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Management Guide for

Western Hemlock Looper

Lambdina fiscellaria lugubrosa (Hulst)
(Lepidoptera: Geometridae)

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Key Points

- Larvae feed voraciously on both new and old foliage.
- Most hemlock can recover from less than 50% defoliation.
- Chewing off needles at their bases causing the stand to appear yellowish-red and then brown in color.

The western hemlock looper is a defoliator whose larvae feed on the foliage of most conifers and some broadleaved species, but prefer western hemlock.

Hosts:

- Western hemlock
- Douglas-fir
- Western red cedar

Occasional hosts:
Subalpine fir, amabilis fir, grand fir, white spruce, sitka spruce, larch.

History of Outbreaks and Distribution

The western hemlock looper is a defoliator whose larvae feed on the foliage of most conifers and some broadleaved species, but prefer western hemlock (*Tsuga heterophylla*). Populations periodically increase sharply in coastal and interior forests, persist for 1 or 2 years, and then decline. These high populations often result in the death of large numbers of trees over limited but well defined areas. Although most outbreaks have occurred in mature and over-mature hemlock and hemlock-cedar stands, some infestations have occurred in vigorous hemlock stands 80-100 years old.

Outbreaks are generally brought under control by the action of parasites, predators, and diseases. Heavy rains during the moth flight period can reduce egg-laying and hasten the decline of an outbreak. In northern Idaho and western Montana outbreaks of this insect have been recorded in the 1930's, 1970's, and most recently in 2000-2003.

Relative to other defoliators, the wasteful feeding of this insect increases the amount of damage. Young larvae feed initially on new foliage, but they quickly move to old foliage. They return to the new foliage only when the old foliage is depleted. High populations can remove nearly all the new and old needles in a single season.

The western hemlock looper occurs from Oregon north through British Columbia and up into southeast Alaska. A related species, the hemlock looper (*Lambdina fiscellaria*) occurs in eastern North America from Georgia north to Nova Scotia and west to Wisconsin.

Adult western hemlock looper displaying the black wing markings. Photo by Jed Dewey

Damage

Western hemlock in the interior is intolerant to defoliation so mortality can occur following only one year of heavy defoliation and may continue for up to four years after the collapse of a western hemlock looper infestation. Coastal hemlock seems much more resilient.

Hemlock looper damage usually occurs in mature stands where severe defoliation can result in growth reductions, top-kill, and tree mortality.

Defoliation occurs most commonly on sites located in valley bottoms with a major western hemlock component, and is often in distinctive elevational bands.

Historically, this insect only reached epidemic levels in old growth, multi-canopy forests since it prefers to lay its eggs in mosses and lichens that hang from these older trees. Areas of second growth, single canopy forests were affected during recent outbreaks. Most hemlock can recover from less than 50% defoliation.

This looper is a wasteful feeder, often nipping only a small part of a needle before moving to another. As the needles dry out they change color and along with the exposed twigs, result in a reddish brown color characteristic of an infested stand. Often a mat of clipped needles collects under the tree. The wasteful feeding of this insect greatly increases the amount of damage relative to most other defoliators.

Older hemlocks, amabilis fir, and Sitka spruce are most vulnerable to damage. Young Douglas-fir appears to suffer more than older Douglas-fir.

Damage on spruce stand from hemlock looper. Photo by Manfred Meilke.

Life History

Classic “inch worm” looper larvae hatch from eggs in the late spring and begin feeding in the newly opened buds in the upper crown. Young larvae are marked with light gray and black bands. Feeding by early instars during May, June, and early July is light, and not particularly noticeable.

As larvae grow larger, from the middle of July to October, they become mottled gray to dark brown with an intricate pattern of darker markings. They feed voraciously on both new and old foliage and are more evenly distributed throughout the crown. Mature larvae are quite mobile and produce an abundance of silk webbing which is very evident in defoliated stands. The larvae are wasteful feeders, chewing off needles at their bases causing the stand to appear yellowish-red and then brown in color.

Defoliation starts in the upper crown, but as feeding progresses more and

Life History

Damage is similar to other defoliators, such as the western black-headed budworm, but the larvae are very distinctive.

more of the crown is affected, increasing the risk of mortality. Late in summer, larvae are very mobile, crawling over tree trunks and shrubs, and dropping by silken threads from the trees to the ground.

Larvae then move to bark crevices, moss, lichen, or under debris to pupate. Pupae are mottled greenish-brown, ¾ inch long.

Buff colored moths emerge from pupae in 10-14 days. Moths have wings that are narrow at the base with a banded pattern, 2 bands on the forewing, 1 on the rear wings and a wing span of about 1 1/2 inches. Moths mate, and lay eggs on foliage, concentrating eggs in the upper crown of host trees.

By fall, the ground may be littered with parts of needles, insect frass, and later by thousands of dead moths.

Hemlock looper larvae feeding on grand fir. Photo from the Canadian Forest Service.

Identification

Signs of Attack—By the middle of July looper defoliation of new and old foliage is evident throughout the crown.

Look for mottled gray to dark brown larvae with an intricate pattern of darker markings feeding on old and new foliage.

Mature larvae produce an abundance of silk webbing which is very evident in defoliated stands. In areas of looper epidemics "these silken webs may become so abundant that the whole forest looks and feels like one big cobweb" (Keen, 1952).

Buff colored moths emerge from early September through October and "during an epidemic are so abundant as to give the impression of a snowstorm in the woods." (Keen, 1952). Eggs are present in the fall and winter.

