Douglas-fir Tussock Moth Handbook

United States
Department of
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Combined Forest Pest
Research and
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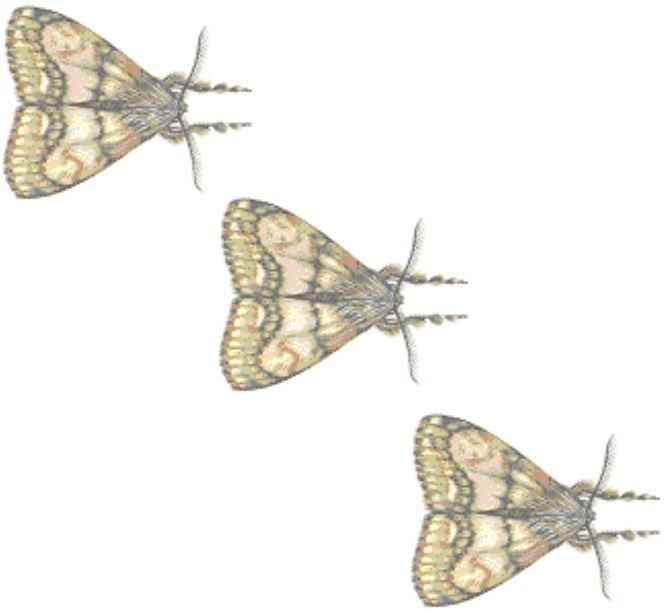

How to Use Pheromone Traps to Determine Outbreak Potential

In 1974 the U.S. Department of Agriculture initiated the Combined Forest Pest Research and Development Program, an interagency effort that concentrated on the Douglas-fir tussock moth in the West, on the southern pine beetle in the South, and on the gypsy moth in the Northeast. The work reported in this publication was funded in whole or in part by the Program. This manual is one in a series on the Douglas-fir tussock moth.

How to Use Pheromone Traps to Determine Outbreak Potential

by G. E. Daterman[1], R. L. Livingston[2], J. M. Wenz[3], and L. L. Sower[1]

Except during outbreaks, the Douglas-fir tussock moth is very difficult to detect in western forests. Tussock moth populations too low to be detected by conventional means can erupt, however, into destructive outbreaks in Douglas-fir and true fir forests in just 1 or 2 years. Substantial tree damage can occur before the forest manager is even aware there is an outbreak.

To help alleviate this problem, a new system has been developed to survey forests for tussock moths. Called an evaluation survey, this system uses traps baited with a synthetic version of the female moth's sex attractant or pheromone (Z-6-heneicosen-11one). The traps capture male tussock moths in late summer and early fall during the mating season. The number of moths caught is an indication of the number of larvae that will be present the following spring and the subsequent potential for defoliation.

1. Assembling Traps and Baits

The survey system is primarily a management tool for focusing attention on potential trouble spots in the forest. If the surveys are done every year in the prescribed manner, they will provide an index of population changes of the moth and make it easier to identify areas building toward outbreak populations. This gives the forest manager an "early warning" of outbreaks and a chance to plan control methods before excessive damage has occurred.

The trapping system requires four steps: (1) assembly of traps and baits, (2) selection of plots, (3) placement of traps, and (4) interpretation of results.

The standard trap for evaluation surveys is a triangular structure made from a 1/2-gallon paper milk carton (fig.1). The interior of the trap is lined with a very sticky adhesive which traps the moths attracted by the pheromone.

