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Overwintering Aggregation of *Boisea rubrolineatus* (Heteroptera: Rhopalidae) in Western Oregon

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ABSTRACT Overwintering behavior of *Boisea rubrolineatus* (Barber) was studied during 1984–85. Large numbers of this insect aggregated on a single, large Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, tree, with deep bark fissures, at the edge of a stand ca. 1 km from a grove of maples, *Acer macrophyllum* Pursh, the feeding host. Other trees near the overwintering site were smaller and lacked deep bark fissures, or were shaded by trees along the edge of the stand. Density measurement was used to estimate number of overwintering insects at ca. 8,000. These results demonstrate the degree of aggregative behavior in this insect and suggest that aspects of stand structure influence the availability of suitable overwintering sites.

KEY WORDS *Boisea rubrolineatus*, population dynamics, forest structure, resource utilization, overwintering site selection

THE SURVIVAL OF overwintering adults of several forest insect species may be critical to population trends and economic impacts (Furniss & Carolin 1977, Schowalter et al. 1986). Behavioral attributes of overwintering insects can influence the survival of such species (Tinker 1952, Pettinger & Johnson 1962), but little information exists on overwintering strategies of many forest insects (Furniss & Carolin 1977, Hedlin et al. 1981).

Dennys (1927) and Spencer (1942) noted that boxelder bugs, *Boisea* (formerly in *Leptocoris*) *trivittatus* (Say), and western conifer seed bugs, *Leptoglossus occidentalis* Heidemann, could be found overwintering singly or in small groups in exposed standing dead trees and in houses. Tinker (1952) reported aggregation by *B. trivittatus* on walls of buildings apparently in response to temperature thresholds. However, the magnitude of aggregation and the influence of forest spatial structure on overwintering-site selection by forest Heteroptera have not been reported. This paper addresses the overwintering aggregation and host selection of the western boxelder bug, *Boisea rubrolineatus* (Barber).

Materials and Methods

The study was initiated on 7 October 1984 following observation of a large number of *B. rubrolineatus* swarming around a 0.92 m diameter at 2.0 m height Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, at the southern edge of a city park in Corvallis, Benton County, Oreg. Other trees along this wooded edge were <0.30 m diameter at 2.0 m height, and other large trees were located deeper in the stand. The source of this overwintering population was most likely the roadside maples, *Acer macrophyllum* Pursh, ca. 1 km N of the overwintering site. These maples are the major feeding host of this insect (Furniss & Carolin 1977) and supported large populations of *B. rubrolineatus* during spring and summer (personal observation). These trees were exposed to solar radiation but lacked deep (>1 cm) bark crevices.

The insects subsequently settled on the study tree. They were exposed on the bark surface during warm, sunny days but retreated into deep bark crevices at night and during periods when temperatures remained <10°C. Daily observation indicated no further movement to or from this tree or nearby trees.

Population density was measured on 16 November 1984, a clear, warm (20°C) day that brought most of the bugs to the bark surface. A frame (100 cm^2) was placed over 10 randomly selected points between 0.5 and 3 m in height on the north (shaded) aspect of the tree, and over 10 similar points on the south (exposed) aspect. All bugs visible on the surface or in bark crevices were counted.

Results

Mean density of *B. rubrolineatus* (±1 SD) on the north side of the tree from 0.5 to 3 m was 1.2 (±2.3) bugs per 100 cm^2; mean density on the south side of the tree from 0.5 to 3 m was 1.7 (±1.4) bugs per 100 cm^2. The frequency distribution for the north aspect was strongly skewed ($\bar{x} < s^2$), reflecting the crowding of bugs in bark crevices; the frequency distribution for the south aspect indicated a more random distribution of bugs ($\bar{x} = s^2$). However, the means and variances for the two aspects did not differ at the 0.05 level. An average density of 1.45 bugs per 100 cm^2 between 0.5 and 3 m in height was used to estimate the number of bugs at 1,048. Bugs had been swarming around the tree as high as the lowest branches at 20 m in height. If the density on the lower bole was representative of the upper bole, >8,000 bugs were overwintering on this tree. No bugs were found on nearby trees.

The bugs vacated the overwintering site between 18 February and 1 April 1985. Warmer temperatures and budburst on the nearby maples in late March during this study presumably stimulated dispersal (Tinker 1952). Only two dead, fungus-infected *B. rubrolineatus* remained in bark crevices on the north side of the overwintering site on 1 April.

Discussion

Attraction of large numbers of *B. rubrolineatus* to large, exposed trees suggests an important effect of forest spatial structure on insect population dynamics (Campbell & Sloan 1977, Nielsen & Ejlersen 1977, Schowalter et al. 1986). Aggregation of ca. 8,000 bugs from a distance of 500–1,000 m suggests pheromonal attraction to suitable overwintering sites separated from feeding hosts (Aldrich et al. 1978). The apparent tendency of the bugs to cluster in bark crevices on the shaded (cooler) aspect of the tree, compared with more random distribution on the exposed (warmer) aspect in the study, supports the hypothesis that clustering may contribute to thermoregulation by these insects (Tinker 1952).

Similar aggregation was observed in an *L. occidentalis* colony in an unheated greenhouse at Oregon State University. Sixty seed bugs collected in late August and September 1984 were placed in a plastic- and cloth-covered wooden frame (0.5 by 0.5 by 0.5 m). Vials filled with water and plugged with cotton maintained humidity. Crushed Douglas-fir seed and Douglas-fir branches inserted into water-filled beakers provided food and shelter. The bugs were active and distributed throughout the cage, feeding on seeds, until late November. As temperatures in the greenhouse fell, the bugs aggregated in the upper south-facing corner of the cage and remained in the cluster until the temperature rose in the greenhouse during February. An unexpected activity observed during the dissemination period was seed bug feeding on the Douglas-fir stems. As many as 10 bugs were observed at any given time with stylets inserted into the stems (2 mm diam). This activity continued through March and may have been a requirement for the mating and oviposition activity observed during that period.

These observations of overwintering behavior by forest Heteroptera have important implications for population management, especially for *L. occidentalis*, which causes economically significant losses of conifer seed (Hedlin et al. 1981). Clearly, the abundance of suitable overwintering sites and their proximity to food resources could influence population dynamics of such insect species. Hence, understanding of factors influencing overwintering-site selection, as with feeding-site selection, can contribute to development of appropriate pest management strategies (e.g., manipulation of the abundance or condition of suitable trees along forest edges to reduce overwintering survival by these species).

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