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Gypsy Moth
Handbook

Using Pheromone Traps to Detect and Evaluate Populations of the Gypsy Moth

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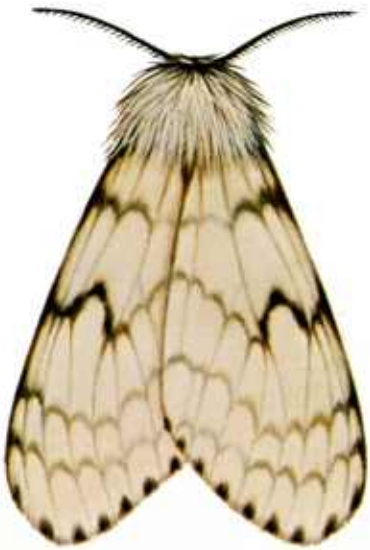

Using Pheromone Traps to Detect and Evaluate Populations of the Gypsy Moth

by Charles P. Schwalbe [1]

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 gypsy moth.

Introduction

The gypsy moth, *Lymantria dispar*, is a destructive insect pest of hardwood forests and shade trees in the United States. The larva feeds on leaves of many types of deciduous trees, and severe or successive defoliations result in decreased tree growth and vigor. Mortality may occur because these trees are predisposed to attack by secondary insect pests and microbial pathogens. Large caterpillars will feed on coniferous trees that are not preferred by smaller larvae, and a single defoliation of these species usually results in death.

The range of this insect now extends over most of the Eastern United States. Although the gradual enlargement of this generally infested region is due to natural spread, infestations are caused by artificial spread also. Natural spread occurs when newly hatched larvae spin down on long strands of silk and are bouyed by air currents. Such dispersal is highly seasonal, occurring during the time of egg hatch, and is dependent upon wind speed and direction. Artificial spread occurs when gypsy moth life stages are inadvertenly carried to uninfested areas by man. Logs, firewood, mobile homes, and recreational

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vehicles are commonly found to be infested and have been implicated with the establishment of a number of small infestations far from the generally infested areas. Quarantine and inspection activities are conducted to minimize the incidence of such movement.

In spite of the efforts to retard artificial spread, new isolated infestations are frequently established. During the mid-1970's, three to four infestations were discovered each year. Early detection of these infestations is necessary if they are to be prevented from building to damaging population levels. The boundaries of the infestation must also be clearly delineated so that appropriate control measures can be accurately applied. Traps baited with attractants are effective devices for determining the occurrance and distribution of pest insects.

Female gypsy moths produce a chemical sex pheromone that attracts mates to them and evokes male mating behavior. The chemical, (+)-cis-7, 8-epoxy-2-methlyoctadecane, has been isolated, identified, and synthesized. The common name of the pheromone, disparlure, is derived from the scientific name of the gypsy moth, *Lymantria dispar*. This optically active form of disparlure is being phased into the USDA survey program to replace the less effective racemic mixture previously used.

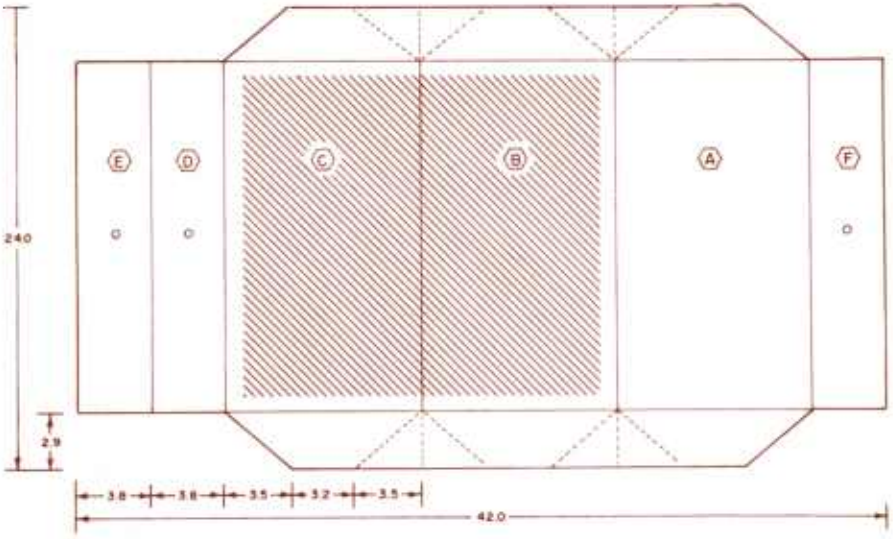
Disparlure is commercially formulated for use by incorporation into three-layer plastic laminated dispensers. Each dispenser measures 1 × $^1/_8$ in and contains approximately .000037 oz of disparlure that is released into the air at a constant rate throughout the field season. (Because research is continuing in an effort to utilize more efficiently this costly attractant, these specificiations may change.)