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[1] *Forest Service, Pacific Northwest Forest and Range Experiment Station.*
[2] *State of Idaho Department of Public Lands.*
[3] *Forest Service, Region 5, California.*

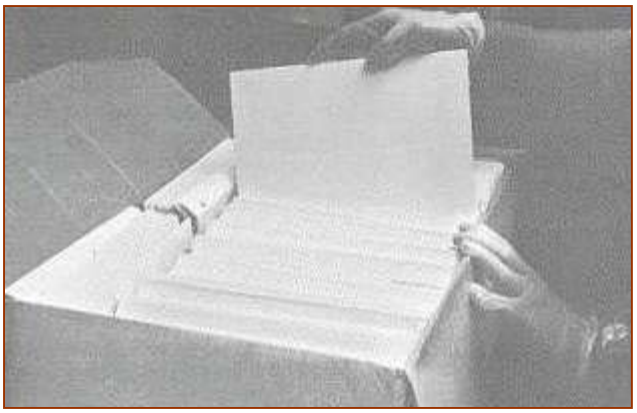

Figure 1. –Folded, partially assembled milk carton traps in packing case of 250.

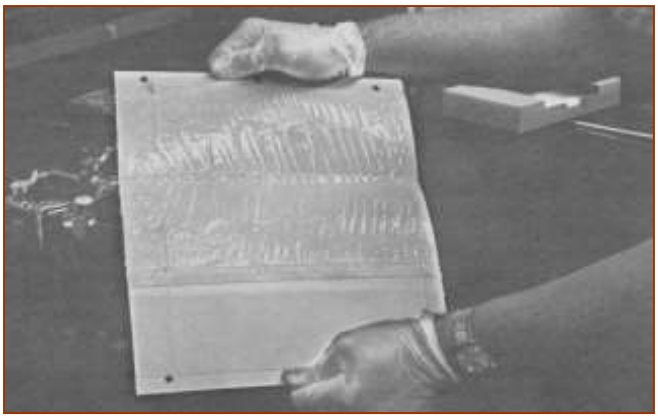

Figure 2.—Trap walls should be folded against one another to uniformly spread adhesive on all three interior walls of the trap.

These traps can be partially assembled and packed for shipping or later use. For convenience, pack the containers in a folded position with the adhesive material applied to two sides that are folded together. Just before use, the sticky walls can be pulled apart and all three interior surfaces folded against one another several times to uniformly spread the adhesive (fig. 2). To complete assembly of the traps staple the end flaps together and attach the wire hanger (figs. 3 and 4).

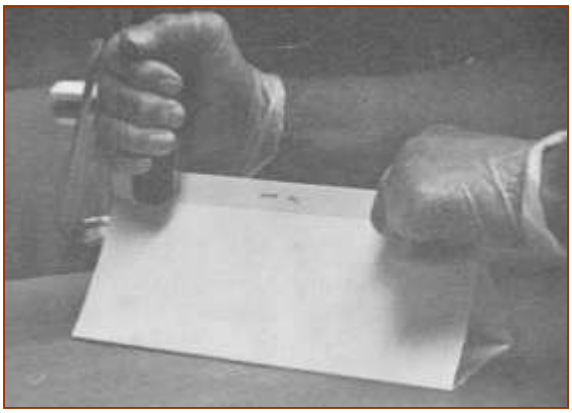

Figure 3. -- Trap is stapled into triangular shape.

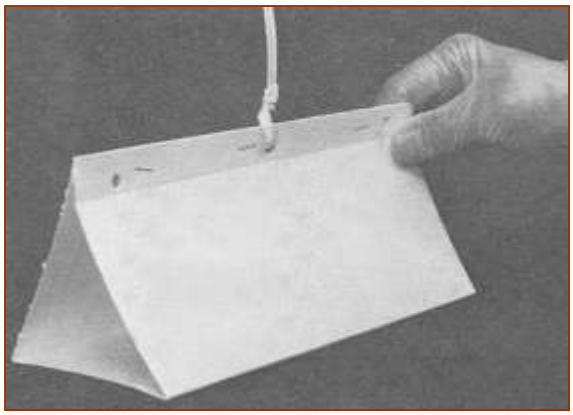

Figure 4. -- Final assembly of standard survey trap.

