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Observations of *Xyleborus affinis* Eichhoff (Coleoptera:Curculionidae:Scolytinae) in Central Michigan

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Abstract

Xyleborus affinis Eichhoff colonized wind thrown timber in the moist floodplain habitats of Central Michigan. Single adult females constructed a complex gallery system consisting of phloem–sapwood interface tunnels and sapwood tunnels. An average of 24 progeny adults and a sex ratio of 14 females to 1 male were found in mature galleries after the first of September.

Xyleborus affinis Eichhoff (Coleoptera: Curculionidae: Scolytinae) has a pan-tropical distribution infesting some 300 woody hosts (Schedl 1963, Wood 1982, Rabaglia et al. 2006). Wood (1982) considered the beetle to be tropical American in origin, and it is distributed from Florida north to Massachusetts and west to Michigan, Missouri, and Texas within the USA. The beetle has extended its range or has been introduced into Africa, Hawaii, and Southeast Asia through New Guinea and some Pacific islands. Bright (1968) listed the genera *Betula, Carya, Castanea, Celtis, Diosypra, Liquidambar, Mimosa, Quercus and Robinia* as temperate tree hosts. Schneider (1987) listed *Fraxinus*. Schedl (1963) provided observation of beetle's habits in Africa under the synonym *X. mascarensis* Eichhoff. Roeper et al. (1980a and b) cultured the beetle using *in vitro* techniques and provided life cycle observations. This study reports on the natural habits of *X. affinis* infesting deciduous woody hosts in Central Michigan.

Methods

These observations were made over three decades from the mid-1970s to the 1990s during the collection of live beetle specimens for use *in vitro* culture studies. The study areas were the Pine River floodplains near the village of Sumner, Gratiot County, Michigan. Overall 32 host logs were collected and returned to the laboratory. Within days each collected bole was cut into disks and then carefully dissected using wood chisels. Eighty-eight complete galleries and 77 partial galleries of *X. affinis* were dissected for this study. Life stages of *X. affinis* and measurements of tunnel lengths were recorded.

Results and Discussion

Host Characteristics. *Xyleborus affinis* primarily attacked wind-thrown silver maples boles (*Acer saccharinum* L.) (N = 29) in the moist floodplain forests and river habitats in central Michigan. The prone trees were found over standing water of temporary ponds or flowing water of the river. On some occasions the bole of the silver maple was partly submerged in the river water. These observations suggest the beetles preferred a high moisture and/or high relative humidity environment. The boles of the host trees were horizontal and uprooted, yet often had live leaves existing on lateral branches. On two occa-

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sions *X. affinis* were observed on wind- thrown northern red oak **(***Quercus rubra* L.) and once on a wind-thrown ash (*Fraxinus* sp.). *Acer* is recorded as host for this beetle here for the first time. The beetle was never found in wind- thrown trees in adjacent, upland, non–floodplain habitats after three years of study.

Host Colonization Patterns. Similarly to other *Xyleborus* species, only the adult females fly to infest new host material. In Gratiot County only a single colonization period was observed with the earliest attacks beginning in mid-May and continuing to mid-June. The density of attack entrance attack holes averaged 25.2 per dm^2 (SE = 3.7, N = 16), ranging from 11.3 to 41.0 entrance holes per dm^2 on the surface of the maple boles.

Gallery Characteristics. Schedl (1963) speculated that two or more females would cooperate in the construction of a gallery system. We found no evidence supporting Schedl's hypothesis based on these Michigan observations. Single foundress females constructed each gallery system. The boring frass produced by the female adult was granular sawdust of woody material pushed out the beetle's entrance hole.

Among developed gallery systems (N = 69) we observed that within 53 galleries (76.8%) the adult females bored through the bark and constructed a lateral tunnel at the phloem-sapwood interface. These laterals are always straight and constructed perpendicular to the length of the longitudinal axis of the host bole in contrast to Schedl (1963) who described these phloem-sapwood laterals as curving and joining other similar laterals. In 36 galleries (52%) the phloem-sapwood laterals were constructed in one direction from the entrance. In 17 (24.6%), phloem–sapwood laterals were constructed in two directions from the entrance. The average length of these phloem-sapwood lateral galleries was 28mm (SE = 2.8, N = 53) and ranged from 4.0 to 49.0 mm in length. The phloem-sapwood laterals appear to be an unusual characteristic compared with other ambrosia beetle species that usually excavate tunnels directly into the sapwood. *Xyleborus ferrugineous* F. (Wood 1962) and *X. seriatus* Brandford (Hoebeke and Rabaglia 2008) also construct phloem-sapwood galleries. Schedl (1963) speculated that the construction of these tunnels provided supplementary nutrition to the beetle's normal xylomycetophagous habit found in the sapwood tunnels. The lateral tunnel constructed at the phloem-sapwood interface rarely varied in depth. Occasionally along their length there were short segments that were burrowed 2 to 3 mm into the outer most portion of the sapwood xylem. These phloem–sapwood laterals never extended deeper into the sapwood. The adult females were observed ovipositing two to four eggs at the end of the phloem interface tunnels in only three of 43 galleries.

Sixteen (23.2%) of the mature galleries lacked phloem-sapwood lateral galleries, and all the gallery systems tunnels were further constructed into the sapwood, as is typical of ambrosia beetles. The sapwood tunnels were at first usually constructed perpendicular to the outer surface of the host near the initial entrance hole of the female adult. The tunnels constructed to a particular depth into the sapwood then each curved laterally, not always following a growth ring. Further penetration into the sapwood led to the construction of as many as six secondary or tertiary lateral sapwood tunnels that usually curved toward the heartwood. The fungal symbionts failed to cause dark staining of the wood around the galleries that is generally typical of ambrosia beetle gallery systems. The sapwood galleries during June averaged 39.3 mm in length (SE = 1.8; N = 29) and ranged from 21 to 65mm. During July to mid August the sapwood tunnels averaged 70.3 mm in length (SE = 1.7, N = 22) and ranged from 60 to 91 mm. In mid August galleries were mature with a mean length of 112 mm (SE = 5.6, N = 37) and ranging from 82 to 163 mm long since boring activity had ceased, evidenced by the lack of fresh boring frass.

Progeny. From dissection of galleries though the summer period, eggs were observed from mid-June to late July. Larvae were found from mid-June to

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mid-August and pupae from late July to late August. The larvae appeared to be mycetophagous because they were not involved in the enlargement of the gallery system. The first teneral adults were observed in late July. The approximate time of development from egg to adult was 5.5 to 7 weeks. The teneral adults overwintered in their parental gallery system. From mature gallery systems after the first of September the number of progeny adults averaged 24.0 per gallery (SE = 0.61, N = 22) and ranged from to 17 to 41. The sex ratio was found to be 14 females to 1 male (493 females to 35 males from 22 galleries).

We observed only a single generation breeding in each particular log. However, when *X. affinis* females were removed from their gallery system and cultured *in vitro*, they did not exhibit any reproductive diapause and constructed gallery systems and oviposited in culture media (Roeper *et al*. 1980a, 1980b). We never observed progeny adults using an old parental gallery system for a second breeding season as suggested by Schedl (1963) in Africa and Schneider (1987) in Kansas. Seasonal changes may account for the differences in *X. affinis'* gallery habits observed in this study.

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