The Trap

The trap currently in use for gypsy moth survey is called the delta trap, because of its triangular shape (fig. 1). It is fabricated of bleached sulfate, medium-density, solid paperboard, 0.022 in nominal thickness. Polyplastic coating 0.75 mil thick prevents water absorption and improves the field weathering characteristics of the trap. The trap is die cut, creased, and perforated, as shown in figure 2. Certain creases are perforated to facilitate folding of the baffled ends inward (fig. 3). Approximately 42 in^2 of surface area is covered with 0.3 oz of adhesive, Tack-Trap®, which is sufficient to ensnare 15–20 moths.

The first step in preparing the trap for field use is to install the pheromone dispenser. The technique used should allow for ample air circulation around the dispenser to facilitate pheromone release. At no time should it come in contact with the sticky adhesive. An acceptable method is to staple one end of the dispenser to panel A (fig. 2) in such a way that it hangs freely within the assembled trap. Folding the trap is facilitated by first "breaking" all creases and perforations. If the trap will be checked frequently, it can be stapled to a tree through panel D, folded into place, and held closed with two paper clips. Traps that do not require

Figure 1.—Assembled delta trap. The orange color is readily visible to facilitate recovery. Green and brown traps are used in areas where high visibility is not desired.



frequent inspection can be assembled and stapled several times through panels D, E, and F. The completed trap is then stapled to a tree or suspended with string or wire threaded through the holes in panels D, E, and F.

Traps should be placed as low as possible on the boles of trees since most moth flight activity is near the ground. The standard height for placement is between 3 and 5 ft. To discourage vandalism, traps may be placed higher. However, increasing the height of trap placement decreases the probability of male capture. Also, fixing the trap to a vertical silhouette such as a tree, instead of free hanging the trap, will increase the probability of male capture. When placing traps, care should be taken that entrance ports are not obstructed by leaves or branches. Also, if the trap is in a location exposed to direct sunlight, it should be hung on the north side of the structure. High temperatures within the trap caused by direct sunlight may cause the adhesive to dry out and become ineffective.

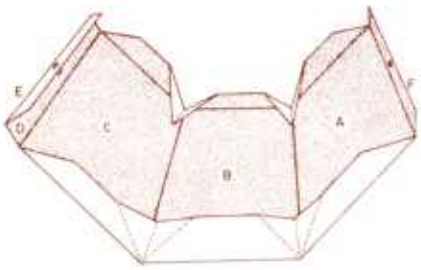


Figure 2.—Schematic layout of the delta trap (in centimeters). Shaded areas indicate where adhesive is applied. Creases are indicated by solid lines and perforations by dotted lines.

Figure 3.—Perspective drawing showing partially assembld and completed trap.