The attractant bait is formulated in liquid plastic (polyvinyl chloride) which is hardened by heating and cut into 5- x 3-mm pellets (fig. 5). These baits are thousands of times weaker than the scent of a live female moth so they do not attract moths from very far away. Instead, the traps capture only those moths that come close

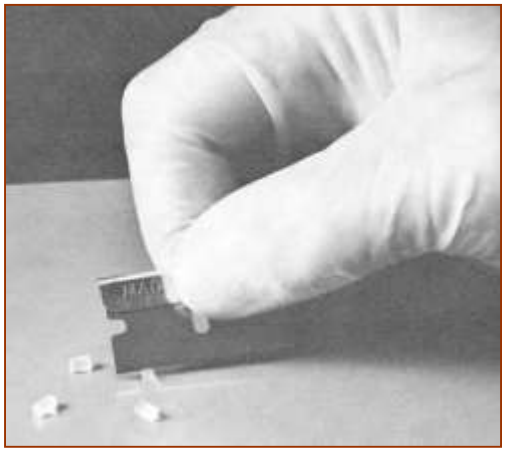

Figure 5. – Evaluation survey baits are cut to size (3- x 5-mm).

(less than 1 meter) to the traps during their normal flight activity. As a result, the number of moths captured is more representative of the number of moths in an area than if stronger baits are used and moths are attracted over long distances.

It is important that this trap design and bait formulation be used for tussock moth surveys. Other traps and bait preparations will readily capture moths, but it will be impossible to interpret the results. Both the design of the trap and the strength of the attractant affect the number of moths caught. For example, a trap bait equal to the attraction of a live female can cause a trap to fill with male moths in a day or two, whereas an evaluation survey trap will probably catch less than 10 moths during 8-10 weeks in the same area.

To maintain uniformity of trap construction and bait strength, these materials will be prepared or obtained by contract for the next several years by the Forest Service's Insect Behavioral Chemicals Research Unit at Corvallis, Oreg.

2. Selection of Plots

The range of the Douglas-fir tussock moth has been determined through analysis of past outbreaks and captures with pheromone-baited traps (fig. 6). Within this very large range, plots should be located in the areas of greatest susceptibility or highest risk. These are usually stands with a high proportion of true firs and/or Douglas-fir on or near ridge-tops. Often these are relatively dry sites of low productivity.

A workable guideline for high risk areas is one plot for every 10 square miles of forest with relatively uniform stand structure, species composition, and topography. Forest insects are known for their tendency to aggregate within a forest stand. Great variation in the number of larvae or eggs can occur on trees only a short distance from one another. Because insect larvae and eggs are immobile and clumped in a nonuniform manner within the stand, a large number of samples is generally necessary to obtain an accurate estimate of density. The evaluation survey system reported here will alleviate this problem because the male moths are highly mobile during the mating season and distribute themselves fairly uniformly over an area. It is for this reason that only one plot per 10 square miles is recommended.

Pest managers may wish to establish more than one trapping plot in areas of this size considered especially susceptible to damage by the tussock moth. No more than three trapping plots should be needed in any 10-square-mile area, however. Trapping only determines if a potential problem exists; followup sampling is necessary to determine more precise information.

3. Placement of Traps

Place 5 traps in a looping configuration in the plot with the first trap 75 feet (23 meters) into the forest from the road, and each succeeding trap a minimum of 75 feet (23