By fall, the ground may be

littered with parts of needles, insect frass, and later by thousands of dead moths.

Recent outbreak in the Prince George Forest Region can be seen along Highway 16 east between Purden Lake and McBride. Photo file from British Columbia Defoliator Management Guide.

Predictive Sampling Techniques

Egg sampling is done in the fall when defoliation has been noticed, or when an outbreak is anticipated, to predict levels of defoliation the following summer.

1. Samples of lichen found on the bole and branches of hemlock are taken from the lower crown of 5–10 trees per site, using pole pruners.

2. Eggs can be counted using a magnifying lamp or by using a hot water extraction method to determine the average number of healthy eggs per 100 grams of dry weight lichen. The procedure is as follows:

- spread lichen and allow to air dry (for 72 hours), or oven dry (at a low temperature) for 24 hours
- weigh each sample and record weight
- lace cut-up lichen sample into 100°C water for at least 30 seconds
- stir gently to dislodge eggs from lichen, then pour contents through 2-stacked strainers (0.297 mm or 20 mesh for top sieve)
- wash contents with strong jet of water to force eggs through top sieve (eggs will be retained in lower sieve)
- rinse eggs onto filter paper and dry
- count eggs using a magnifying lamp and categorize as noted below.

3. Healthy eggs must be distinguished from parasitized, infertile or old eggs as follows:

Condition	Color of eggs
healthy	bronze
parasitized	black
infertile	yellow
old	opaque

Predictive Sampling Techniques

Predicted defoliation using the hot water method:

Number of healthy eggs per 100g dry wt lichen	Predicted defoliation
0-4	none
5-26	light
27-59	moderate
60+	severe

Management Considerations

Prevention— Well spaced, even-aged thrifty stands should be less susceptible and suffer fewer impacts from western hemlock looper defoliation. Promoting mixed species stands composed of less than 50% western hemlock, avoiding cedar hemlock mixes, and preferring non host species will also lessen susceptibility. Stand tending treatments such as spacing and fertilization will help maintain a healthy stand that is more resilient to western hemlock looper defoliation. Canadian researchers have developed system for assigning western hemlock looper hazard to stands. This system is summarized in Table 1. Stand tending practices which reduce hazard by altering stand composition, structure, density, or age should improve a stand's resilience to western hemlock looper attack.

Indirect Control-- Western hemlock looper populations are normally held to low levels by several natural factors:

- Parasites.
- Predators including insects and birds- small forest song birds are known to be effective natural enemies.
- Diseases- caused by fungi and viruses have been found in collapsing populations.
- Abnormal weather conditions- especially cold, wet summer periods. Heavy rains during the moth flight period can reduce egg-laying and hasten the decline of an outbreak.

Pheromone—Components of the sex pheromone have been identified and Canadian researchers are hoping to develop a pheromone based early warning system for building western hemlock looper populations.

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-Warning-

Remember, when using pesticides, always read and follow the label!

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The system being developed would employ a series of permanent pheromone trapping stations. Data collection is still underway.

Pesticides—In British Columbia two formulations of the bacterial insecticide *Bacillus thuringiensis kurstaki* (Btk) were tested in 1993 and shown to effectively control the western hemlock looper. The western hemlock looper was included on the December 2003 FORAY7 96B pesticide label. Other chemical insecticides have also been labeled for use against western hemlock looper. Please check current labels to insure use is permitted for populations of western hemlock looper.

Table 1. Parameters influencing hazard for western hemlock looper in British Columbia.

	Hazard		
Stand characteristics	**High**	**Moderate**	**Low**
Biogeoclimatic zone & subzone	Interior: ICH wk2; ICH wk3; ICH wk1; ICH mw3; Coast: CWH vm1; CWH dm1;	Interior: ICH mm; ICH mw2; ICH vk1; ICH vk;	Interior: ESSF mm1; ESSF wk2; ESSF wc2; Coast: CWH vw2;
Site	Lower elevation, cool wet poor site classes	Mid-slope, cold, wet medium site classes	Higher elevation, cool,wet good site classes
Species mix	>50% western hemlock, hemlock-western red cedar mixes	<50% western hemlock, cedar-hemlock mix, pure cedar, spruce -balsam mix	Non-hosts or pine, larch, and Douglas-fir stands
Stand density	Dense, overstocked	Spaced, gaps	Open grown
Stand structure	Layered or 2-story co-dominates	Single layer dominates	Even canopy
Maturity	Mature, > age class 6	Intermediate, age classes 3-6a	Immature/young <age class 3

[a] An increased incidence of spruce beetle (1994 –attacks of 8-12%) has been noticed in severely defoliated spruce-balsam stands on medium age sites.

Other Reading

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Photo Credits

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http://imfc.cfl.scf.rncan.gc.ca/insecte-insect-eng.asp?geID=1000002&ind=W

University Of British Columbia Webcourse Defoliation Guidebook
http://web.unbc.ca/ctl/webcourses/fsty307/defol/defol.html

Forest Health Protection and State Forestry Organizations

Assistance on State And Private Lands

Montana: (406) 542-4300

Idaho: (208) 769-1525

Utah: (801) 538-5211

Nevada: (775) 684-2513

Wyoming: (307) 777-5659

Assistance on Federal Lands

US Forest Service
Region One
Missoula: (406) 329-3605
Coeur d'Alene: (208) 765-7342

US Forest Service
Region Four
Ogden: (801) 476-9720
Boise: (208) 373-4227