



United States Department of Agriculture

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# Monitoring Western Spruce Budworm With Pheromone-Baited Sticky Traps to Predict Subsequent Defoliation

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## Abstract

A detailed procedure is described for monitoring western spruce budworm with pheromone-baited sticky traps and interpreting the results to predict defoliation the following year. Information provided includes timing of the survey, how to obtain traps and baits, how many traps are needed, trap assembly, field placement of traps, and how to evaluate the catches.

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Forest  
Service

Pacific Northwest  
Research Station

Research Note  
PNW-RN-571

June  
2015

## Introduction

Because outbreaks of the western spruce budworm (*Choristoneura freemani* Razowski (= *occidentalis* Freeman)) can last a decade or more, there are many occasions when knowing the future course of stand defoliation will aid in management decisions. This is particularly true whenever an insecticide treatment is under consideration.

Forest Service scientists with the U.S. Department of Agriculture (USDA) have developed a technique for predicting spruce budworm defoliation.<sup>2</sup> This technique relates the number of moths caught in pheromone-baited traps to stand defoliation the following year. Described herein are the methods for monitoring spruce budworm and procedures for evaluating trap catch to predict future impacts from this pest.

## Timing of the Survey

The timing of trap placement is critical to the accuracy of the survey. Throughout most of its range, the western spruce budworm (WSBW) completes its life cycle in 12 months. Depending on local conditions, moths usually emerge from pupal cases in July or early August; in the southern Rockies, adults often begin emerging in early July.

Ideally, traps should go out at the time budworm larvae start to pupate. Budworm larvae near pupation are 1 to 1-¼ in long with tan heads and white spots on an olive to reddish brown body (fig. 1). Budworm pupae are ½ to ¾ in long (fig. 2) and are yellow- to reddish brown. Both mature larvae and pupae are found near the tips of branches.

If information on budworm pupation is not available, traps should be put out during the second week in July for most areas in eastern Oregon. When

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<sup>2</sup> The trap technique for predicting budworm defoliation was developed by Charles Sartwell, Christine Niwa, and Gary Daterman, USDA Forest Service, Pacific Northwest Research Station, Corvallis, Oregon. Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331. <http://www.fs.fed.us/pnw/contact/corvallis.shtml>.

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William M. Ciesla

Figure 1—Mature budworm larva.



Christine Niwa

Figure 2—Budworm pupa.

trap locations differ in elevation by more than 800 ft, the deployment of traps should be delayed approximately 1 week for each 800 ft of increased elevation. All traps should be retrieved and evaluated in late August. The WSBW pheromone bait uses a very low dosage, 0.0001 percent, and is less stable over time than the Douglas-fir tussock moth (*Orgyia pseudotsugata* McDunnough) bait; therefore, it is recommended to put the traps out after the larvae have pupated, but before they emerge. Putting traps out while the larvae are still feeding will not ensure accurate results.

## Obtaining Traps and Baits

The traps used for WSBW monitoring are white triangle sticky traps, the same as those used for Douglas-fir tussock moth. Traps may be ordered through regional Forest Service Forest Health Protection coordinators or local state forestry offices in January. The WSBW baits are purchased directly from semiochemical supply companies. Contact your regional or state entomologist for the current accepted manufacturer. Use only those baits and traps that have been recommended and calibrated. Different bait formulations could have a different chemical composition or release rate that could affect trap catch, and the correlation with defoliation could be different from what is currently being used.

## How Many Traps Are Needed?

Budworm traps provide a method of predicting defoliation levels on an area basis. To make an accurate defoliation estimate, traps should be distributed to cover as much of the entire survey area as possible. The following tabulation summarizes the approximate number of traps needed to survey a range of acreage.

<b>Acres surveyed</b>	<b>Number of traps required</b>
500 or less	10
500 to 10,000	10 to 20
10,000 to 25,000	20 to 30
25,000 to 50,000	30 to 40
50,000 to 100,000	40 to 50

When surveying large areas, traps should be labeled with an exact legal description. When many traps are deployed, location information is very important as adjacent traps with high moth catches may help delineate a hot-spot where severe defoliation and tree damage are likely.