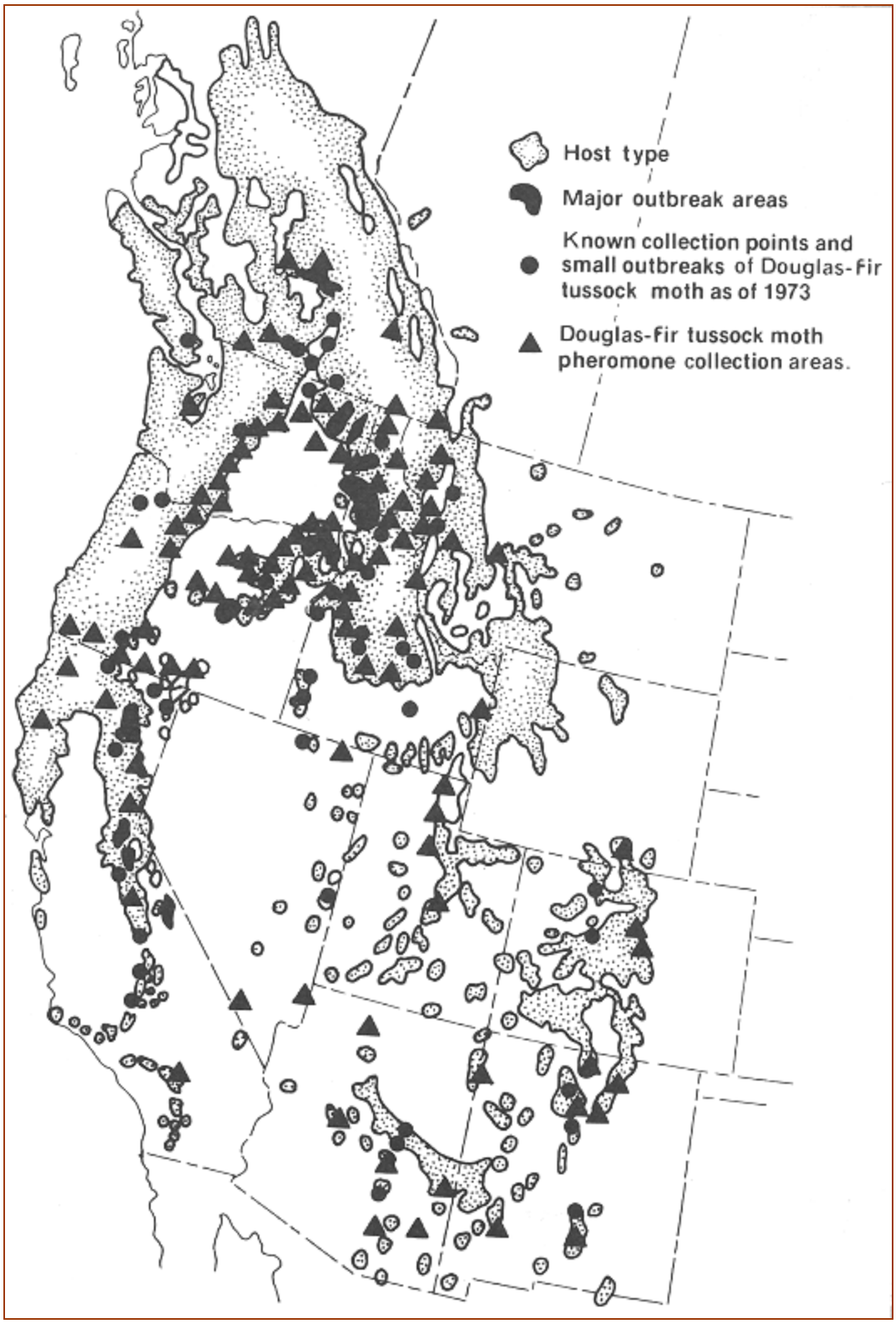

Figure 6. – Known distribution of the tussock moth within range of host trees.

meters) from the previously placed trap. Place each trap in a relatively open grown tree or at the edge of a dense thicket. Traps should not be hung in dense foliage or in thickets.

Bait the traps by impaling a bait pellet on a sharp pin, and then suspending the pin and pellet inside the trap by sticking the pin through an interior, center wall of the trap. The tip of the pin should be bent over where it protrudes from the outside wall of the trap to prevent it from slipping out. Then wire the trap to the end of a host tree branch $1^1/2$ to $2^1/_2$ meters above the ground. Traps should be wired very close to the branch. If long wire hangers are used, the wind may blow the trap about, breaking the wire or blowing the trap into dense foliage. The trap should hang crosswise under the tree branch. If necessary, remove any foliage that blocks the ends of the trap. Check to be sure the bait pellet has not fallen out during positioning of the trap.

