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A Simple Ground-Based Trap For Estimating Densities Of Arboreal Leaf-Eating Insects

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ABSTRACT.—Describes a trap design to use in collecting larval frass or head capsules for estimating densities of aboveground arthropods. The trap is light, compact, durable, and easily constructed from common inexpensive items.

KEY WORDS: Insect trap, insect survey, insect monitoring, frass, head capsule.

Several direct and indirect methods have been devised to estimate populations of defoliating insects. Direct methods that require climbing trees or cutting branches are often impractical and at times dangerous. Two indirect methods for estimating larval densities of forest defoliators involve quantifying the amount of insect frass (fecal pellets) or number of larval head capsules (shed when larvae molt) collected in traps on the ground and then relating these values to the number of insects in the canopy. Some of the researchers that have tested these methods include: Campbell (1967), Friden (1958), Green and DeFreitas (1955), Higashiura (1987), Liebhold and Elkinton (1988a, 1988b), Morris (1949), Paramonov (1959), Tenow and Larsson (1987), Tinbergen (1960), and Zhang *et al.* (1986).

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Frass and head-capsules are often very distinct and can be used to identify insects down to the family, genus, or even species level. Collecting frass is best suited for estimating populations of free-living defoliators such as many caterpillars (Lepidoptera), sawfly larvae (Hymenoptera), certain beetles (Coleoptera), and grasshoppers and walkingsticks (Orthoptera). Collecting head capsules is best suited for free-living caterpillars. However, these methods are of limited value in estimating populations of certain defoliators such as leaf tiers, leaf rollers, leaf miners, and webworms whose frass and head capsules are often not free to fall.

Traps used to collect insect frass and head capsules generally have a raised frame into which a fine-mesh cloth is secured. Liebhold and Elkinton (1988a) recommended a funnel-type trap design over four other designs they tested. We recently conducted a survey of hardwood defoliators along a 1,200-km gradient (see study description in Haack and Blank 1991), which required more than 600 traps. For use in this survey, we designed a light, compact, durable trap, which was easily constructed from common, inexpensive materials.

MATERIALS AND COSTS

Each trap consisted of a 1-gallon (3.8-L) plastic jug, four 12-inch (30-cm) garden stakes, and a fine-mesh nylon bag. We used stakes treated with a wood preservative; however, untreated stakes are less expensive and would be acceptable in short-term studies. Four stakes were stapled to each jug, using 5/8-inch (1.6-cm) staples; shorter staples did not hold well. Bags were sewn using a nylon fabric (several other synthetic fabrics could work equally well) and nylon thread (cotton thread can decay). The cost of material for each trap was $0.63: $0.20 for 1 jug, $0.24 for 4 stakes, $0.01 for 12 staples, $0.01 for 8 paper clips, and $0.17 for 1 bag (fabric and thread). Labor costs can be estimated based on the 2.5 minutes required to construct one trap and bag.

TRAP CONSTRUCTION AND FIELD PLACEMENT

A trap (fig. 1) is made by first cutting off the bottom of the plastic jug. We cut along a specific horizontal line to make the opening in all jugs approximately equal. The jug is inverted and a garden stake is stapled to each of the jug's four sides. A bag is then placed inside the jug and secured to the rim with eight paper clips; use of fewer paper clips fails to keep the bag smoothly aligned along the trap's walls. The screw cap of the jug is removed to allow rain water to drain out. Our traps had an effective trapping area of about 0.02 square meters, an area which Liebhold and Elkinton (1988a) found to be as efficient for collecting frass as a catchment area of 0.67 square meters.

In the field, the trap is positioned by pushing the stakes into the soil and adjusting so that the trap opening is kept horizontal. Our study began in spring, so it was easy to push the stakes into the soft ground. We placed a metal pin with flagging in the ground directly under the spout of the jug, so the trap could be repositioned easily if disturbed. Traps can be labelled with waterproof markers or tagged for identification purposes.

