The Great Lakes Entomologist

Volume 55
Numbers 1 & 2 - Spring/Summer 2022 *Numbers 1 & 2 - Spring/Summer 2022*
Article 7

November 2022

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Recommended Citation

Roeper, Richard; Dickerson, Daniel; Kurtzhals, Paul; Bunce, Mark; and Brewer, Steven 2022. "Observations of the Mating habits and Attack Pattern of Trypodendron retusum (Coleoptera: Curculionidae: Scolytinae) on Populus grandidentata in Central Michigan," *The Great Lakes Entomologist*, vol 55 (1)
DOI: https://doi.org/10.22543/0090-0222.2323
Available at: https://scholar.valpo.edu/tgle/vol55/iss1/7

Observations of the Mating Habits and Attack Pattern of *Trypodendron retusum* (Coleoptera: Curculionidae: Scolytinae) on *Populus grandidentata* in Michigan

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Abstract

Trypodendron retusum (Leconte) (Coleoptera: Curculionidae: Scolytinae) mating habits and attack pattern on *Populus grandidentata* Michx. (Big Tooth Aspen) were studied. Mating habits of males and females involved copulation at the entrance hole bored by the female. The mated pair was thus established for each gallery system. Attack (entrance) holes averaged 15.9 cm. apart and were found to be uniformly spaced on the bark surface. Entrance attack hole density was greater on standing snag trees than wind-thrown logs.

Trypodendron retusum (Leconte) (Coleoptera: Curculionidae: Scolytinae) has been reported infesting wind broken and thrown, cut or stressed trees of *Populus* species from Alaska to New Brunswick and south to California, New Mexico and West Virginia (Wood 1957, Wood 1982, Atkinson 2015). Kuhnholz (1994) found that females of *T. retusum* produce a detectable concentration of the aggregating pheromone lineatin only after the initiation of gallery boring, and the angiosperm volatiles of salicyaldehyde and ethanol also tend to aide the attraction of the beetle to its host. Brewer et al. (1988) described the gallery habits of *T. retusum* infesting big tooth aspen (*Populus grandidentata* Michx.) in Central Michigan. A monogamous pair of beetles constructed a gallery system from an entrance hole. The female constructed a series of niches into the wall of lateral tunnels. One egg was deposited by the female into each niche . Larvae enlarged these niches into cradles as they consume both wood and the symbiotic fungi. *T. retusum* has a single generation per year and progeny adults emerge from their parental gallery and overwinter in the litter (Brewer et al. 1988). The purpose of this study was to describe the mating habits and attack pattern of *T. retusum* on their host trees.

Materials and Methods

Direct observations of the active habits of adults were made for 27 hours in 17 days in April and May of 1985 and 1986 at the Alma College Ecological Tract (43° 23´N, 84° 53´ W.) in Montcalm Co. Michigan. The observations were conducted in the afternoon hours on days exceeding 22 °C as flight adults landed on their host trees. Sixteen *T. retusum* attacked big tooth aspen (*P. grandidentata*) trees which were used to study the density and distribution of attacks in June following completion of the beetles' flight periods in 1985 and 1986. Six trees were wind-thrown, horizontal logs on the forest floor; they had basal diameters of 27 and 28 cm and tapered to 10-12 cm diameter. Ten standing snags of Aspens with breast height diameter that measured 11 cm to 26 cm tapered up to 5 cm. were also cut down for study.

The distances between entrance holes of *T. retusum* were measured on sections from both the wind thrown and standing trees. The nearest neighbor method of Clark and Evans (1954) was used to measure the spatial relationship of the entrance holes of *T. retusum* on the surface of the bark. The number of attack entrance holes were counted per square meter on the lengths of wind thrown logs and up the heights of cut standing snag trees separately for comparison of density differences.

Observations and Discussion

Beetle Behavior on the Bark Surface. Observations were made during April-May as parent flight beetles alighted on the bark surface of the standing snags. The adults walked rapidly in an upward direction on the trees. Females sought out bark fissures and initiated their attack entrance holes. Males, after landing, walked about on the bark surface seeking receptive females that had started to bore into the host. This

observation can be explained by the fact that boring females produce the sex (lineatin) pheromone (Kuhnholz 1994). When encountered by a male, a female located at her entrance hole would exit the tunnel or remain with just her head in the tunnel entrance. The male would mount the abdomen of the female and copulate. The mean time of copulation was 2.4 minutes (S.E. = ±0.4, range 1.9-3.0 min., n = 15). This compares to the mean copulation time 3.5 minutes observed for *T. lineatum* (Olivier) by Fockler and Borden (1972). After the mating pair separated the female would enter into her tunnel and soon to be followed by the male (n = 11 observations). This would establish the monogamous pair of beetles found in each gallery system as observed by Brewer et al. (1988). If another male approached an entrance attack hole that was occupied by a mated pair, the approaching male would stop briefly and then continue up the bole seemingly in search of an unmated female (n = 7) which indicates that a repellent signal (e.g. volatile or sound) was emitted by the mated pair.

Distribution and Density of Attack Holes. Following the female's initial boring into the host's sapwood, the attack holes of *T. retusum* could easily be distinguished from those of other ambrosia beetles (i.e., species of *Anisandrus*, *Monarthrum*, *Xyleborinus* and *Xyloterinus*) by the presence of a unique conical mound of wood borings surrounding each attack hole. The boring of other species of ambrosia beetles formed loose mounds of frass or a cylinder of frass by *Xyloterinus politus* (Say).

Nearest neighbor distances between attack holes on heavily infested sections only infested by *T. retusum* were measured and had mean distance between entrance holes of 15.9cm (S.E = ±2.7 cm (range 4.8 to 37.6 cm, n = 98) with only three entrance holes were within 6.0 cm distance of each other. Applying Clark and Evans (1954) nearest neighbor method, an R value of 2.03 ($P > 0.0001$) was calculated. Thus one can assume with a Clark and Evans R value >1 that the population of attack holes of *T. retusum* are uniformly distributed on the surface of the tree. The uniform spacing of attack holes on the bark surface probably minimizes overcrowding of gallery systems within the bole. Brewer et al. (1988) never observed the fusion of two gallery systems of *T. retusum* within these hosts.

The mean density of entrance attack holes of *T. retusum* on six wind-thrown aspen logs was 5.1 entrance attack holes/m^2 (n = 30). This was significantly lower ($T = 3.09$, d.f. = 73, $P = 0.006$) than the mean density of 17.1 entrance attack holes per square meter (n = 44) of the ten standing (snags) aspen trees studied during the same years of 1985 and 1986. Either these wind-thrown aspen logs are below the flight altitude of the majority of the beetles or perhaps the beetles may prefer to orient to vertical trunks of snags. These observations that vertical snags were attacked at a higher rate than horizontal logs are similar to those of Hammond et al. (2004).

Acknowledgments

We thank Robert A. Haack and the late Arlan L. Edgar for their helpful suggestions on an early draft of this manuscript and Peter Biedermann and reviewers on the current draft.

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