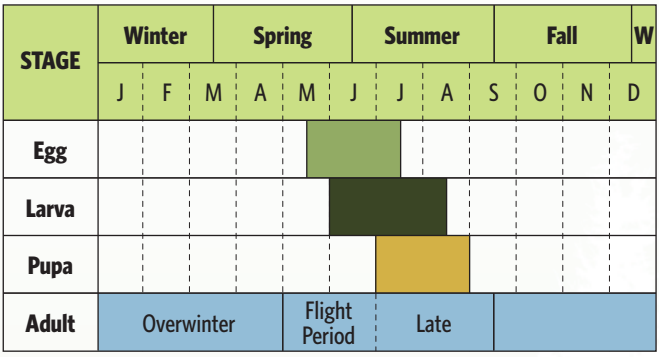
Life Cycle



In most areas of the pine engraver beetle's range, two to three (and sometimes as many as five) generations are produced each year. However, in Yukon, pine engraver beetles typically produce only one generation per year. In early spring, adults that have overwintered in the duff emerge to attack new host material (May/June). Males bore into the host tree and create a nuptial chamber. Females are attracted to the tree by an aggregating pheromone and one to five beetles will enter the nuptial chamber **(photo 6)** for reproduction. Females create egg galleries, generally 5 to 25 cm long, that radiate out from the main chamber **(photo 8)**. Both the egg galleries and nuptial chambers are kept free from frass by the adults.

Eggs are laid along the sides of galleries and take approximately two weeks to hatch. Larvae emerge and feed (perpendicular to the parent gallery) engraving both cambium and sapwood for approximately two to four weeks, then pupate at the end of their galleries. Unlike the parent galleries larval galleries are packed with frass. After two more weeks, pupae mature into adults. Adults will remain in the host tree and feed before emerging to either: a) drop to the duff, burrow underground and overwinter; or, b) disperse and attack new host material without producing brood. These adult beetles take part in a "feeding" attack where no broods are produced. During late summer and early fall these adults drop from the tree and overwinter in the duff.

Definitions:

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

Cambium: *the actively dividing layer of cells which produces the conducting tissues in a tree, therefore increasing the girth of a tree.*

Bole: *the main stem of a tree.*

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

Host Species Attacked and Damage

Tree species attacked in Yukon: Young, over-stocked stands and over mature stands of lodgepole pine.

Ips pini egg galleries take a "Y" or "H" configuration with small larval galleries off at right angles. Engraver beetles are so called because when constructing their galleries they etch deeply into the sapwood; much deeper than other species of bark beetle **(photo 1)**. When trees are mass-attacked, fine, yellow-red boring dust **(photo 7)** can be seen within bark crevices and around the base of the bole. Pitch tubes are often absent. Ips beetles have a symbiotic relationship with the blue-stain fungus and trees killed by the pine engraver normally exhibit blue-stains in the sapwood.

In the late spring and early summer of the year following attack, trees will begin to discolour, first turning yellow-orange and later bright red **(photo 2)**. If trees are drought-stressed at the time of attack, they can begin to discolour as early as one month after attack. In these cases needles are shed by the end of the first summer.

Key features for identification:

- The oblong egg is pearly white (1.5 mm).
- All four larval instars are stout, cylindrical and legless (3.2 mm at maturity).
- Pupae are opaque white, inactive and similar in size and shape to the adults **(photo 5)**.
- The adult beetle is 3–6 mm long, and reddish-brown to black. *Ips pini*, like other species of Ips, is distinguished from other bark beetles by wing covers that form a distinct concavity (declivity) at the hind end. Also, when viewed from above the head of the pine engraver beetle is not visible **(photo 3)**.
- Main egg galleries etch deeply into the sapwood and are free from frass **(photo 4)**.
- Numerous (up to five) larval galleries radiate from a single nuptial chamber.

Photo number:

1. **Old gallery.** Citation: Rod Garbutt, Canadian Forest Service.
2. **Tree mortality.** Citation: Steven Katovich, USDA Forest Service, Bugwood.org
3. **Adult beetle.** Citation: Pennsylvania Department of Conservation and Natural Resources — Forestry Archive, Bugwood.org
4. ***Ips pini* gallery.** Citation: Scott Tunnock, USDA Forest Service, Bugwood.org
5. **Pupae in gallery.** Citation: Rod Garbutt, Canadian Forest Service.
6. **Nuptial chamber.** Citation: Rod Garbutt, Canadian Forest Service.
7. **Boring dust on bark.** Citation: Rod Garbutt, Canadian Forest Service.
8. **Adult in nuptial chamber/egg gallery.** Citation: Rod Garbutt, Canadian Forest Service.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Similar damage

Damage caused by lodgepole pine beetle (*Dendroctonus murrayanae*) and mountain pine beetle (*Dendroctonus ponderosae*) can be confused with that of the pine engraver beetle. The galleries of the lodgepole and mountain pine beetle are single and vertical and do not etch as deeply into the sapwood.