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## **Assembly of Traps**

Equipment and supplies needed:

- 0.0001-percent WSBW baits from supplier—baits should be stored in a freezer prior to use and in a cooler in the field
- USDA Forest Service Douglas-fir tussock moth traps
- ¼-in thick foam cut into ½- to 1-in squares (provided with traps)
- Wire ties (provided with traps)
- 1-¼-in straight pins
- Stapler and staples
- Needle-nosed pliers or long tweezers
- Black waterproof marker
- Flagging

## **Instructions for trap assembly**

Traps and baits may be assembled indoors prior to taking them to the field. Refer to figure 3, and follow these steps when assembling traps and preparing the baits:

1. Cut ½- to 1-in square pieces of foam.
2. Push the pin through the center of the foam square with the head of the pin on the bottom of the square; impale a bait pellet on the end of the pin and slide part way down the pin. Place the foam squares with the pinned baits in a waterproof container.
3. The entire inside surface of the sticky trap should be evenly coated with adhesive. If it is not, rub the inside surfaces of two traps together in order to obtain an even distribution of adhesive.
4. Staple the flaps together to form the triangular shape of the trap.
5. Attach the wire hanger through the center hole of the trap and twist it several times.

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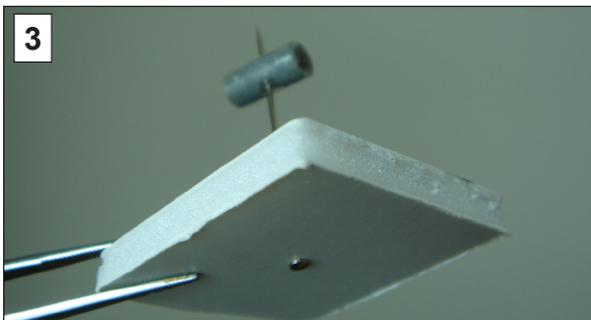
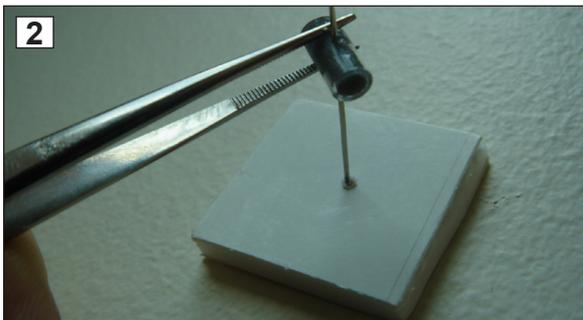


Figure 3—Bait placement in traps. Place the foam square on the bottom of the trap, as close to the center of the trap as possible. Note that the pin and bait sit upright and do not come in contact with the sides of the trap. (Photos 1 through 5 by Mark Hitchcox; photo 6 by Karen Ripley)

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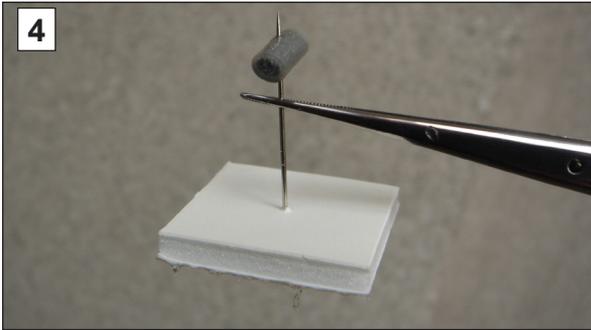


Figure 3—Continued.

6. When ready to place a trap in the field, use a pliers or tweezers to grasp the pin and place the foam square on the bottom side of the trap, as far to the center of the trap as possible. It is important that the bait never touches the adhesive. Keep the baits in a cooler when in the field.

