Overwintering of the Native Elm Bark Beetle, *Hylurgopinus rufipes* (Coleoptera: Scolytidae), in Siberian Elm, *Ulmus pumila*

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At three sites near Winnipeg, Manitoba, Siberian elm, *Ulmus pumila*, and American elm, *U. americana*, trees were examined for the entrance holes of the native elm bark beetle, *Hylurgopinus rufipes*. At weekly intervals in September and October 1992, entrance holes were counted in the basal 30 cm of the trunks of ten trees of each species at each site. The density of new holes accumulated was calculated from the difference between the initial and final hole count. Densities of accumulated entrance holes in Siberian elm were 31–51% of those in American elm in the same site. Densities of holes in Siberian elm trunks were inversely related to the distance to the nearest American elm. The following spring, living *H. rufipes* were collected from overwintering tunnels in Siberian elm. We conclude that in Manitoba adult *H. rufipes* overwinter in both common species of elm.

INTRODUCTION

Dutch elm disease is the most important disease of elm trees in the northern hemisphere. The causal pathogen of the disease is the fungus *Ophiostoma ulmi* (Buismann) Nannf., which is spread from tree to tree by elm bark beetles. In North America, the major vectors of Dutch elm disease are the introduced European elm bark beetle, *Scolytus multistriatus* (Marsham), and the native elm bark beetle, *Hylurgopinus rufipes* (Eichoff) (Strobel and Lanier 1981). In the prairie provinces, *H. rufipes* is the principal vector (Hildahl and Wong 1965). Although *S. multistriatus* are found in Manitoba (Buth and Ellis 1981), more than 99% of the vector population in Manitoba is *H. rufipes* (Westwood 1991).

Hylurgopinus rufipes overwinter in the outer bark of the lower trunk of elm trees (Strobel and Lanier 1981). In the northern Great Plains most *H. rufipes* overwinter as adults, and almost all of these overwinter within 30 cm of the ground (Landwehr *et al.* 1982; Anderson 1996). Adult *H. rufipes* that emerge from brood galleries in summer fly to healthy elm trees where they first feed on twigs in the canopy, then overwinter in the trunk (Swedenborg *et al.* 1988). The mechanism by which these trees are selected is not known. It appears that adults are attracted to vertical objects and that selection of a suitable tree may be a result of repeated trial and error (Lanier 1983). Distance from the brood tree may influence tree selection, as elm trees with overwintering beetles are more frequent close to wood from which new adults emerged (Becker 1935). Whether all elm species are equally utilized for overwintering is not known.

Both American elm, *Ulmus americana* L. and Siberian elm, *U. pumila* L. are widespread in southern Manitoba and southern Saskatchewan. Adults overwinter successfully in American elm (Anderson 1996), but it is unknown whether overwintering occurs in Siberian elm. Surveys in the area in the mid-1960s detected *H. rufipes* in 7 – 27 % of American elm samples, but none of the samples of Siberian elm contained beetles (Hildahl and Wong 1965). However, these samples were taken from dead or dying parts of elm trees, and so may represent beetles in brood trees, rather than beetles feeding or burrowing in trees in which they overwinter.

Information about the selection of overwintering sites by *H. rufipes* is of considerable economic and practical significance. The control of overwintering beetles by insecticide applications to the lower trunk of elm trees is a key component of Dutch elm disease management in Manitoba (Westwood 1991), and basal sprays are applied to both American elm and Siberian elm. A considerable reduction in pesticide use would be possible if it were shown that Siberian elm is not used by overwintering *H. rufipes*. The purpose of this study was to determine if *H. rufipes* overwinters in Siberian elms in Manitoba.

METHODS

In fall 1992, we selected three sites where both American elm and Siberian elm occur. All sites were within 5 km of the Winnipeg city limits. Site 1 was east of the city, site 2 was west of the city and site 3 was south of the city. At each site, ten Siberian and ten American elms were selected and the diameter at breast height (DBH) of each tree was estimated from the measurement of the trunk circumference with a tape measure. In addition, the shortest distance between Siberian and American elms was measured for each site. Also, for site 1, where trees of the two species were closest together, the distance between each of the 10 selected Siberian elm and their closest American elm neighbour was measured.

For each of the selected trees in each site, counts of bark beetle entrance holes were made at weekly intervals from 23 September 1992 to 30 October 1992. Counts were made only for the bottom 35 cm of each trunk. The accumulation of holes was calculated by subtracting the initial hole count from the final hole count. Accumulations of entrance holes were converted to densities per unit area, based upon the assumption that the sample unit was a cylinder of measured circumference and height 35 cm. Hole density was compared among tree species by unpaired *t* tests, and subjected to regression and correlation analysis using Systat (Systat 1999).

In April of 1993, the Siberian elm trees in site 1 were examined non-destructively to determine whether adult *H. rufipes* had survived the winter in them.