Risk Assessment

The following tables summarize the likelihood of occurrence and magnitude of impact of a pine engraver beetle outbreak at the stand level. These tables are a coarse guide for estimating the risk of an outbreak when populations are at endemic levels.

Likelihood of Occurrence

Stand Attack Hazard:	**High** →	**Low**
Recent stand level disturbance causing pine mortality/debris[1]	Present (within 120 m)	Absent
Stand health[2]	Stressed/Decadent	Vigorous
DBH[3] (Diameter at breast height)	<20 cm	>20 cm

Notes:

1. Ips beetles are attracted to recently killed and stressed standing trees or slash. If broods are successful, adjacent standing pines can be at risk the following year.
2. Ips beetles are attracted to recently killed and stressed pine; therefore, stands under stress increase the likelihood of attack.
3. Small diameter pine are preferred habitat for ips beetles.

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:	No impact anticipated							
Visual Quality[2]			■	■				
Comment:	Red/grey-attack period (-)							
Timber Productivity[3]			■	■				
Comment:	Young plantation mortality (-)							
Wildfire Hazard[4]		■	■	■				
Comment:	Increased fuel load (-)							
Public Safety[5]		■	■	■				
Comment:	Hazard trees (-), increased fuel load (-)							
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 outbreaks tend to affect scattered or small groups of small-diameter trees, no significant impact is anticipated.
2. Visual quality is negatively impacted initially during the red-attack period and then during the grey-attack period until the trees begin to fall and the green understory takes over.
3. Given that small diameter trees are generally killed, timber productivity may be reduced in the medium term until young forest regenerates.
4. Wildfire hazard increases in the short term while the dead needles are retained on the pine. It then decreases in the medium term when the needles have dropped. Hazard increases again in the long term when the dead trees fall to the forest floor and contribute large diameter fuels to the regenerating pine fuel complex.
5. Public safety is negatively impacted by the increase in hazard trees and wildfire hazard.
6. Given that outbreaks tend to affect scattered or small groups of small-diameter trees, no significant impact is anticipated.

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. Bark beetle species may benefit from warmer temperatures because of:

- longer summer season for growth and reproduction (potential for more generations in a given year)
- moisture stressed trees with less resistance to attack
- more major disturbances such as wildfires

A warmer/drier climate scenario is likely to benefit the pine engraver beetle if it causes drought stress in pine. If mountain pine beetle expands its range into Yukon, Ips beetles are likely to benefit from increased primary bark beetle activity.

Management Options

Monitoring

Ips pini activity can be viewed from both aerial and ground surveys. The best time of year for monitoring is mid-summer when the foliage colour change is most conspicuous. For efficiency, aerial monitoring should focus on pine leading stands. For efficiency, survey work should be focused in larch leading stands. For aerial survey standards, refer to 'B.C. Aerial Survey Standards' (MoF, 2000).

Direct Control

Direct control for pine engraver beetle is not generally recommended except when the population is at endemic levels or when attempting to stop an outbreak in its early stages. Options for direct control include:

- Sanitation logging is the most commonly used means of direct control. Complete timber removal of infested stands combined with prompt processing can greatly reduce the beetle population. Stumps can be either peeled or burned.
- Conventional trap trees are healthy trees that are felled in the early spring prior to adult flight and, once infested, are removed and milled or debarked or burned. Conventional trap trees should be felled into open exposed locations.
- Lethal trap trees are felled, sprayed with aggregating pheromone and then treated with an insecticide. Note the pine engraver beetle will not attack areas exposed to direct sunlight and will only attack the underside of trap trees felled into the open. It is recommended that all trap trees be felled into shady locations.
- Pheromone trapping.

Harvesting Considerations

Harvesting of pine may occur either as a by-product of private/industrial land clearing or if a commercial forestry operation is undertaken. The following considerations can apply to both small and large-scale tree harvesting and to either green-tree or salvage harvesting:

- Time harvesting operations to occur outside the beetle flight period and remove or dispose of logs/debris prior to the next beetle flight period.
- Minimize amount of green debris left on site through pile-and-burn, broadcast burn or chipping.
- Minimize windthrow hazard when designing the harvest area. Following harvest, survey windthrow in mid- to late June to determine if it is being attacked. Salvage of green windthrow in the years following harvesting will minimize host material.
- Minimize stump height.
- If possible, debark logs to be decked, used for access control or other on-site purposes so that it does not provide habitat for beetles.
- Minimize site disturbance to ensure hydrology is not impacted and that residual trees are not mechanically damaged or under stress.
- Partially burned trees in the fringe area of a wildfire should be harvested immediately after the fire if the fire occurs in the early spring. Otherwise, trees can be harvested before the next beetle flight.
- Do not stack infested, or uninfested, green fire wood next to healthy trees.
- If possible, completely debark or score the bark in strips on decked timber or larger slash so that it does not provide habitat for beetles.

Silvicultural Considerations

Silvicultural considerations are relevant post-harvest if a stand is being managed for commercial forestry or if an area is being replanted:

- Increase stand biodiversity by utilizing a range of preferred and acceptable species for planting.

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