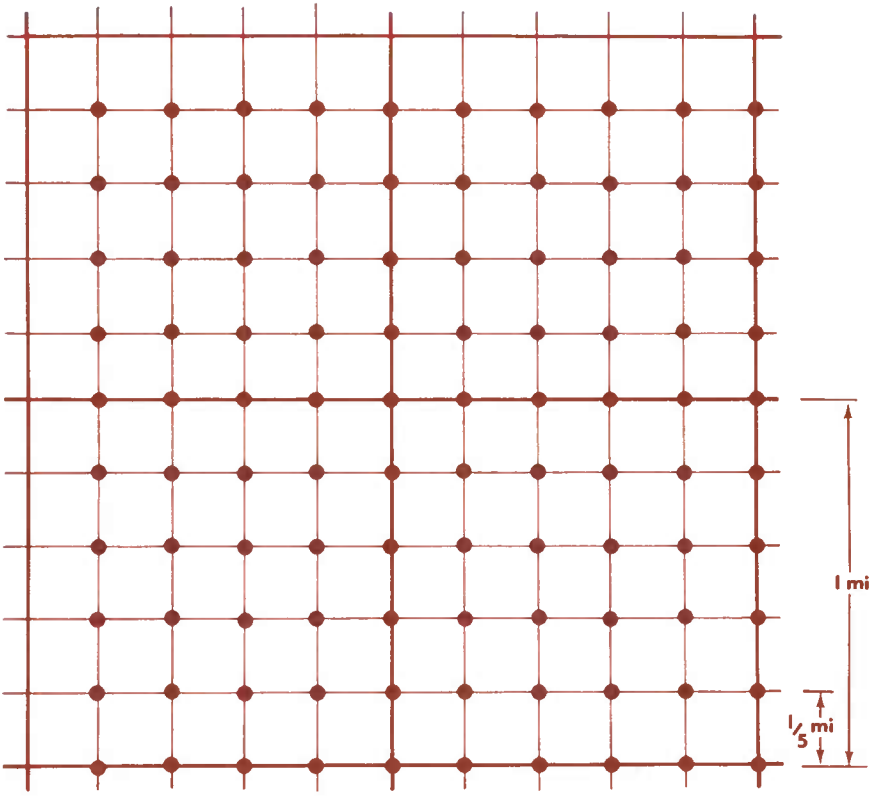
Detection Survey Methods

One of the most important features of an effective survey is consistency. Following a standard plan allows comparison of results from location to location and from time to time. The probability of detecting an infestation is dependent upon the size and density of the pest population and the distance between traps (trap density). For routine detection surveys, trap density should be 1 trap per 3 mi^2. If resources are limited, it is advisable to trap smaller areas of a region on a rotating basis. This way trap density is not compromised in the interest of surveying large areas, and each area will be surveyed on a regular basis. In planning the survey, a uniform grid is overlayed on a map, and trap locations are approximated. In many situations traps can thus be identified according to State, county, township, and section locations. Actual placement of the traps should be as close to the grid point as possible.

A general rule of thumb is not to deviate from a trap site by more than 25 percent of the distance between traps ($1/4$ mi in a detection survey). This flexibility in locating traps permits placement in accessible areas most likely to harbor infestation. When locating trap positions, fence rows and wood lots should not be disregarded. When host material is present, the area should be regarded as a possible trap location. Since artificial movement of gypsy moth is associated with the movement of people and their commodities, it is often worthwhile to concentrate detection survey efforts in populated areas or on commercial or recreational sites. Examples are roadside rest stops, campgrounds, mobile-home parks, logging mills, nurseries, and forested urban and suburban communities that generally favor the introduction and establishment of the pest. In small, high-risk sites such as campgrounds, parks, and sawmills, trap density may be increased up to several traps per square mile, thus improving the probability of detecting very small, isolated infestations.

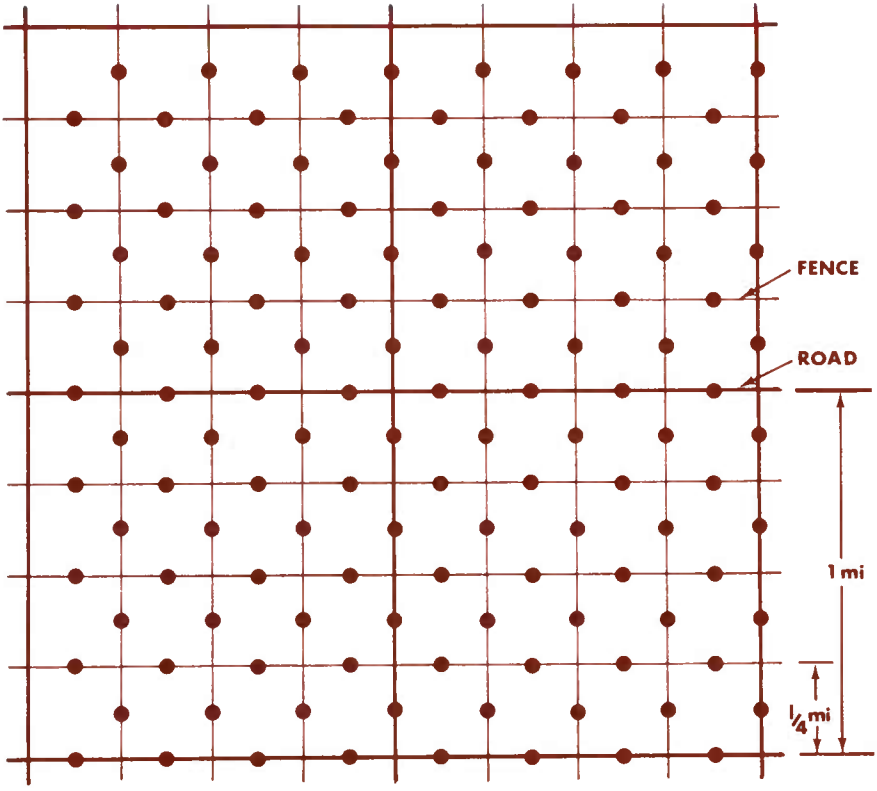
Detection traps should be placed in the field by mid-June, before male flight normally occurs. Frequent checking of these traps is not necessary as they are designed to remain effective throughout the season. It is good practice, however, to check them at least once. Traps are often lost to vandalism, and those near dusty roads may become ineffective as the Tack-Trap® becomes covered with dust. Trap replacement may occasionally be necessary. Also, if a midseason check reveals evidence of infestation, it is possible to begin a delimitation survey to determine the extent of infestation.