RESULTS

Tree sizes differed significantly between species for two of the three sites (Table 1), however, there was no consistent trend for one tree species to be bigger than the other. In contrast, the mean density of entrance holes accumulated during the observation period was invariably less for Siberian elm than for American elm although this difference was significant in only two of the three sites (Table 1). In all sites, density of entrance holes in Siberian elm was significantly different from 0 (one sample *t* test, d.f. = 9, site 1: $t = 4.9$, $P < 0.001$; site 2: $t = 5.2$, $P < 0.001$; site 3: $t = 4.4$, $P < 0.01$).

The density of entry holes accumulated in Siberian elm appeared to be related to the density of holes in American elm at the same site (Fig. 1). However, despite the high correlation coefficient ($r = 0.97$), this relationship was not statistically significant ($P = 0.2$), presumably because of the small number of sites contributing to the relationship. For three sites, only a near-perfect underlying relationship, giving an r 0.997, would generate statistically significance.

In site 1, where distance from each Siberian elm to its closest American elm neighbour was measured, that distance was inversely related to the accumulated number of entrance holes in the sampled Siberian elm (Fig. 2). This relationship was statistically significant ($F = 11.0$; d.f. = 1,8; $P < 0.05$). In April 1993, when Siberian elm trees were examined in site 1, two overwintering adult *H. rufipes* were removed from one tree and three adults were removed from a second tree. All five adult *H. rufipes* were alive.

DISCUSSION

Hylurgopinus rufipes adults entered overwintering galleries in Siberian elm in fall and at least some of them overwintered successfully there. However, in all sites, densities of accumulated entrance holes in Siberian elm reached no more than 51% of those in American elm in the same site. It appears that American elm is a more preferred overwintering host than Siberian elm. Indeed, the effect of distance of Siberian elm from American elm on hole density (Fig. 2) suggests that *H. rufipes* adults respond at relatively long range to cues specific to American elm, and that the subsequent choice of Siberian elm may be a result of low discriminatory power by the insect when close to the trees to which they have been attracted. However, mistaken identity at close range is probably not the only mechanism for utilization of Siberian elm as an overwintering site. If it were, then we would expect no *H. rufipes* entry holes in Siberian elm in site 3, where Siberian elm were far removed from American elm. Perhaps overwintering in Siberian elm that are distant from American elm is the result of response to the visual cue of a vertical object (Lanier 1983).

We conclude that programs of basal spraying for control of overwintering adult *H. rufipes* should include Siberian elm as well as American elm. Exclusion of Siberian elm from basal spraying is particularly unwise when trees of this species are close neighbors of American elm.

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REFERENCES

Anderson, P.L. 1996. Overwintering behavior of the native elm bark beetle, *Hylurgopinus rufipes* (Eichoff) (Coleoptera: Scolytidae), in Manitoba. M.Sc. thesis, University of Manitoba, 109 pp.

Becker, W.B. 1935. Some observations on the overwintering habits of the American elm bark beetle, *Hylurgopinus rufipes* Eichh. Journal of Economic Entomology 28: 1061-1065.

Buth, J.L and R.A. Ellis. 1981. Trapping elm bark beetles in the City of Winnipeg, with a new record for *Scolytus multistriatus*, (Coleoptera: Scolytidae) in Manitoba. The Canadian Entomologist 113: 263-264.

Hildahl, V. and H.R. Wong. 1965. Distribution of the native elm bark beetle, *Hylurgopinus rufipes* (Eichhoff), in Manitoba and Saskatchewan. Proceedings of the Entomological Society of Manitoba 21: 36-38.

Landwehr, V., W. Phillipsen and M. Ascerno. 1982. An integrated approach to managing native elm bark beetle populations in Minnesota. pp. 454-465. In E.S. Kondo, Y. Hiratsuka and W.B.G. Denyer (Eds.), *Proceedings of the Dutch Elm Disease Symposium and Workshop*, Winnipeg, Manitoba, October 1981.

Lanier, G.N. 1983. Integration of visual stimuli, host odorants, and pheromones by bark beetles and weevils in locating and colonizing host trees. pp. 161-171. In S. Ahmed (Ed.) *Herbivorous Insects*. New York: Academic Press Inc.

Strobel, G.A. and G.N. Lanier. 1981. Dutch elm disease. Scientific American 245: 56-66.

Swedenborg, P.D., R.L. Jones, M.E. Ascerno and V.R. Landwehr. 1988. *Hylurgopinus rufipes* (Eichhoff) (Coleoptera: Scolytidae): attraction to broodwood, host colonization behavior, and seasonal activity in central Minnesota. The Canadian Entomologist 120: 1041-1050.

Systat 1999. *Systat 9 Statistics 1*. Chicago, Illinois: SPSS Inc.

Westwood, A.R. 1991. A cost benefit analysis of Manitoba's integrated Dutch elm disease management program 1975-1990. Proceedings of the Entomological Society of Manitoba 47: 44-59.