Southern Pine Beetle

Dendroctonus frontalis Zimmermann
Coleoptera: Scolytidae

Stephen, F. M.; Taha, H. A. 1979. Area-wide estimation of southern pine beetle populations. *Environmental Entomology* 8: 850-855.

Objective: To expand existing techniques (Stephen and Taha 1976) to permit estimation of the absolute density of *D. frontalis* within a defined forest stand.

Abstract: The southern pine beetle, *Dendroctonus frontalis* Zimmermann, is the most damaging bark beetle in the southeastern USA. All species of indigenous pines are susceptible to attack except longleaf pine, *Pinus palustris* Mill., presumably due to its high resin flow. Mature, over-stocked stands of loblolly, *P. taeda* L., and shortleaf, *P. echinata* Mill, pines on poorly drained sites are most susceptible to infestation. During beetle epidemics, groups of host trees are typically killed, and termed "spots" to delineate from other infestations in close proximity.

This study was conducted in 800 ha of over-mature pine-hardwood dominated by loblolly and shortleaf pines in Arkansas. Aerial and ground survey methods were combined with within-tree sampling procedures for the purpose of estimating absolute numbers of *D. frontalis* over a discrete forest stand containing a series of spots. Using this survey and sampling technique, a procedure for determining the total area of infested bark within the stand was developed. Trees were selected from actively infested spots and sampled intensively to obtain density estimates of *D. frontalis* stages per unit area of infested bark. On average, the following numbers of 100-cm^2 samples were sufficient to produce an estimate with 90% precision for measuring the number of attacks (107) and mature brood (95), and determining gallery length (17). The mean and variance per 100 cm^2 were calculated from all bark disks. The product of these estimates multiplied by the number of infested trees within the stand provided an estimate of the total number of *D. frontalis* for the stand.

Sampling Procedure:

Aerial survey: A helicopter is used to detect *D. frontalis* spots (Thatcher and others 1982) that were subsequently ground checked.

Ground survey: Record host tree species, d.b.h., stage of beetle development at breast height, and crown color for each tree sampled in the spot. Also, determine the average height, average height of the infested portion of the bole, and pine and hardwood basal areas. If necessary, measure radial growth or tree age depending on your objectives. Flag each tree with a particular color specific to that survey trip.

The date on infested bole lengths are necessary for calculation of infested bark area. Selected trees must be climbed or felled in order to obtain this information accurately.

Population sampling: Trees are selected from actively infested spots and sampled intensively to obtain density estimates of *D. frontalis* stages per unit area of infested bark (Stephen and Taha 1976). On average, the following numbers of 100-cm^2 samples were sufficient to produce an estimate within 10% of the mean 90% of the time for measuring the number of attacks (107), mature brood (95), and determining gallery length (17).

Climb trees to minimize disturbance to the surrounding stand. Remove samples (3 per infested bole length), and process in the laboratory. Record the data for each variable and express that value per unit of infested bark area.

Mathematical model for area-wide estimation of *D. frontalis* populations: To estimate total *D. frontalis* numbers, calculate the mean and variance per 100 cm^2 from all of the bark disks collected. In addition, calculate the mean and variance of the infested bark area for each infested sample tree. The product of the means of these two estimates times the total number of infested trees in the stand provides an estimate of the total number of *D. frontalis* in the stand.

Determination of infested bark area: Procedures for estimating the average infested phloem area (bark area) of a tree are provided by Coulson and others (1976) and Foltz and others (1976).

Notes: The techniques presented here violate some statistical assumptions necessary in obtaining a completely random sample. Sample trees must be large enough to climb and the authors' selection of three sample heights per tree evenly spaced along the infested bole is not random. The techniques are standardized and reproducible, which suggests that any bias introduced into these estimates is relatively constant.

References:

Coulson, R. N.; Pulley, P. E.; Foltz, J. L.; Martin, W. C. 1976. Procedural guide for quantitatively sampling within-tree populations of *Dendroctonus frontalis*. Miscellaneous Publication 1267. College Station: *Texas Agricultural Experiment Station*. 26 p.

Foltz, J. L.; Mayyasi, A. M.; Pulley, P. E.; Coulson, R. N.; Martin, W. C. 1976. Host tree geometric models for use in southern pine beetle population studies. *Environmental Entomology* 5: 714-719.

*Stephen, F. M.; Taha, H. A. 1976. Optimization of sampling effort for within-tree populations of southern pine beetle and its natural enemies. *Environmental Entomology* 5: 1001-1007.

*Thatcher, R. C.; Mason, G. N.; Hertel, G. D.; Searcy, J. L. 1982. Detecting and controlling the southern pine beetle. *Southern Journal of Applied Forestry* 6: 153-159.