Delimitation Survey



When male moths are captured in a detection survey it is necessary to confirm the existence of a reproducing population and to determine the area of infestation. This is done through a delimitation survey. Under most circumstances, male moths are not likely to disperse far (more than 1 mile) from their point of origin. Therefore, it is recommended that delimitation be conducted by placing 25 traps per square mile over 9 mi^2 centered on the positive detection trap(s). Such an array will contain 225 traps on a grid and traps will be about 1,000 ft apart (fig. 4). A system similar to that used for planning and laying out the detection survey can be used. If, in areas of broken woodland, a trap site cannot be located on or near potential host material by

Figure 4.—Delimitation survey grid with 25 traps per square mile. In practice, this trap arrangement would be deployed over 9 mi^2.



deviating from the site by 25 percent of the distance between traps (250 ft), that site should be left untrapped.

In areas subdivided into 640-acre sections, placing 25 traps per square mile is not practical, because very few trap locations will fall on natural boundaries such as roads and fence rows. In such settings, uniform trap distribution can be accomplished by placing 32 traps per square mile, as shown in figure 5. This plan provides for uniform distances between traps, and most trap sites will be on natural boundaries where host plants are most likely to occur. Trap placement and recovery will also be facilitied by following these boundaries.

Figure 5.—Delimitation survey grid with 32 traps per square mile. Note that maximum utilization is made of roads and fence rows. This design is recommended for use in areas subdivided into quarter sections.

The timing of the delimitation survey should be the same as that used in detection survey. Traps should be in place by June 15 and can be removed by September 15. As mentioned earlier, the delta trap has capacity for about only 15 moths. If an infestation does in fact exist within the area under delimitation, traps may quickly fill with moths and become ineffective. Therefore, they should be examined as frequently as practical. Merely removing insects from the trap is generally not adequate because wing scales and other debris will coat the Tack-Trap®. Traps which have captured 15 or more moths should be replaced. It is not necessary, however, to use a new lure dispenser; simply transfer it into the new trap.

Careful and accurate recordkeeping is fundamental to an effective survey. All moth recoveries should be immediately recorded in the field in an appropriate record book. The entry should include the date, exact trap location, number of specimens, and the name of the observer. Observations on weather and trap and insect condition may also be noted. If it is necessary to submit the specimen for positive identification, replace the trap with a new one and forward the insect within the trap to the identifier. If laboratory identification is not necessary, the moth should be removed from the trap so it is not counted again the next time the trap is checked. At the end of each day, field records should be transcribed to a master log. It is important to stress that data regarding empty traps should also be reported; this will serve to determine specifically when each trap was examined.

Survey Interpretation

About all that can be said about the capture of a gypsy moth in a detection survey is that it probably originated within a mile of the trap in which it was captured. As mentioned earlier, if it is discovered early in the season it may be possible to place additional traps in the area. It is not unusual, however, to capture isolated moths in an area where no further evidence of infestation is ever discovered. Those incidents are likely the result of "hitchhiking" insects on recreational vehicles. If a delimitation survey the year following detection is negative—that is, no moths are captured—it may be concluded that a reproducing population does not exist in the area surveyed.

If, however, insects are captured in the delimitation survey, it is possible to characterize the distribution of the infestation. As a general rule, it can be stated that moths are most likely to be captured in those delimitation traps closest to their point of origin. The probability of capture decreases dramatically as this distance increases. Thus, mapping the percentage of captured insects found at each trap location gives an image of relative population density. Establishing the absolute boundaries of the infestation is somewhat more difficult, and it should be kept in mind that a small proportion (less than 1 percent of the captured population) is expected to be found in traps up to 1 mi from where they originated. Delimitation is not necessarily done by encircling all traps containing moths.

The recommended procedure to follow in mapping insect distribution is to total the number of moths caught in all traps in the delimitation survey, then to divide the number of moths found in each trap by this total. Each figure will represent the relative population density near that trap. Those traps containing the most insects represent the densest area of the infestation, and it is in this area

that egg-mass scouting should be concentrated. The boundaries of the infestation can be defined by connecting those traps that contain more than 1 percent of the total captured population.

Because adult male behavior may be affected by influences of temperature, humidity, wind, topography, abundance of female moths and openness of terrain, it is difficult to apply standard survey procedures and interpretation methods universally. Each survey plan must consider factors such as distribution of host-plant material, probable time and location of introduction, and potential for spread of the infestation. Factors such as these may warrant modification of the guidelines for survey described in this handbook. Also, it should be stressed that research and development are continuing in an effort to improve effectiveness of survey techniques, and these guidelines may be changed as new information becomes available.

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