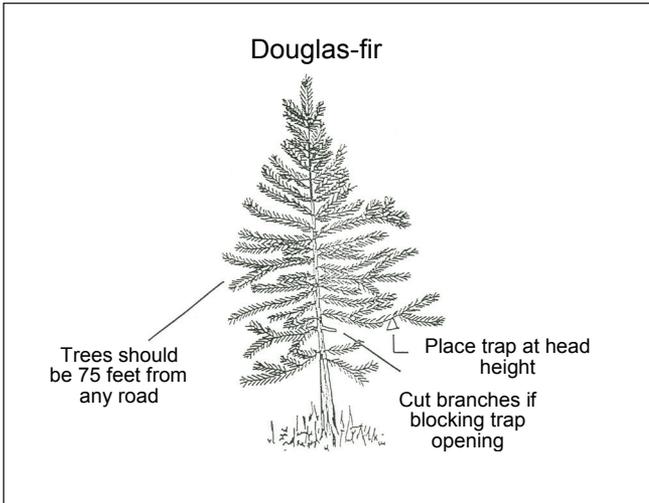
## Field Placement of Traps

Distribute traps singly throughout the trapping area; however, traps should be at least 20 m (21.8 yd) apart. Individual traps should be hung in the lower crown of open-grown Douglas-firs (*Pseudotsuga menziesii* (Mirb.) Franco) that are at least 30 to 60 ft in height (fig. 4). The outer branches on clumps of trees are also acceptable sites for traps. **Do not hang traps in dense foliage or in thickets.** Trees selected for hanging traps should be at least 75 ft off the road. Use a black waterproof marker to label the trap with location information. Bright flagging visible from the road should be used to mark the trap location. Trap location records should include geographic coordinates and be marked on a map to aid in retrieval.

## Evaluating Trap Catches

In late August, traps should be collected and the number of moths in each trap counted and recorded. It is not important that you can distinguish spruce budworm from other moths in the trap. Virtually all moths in the traps during a budworm outbreak will be WSBW (fig. 5). The total number of moths in all traps is calculated and divided by the number of traps, to give an average trap catch. Using the average trap catch, it is possible to estimate the approximate level of defoliation (current foliage loss) expected next year (table 1).

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*Karen Ripley*



*Jeff Jones*

Figure 4—Trap placement in trees.



*Chris Niwa*



*Jeff Jones*

Figure 5—(A) Budworm moth, and (B) moths in traps.

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**Table 1—Predicted percentage of defoliation of new growth and defoliation over the entire area based on average number of moths per trap**

Average number of moths per trap	Predicted percentage of defoliation of new growth	Predicted defoliation over entire area
	<i>Percent</i>	
15	20	Next year light
25	40	Moderate
40	60 to 80	Heavy
60 or more	100	Heavy

In table 1 predictions are for the entire area surveyed, not for individual or small groups of traps. There will be stands within the survey area with higher and lower levels of defoliation.

An average trap catch of 40 or more moths indicates heavy tree defoliation the next year. In instances where trees in the survey area are already moderately defoliated, a trap catch of greater than 40 moths indicates the potential for serious tree damage such as top-kill and tree mortality.

## Acknowledgments

Special thanks to Mark Hitchcox for ensuring that the manuscript was in final form.

## Metric Equivalents

When you know:	Multiply by:	To find:
Inches (in)	2.54	Centimeters (cm)
Feet (ft)	0.305	Meters (m)
Acres	0.405	Hectares

## Other Resources

**Fellin, D.G.; Dewey, J.E. 1982.** Western spruce budworm. Forest Insect and Disease Leaflet 53. USDA Forest Service. <http://www.na.fs.fed.us/spfo/pubs/fidls/westbw/fidl-wbw.htm>.

**Sartwell, C.; Daterman, G.E.; Twardus, D.B. 1985.** Moth captures in pheromone-baited traps relative to subsequent defoliation of Douglas-fir by western spruce budworm. In: Sanders, C.J.; Stark, R.W.; Mullins, E.J.; Murphy, J., eds. Recent advances in spruce budworms research. Proceedings of the CANUSA spruce budworms research symposium. Ottawa, ON: Canadian Forest Service. 240 p.





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