Figure 7. – A trap placed appropriately with top of trap wired flush to outer end of branch and ends free of foliage.

Standardized procedures are very important for trapping surveys aimed at predicting outbreaks. Follow these guidelines closely and be sure that traps are hung like the one shown in figure 7.

The beginning of moth flight varies between areas and between years. In Colorado, New Mexico, Arizona, Utah, southern California, and Nevada, traps should generally be placed in the forest between August 1 and August 10, and should not be retrieved before October 1. In the northern range of the tussock moth, traps should go out between August 7 to 20 and not be retrieved before October 15.

4. Interpreting the Results

After retrieving the traps, keep them in as good condition as possible. Avoid exposure to dust or excessive heat, as might occur if traps were left in a closed vehicle in the sun for an extended period, or any other treatment that alters the appearance of the moths. Count the captured moths as soon as possible after retrieving the traps. The longer specimens stay in the adhesive, the more they "grease up" and darken which makes identification and counting more difficult. High temperatures compound this problem; it helps to store traps in a refrigerator or freezer if insect counting will be delayed.

Be careful to distinguish Douglas-fir tussock moths from other species (Daterman 1977). Keep in mind that parts of the insect may be missing due to scavenging by birds, ants, or yellow jackets. Each moth remnant should be counted as a separate catch. Even a clear imprint of the wings of a captured moth that has been completely scavenged from the trap is sufficient for a count. Do not, however, count moths from traps which have fallen to the ground or have otherwise been damaged.

An average trap catch of 25 moths or more can indicate that the local population is approaching the outbreak stage. When average trap catches reach this level, survey efforts should be intensified in the area by employing additional sampling techniques (Mason 1979).

The male moth capture rate of an average of 25 or more males per trap indicates a larval population the following summer of two or more early (1st and 2nd) instar larvae per 1,000 square inches of foliage. A population of 20 or more early instar larvae will result in visible defoliation the following year. Average captures of 25 or more male moths indicate potential visible defoliation within the next two summer seasons.

Other Considerations

For best performance of this survey system, pheromone trapping should be repeated annually on permanent plots that are representative of all susceptible stands. When average trap catches reach 25 or more moths on a plot, followup intensified sampling for egg masses and larvae should be carefully conducted as described in Mason (1979). The annual survey results will provide forest managers with more lead time to cope with sudden outbreaks of the tussock moth.

This evaluation survey system has already been used successfully to identify potential tussock moth outbreaks. It is still new, however, and some "fine-tuning" of the method may be necessary. For example, the threshold of 25 moths per trap may not be valid for every location. In some places, less foliage might mean that fewer insects could cause visible damage-the opposite may also be true. In addition, the pheromone survey system does not take into account the potential effect of parasites and/or predators. Their activity can greatly affect survival of tussock moth eggs or larvae in subsequent seasons.

Although there is still room for improvement, the survey system in its present state of development is ready for widescale use as an early warning system for detecting potential outbreaks. When applied correctly, the system will provide managers with a headstart in minimizing losses due to tussock moth defoliation.

Additional Information

For additional information on survey trapping and supplies of standard traps and baits write to:

Insect Behavioral Chemicals Project
Forestry Sciences Laboratory
USDA Forest Service
3200 Jefferson Way
Corvallis, Oregon 97331

References

Daterman, G. E. 1977. How to identify tussock moths caught in pheromone traps. U.S. Dep. Agric., Agric. Handb. 517.

Mason, R. R. 1979. How to sample larvae of the Douglas-fir tussock moth. U.S. Dep. Agric., Agric. Handb. 547.

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Adapted for the Internet by Katharine A. Sheehan, USDA Forest Service, Pacific Northwest Region, Forest Health Protection.

To view a summary of current use the DFTM pheromone trapping system, including an evaluation based on 20+ years of observations, visit:
www.fs.fed.us/r6/nr/fid/dftmweb/ews/