Care must be taken to keep the jug walls straight so that the original surface area is maintained. Nevertheless, in some places it will be impossible to push the stakes straight into the ground, such as on rocky sites, and the trap opening will become distorted. Using plastic jugs with thicker walls, such as bleach containers, would result in less distortion. Any distortion can alter the original trapping surface area; recall that for a given perimeter, a circle encompasses the greatest area, a square somewhat less, and other

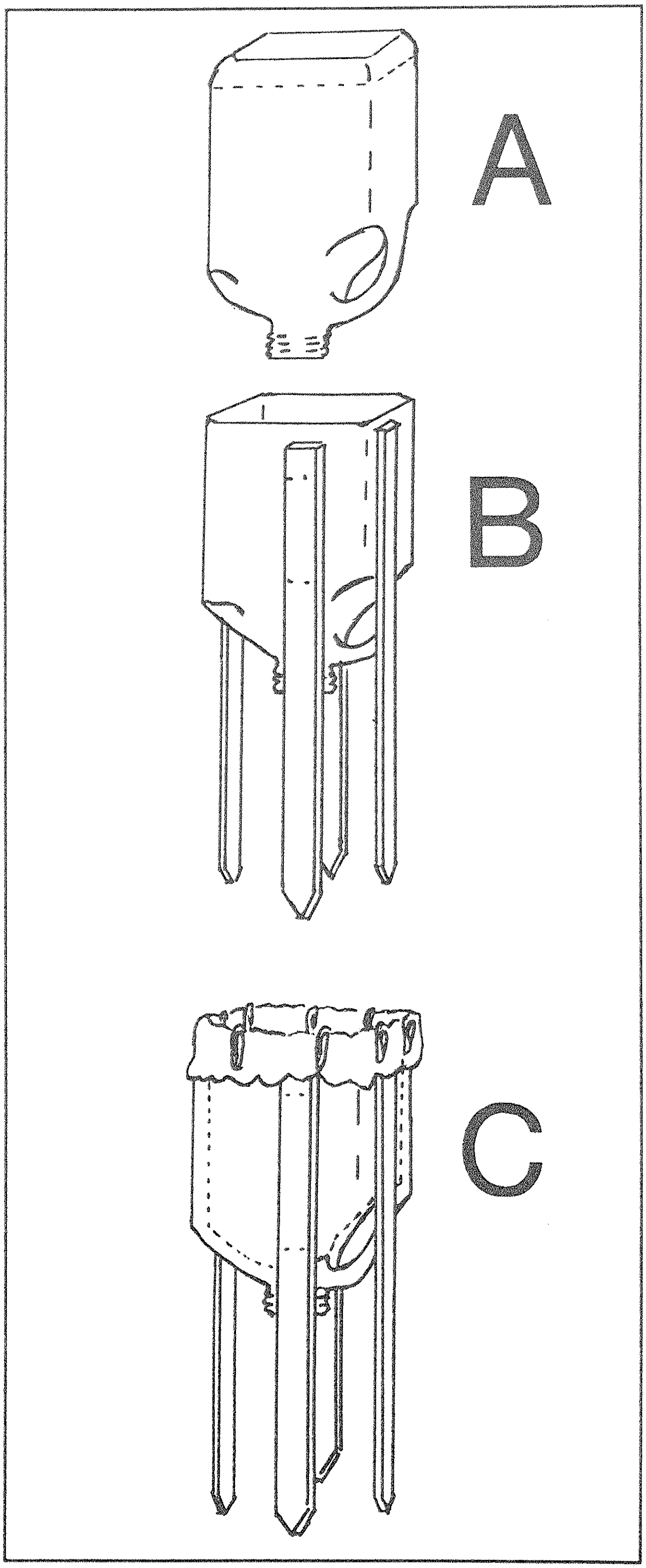

Figure 1.—*A - Cut off bottom of plastic jug approximately 1.5 inches from base; B - Attach garden stakes with staples; and C - Install fine-mesh bag and secure with paper clips. Drawing by Dr. Dean Urie.*

rectangles still less. In our study, we needed an accurate estimate of the actual trapping surface area, so we placed a clear, 1-cm dot grid over several traps, photographed them directly from above, and interpreted each photograph.

Depending on the study objectives, it may be necessary to remove surrounding vegetation that blocks the trap's opening from a direct line to the canopy. Alternatively, lower vegetation could be avoided by mounting the traps higher off the ground, e.g., on 1-m stakes.

When collecting trap contents, we simply replaced the used bag and paper clips with a clean bag and more paper clips. The first bag was folded and placed inside a labelled 1-pint (0.47-L) carton. In addition to frass and head capsules, our traps collected leaves, twigs, catkins, acorns, and much more. Wasp nests were an occasional hazard as well. In studies to estimate woody and foliar litterfall, we recommend using larger and deeper traps than the one described in this paper.

For ease in transport, the pint cartons were stored in plastic milk crates (18 cartons/crate). Two crates were easily carried in a backpack to remote sites.

The traps were found to be extremely durable; almost all lasted throughout our 2-year study. Stake breakage at the soil line was the primary cause of trap failure, but this only occurred during the second year. In addition, the white plastic jugs were easy to see from a distance, simplifying plot relocation. Moreover, although the traps were easily seen, vandalism was rare.

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