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Aphidecta obliterata (Coleoptera: Coccinellidae), an Introduced Predator of the Balsam Woolly Aphid, *Chermes piceae* (Homoptera: Chermidae), Established in North Carolina[1]

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ABSTRACT

Aphidecta obliterata (L.) was introduced into North Carolina from Germany in 1960 to aid in control of the balsam woolly aphid, *Chermes piceae* Ratzeburg, which has killed more than ¼ million Fraser fir trees in the Mt. Mitchell area. The beetle was recovered each year since its release, except in 1961, and appears to be established.

The balsam woolly aphid, *Chermes piceae* Ratzeburg, is a European insect accidentally introduced into North America about 1900 (Balch 1952). It feeds on true fir trees of the genus *Abies* and has caused extensive damage and mortality to North American species (Balch 1952, Johnson et al. 1963, Amman and Speers 1965). The balsam woolly aphid was discovered in North Carolina in 1957 (Speers 1958), and from then until 1963, about 275,000 Fraser fir trees (*Abies fraseri* (Pursh) Poir.) were killed in the Mt. Mitchell area.[2] A research program was begun in 1959 to obtain and test foreign predators to control the aphid (Amman 1961).

Aphidecta obliterata (L.) is a well-known predator of *Chermes* spp. in Europe, and studies of its life history and taxonomy have been conducted there (Wilson 1938, Van Emden 1949, Van Dinther 1951, Delucchi 1953, Pschorn-Walcher and Zwölfer 1956, Varty 1956, Wylie 1958). Several attempts have been made to establish *A. obliterata* to aid in control of the balsam woolly aphid in the Maritime Provinces of Canada (Brown and Clark 1959), British Columbia,[3] Northwestern,[4] and Southeastern United States, but as far as is known, the only success was in North Carolina.

MATERIALS AND METHODS.—On April 21, 1960, 1100 *A. obliterata* adults (Fig. 1) were received from the Canada Department of Agriculture. The beetles were collected in Germany by the European Station of the Commonwealth Institute of Biological Control. They were fed a 50% honey-water solution on absorbent cotton in the Bent Creek Laboratory near Asheville and released near Mt. Mitchell the following day. Part of the shipment was released in cages on heavily infested trees and the remainder was free-released on trees in the same stand. The observations reported here are for free populations on the lower boles of the trees.

OBSERVATIONS AND DISCUSSION.—*A. obliterata* adults dispersed rapidly on the release trees at a temperature of 13.3°C, but flying was not observed. Shortly after release, they began feeding on 2nd- and 3rd-instar and adult *C. piceae*. Approximately 70% of the aphid population was then in the 2nd and 3rd instars and 15% in the adult stage (Amman 1962). Only an occasional aphid adult had started to oviposit.

A. obliterata has 1 generation/year (Delucchi 1953, Wylie 1958). Oviposition was observed for the 1st time on Mt. Mitchell on April 29, when 3 egg masses were found. Eggs were cemented by 1 end to the bark of the tree and perpendicular to the trunk. They were usually under overhanging bark scales and generally arranged in a row. Numerous masses were present by May 9.

Eggs were a pale yellow when first laid, turning orange as development proceeded, and finally gray as embryogenesis was almost completed (Fig. 2). They were 1.02 mm (Sd 0.14) long by 0.51 mm (Sd 0.11) wide. Groups of eggs laid on Fraser fir varied in number from 1 to 6 and 22 groups averaged 2.7 (Sd 1.29) eggs. Wylie (1958) found as many as 10 in a group, and that each adult is capable of laying more than 290 eggs. Eggs present in the field on May 13 underwent a temperature of minus 2.2°C, and although they were in various stages of embryogenesis, no adverse effect was noted.

Larvae were present by May 20 and eggs could still be found until May 31. The larvae are a brownish-gray and blend in well against the bark. By June 7, all larval instars were present. Many pupae were found June 21, usually under bark scales and in bark depressions. Some small larvae and old adults were still present at that time.

Several pupae were found on the soil at the base of 1 tree, apparently washed from the tree by rain. On July 1, only new adults and a few pupae were found; by the last of July, all stages had disappeared. Pupae

[1] Accepted for publication October 14, 1965.

[2] R. C. Heller, R. C. Aldrich, and F. P. Weber. Aerial survey research—Eastern United States. U. S. Forest Serv., Beltsville Forest Insect Lab., Beltsville, Md., Interim Rep. May 1–July 31, 1964. (Unpublished.)

[3] J. W. E. Harris, D. H. Ruppel, S. J. Allen, and D. G. Collis. The balsam woolly aphid, *Adelges piceae* (Ratz.), in British Columbia, 1964. Can. Dep. Forestry, Forest Entomol. Pathol. Lab., Victoria, B. C., 5 p. 1964. (Unpublished.)

[4] P. E. Buffam and R. G. Mitchell. Foreign predator introductions for control of the balsam woolly aphid in the Pacific Northwest 1957–1960. Pacific Northwest Forest and Range Exp. Sta. Progr. Rep., 15 p. 1960. (Unpublished.)

and adults were found in 1962, 1963, and 1964 from the middle to the last of June.

Little is known of the ecology of the adult. In France, they leave the trees after copulation and do not return until spring (Wylie 1958). Wilson (1938) and Varty (1956) observed *A. obliterata* adults on *Chermes*-infested conifers in the fall in Great Britain, and adults were found overwintering under bark scales of spruce and maple in the Alps (Pschorn-Walcher 1964).

In 1961, the lower boles of trees at the release site were examined for *A. obliterata,* but none was found. In 1962, several trees were cut so that the crowns fell on cotton cloth; the foliage was struck with a stick to dislodge insects onto the cloth. Several larvae were recovered and reared to the adult stage in the laboratory. They were identified as *A. obliterata.* Using the same method, the beetle was recovered in 1963 and 1964. *A. obliterata* was always encountered on the upper bole and branches of Fraser fir in the year following its release, a characteristic of its habit of preying on twig-infesting *Chermes* in Europe (Wylie 1958).

Brown and Clark (1959) stated that winter temperatures were probably a limiting factor in attempts to establish *A. obliterata* in Canada, although Pschorn-Walcher (1964) reported that it has a wide ecological range in Europe and was found overwintering in the high Bavarian mountains. Temperatures of −18°C are common in the Mt. Mitchell area during December, January, and February, although usually of short duration. Frequently such temperatures occur with little or no snow cover. For example, in December 1962 the temperature was −30°C with less than 8 in. of snow cover, and in January 1963 the temperature fell to −26.7°C with only a trace of snowfall. Because *A. obliterata* overwinters under bark scales of various trees (Pschorn-Walcher 1964), it is frequently unprotected by snow when extreme cold temperatures occur in the Mt. Mitchell area. Occasionally, considerable snow protection is afforded, such as the 96-in. accumulation in February 1964. The mean monthly temperature of −6°C on Mt. Mitchell for January 1961 was only 1°C colder than temperatures reported for central Europe where *A. obliterata* was found (Pschorn-Walcher and Zwölfer 1960). However, annual precipitation was considerably higher, varying from 49 to 80 in. on Mt. Mitchell, compared with the 28 to 47 in. reported for Central Europe.

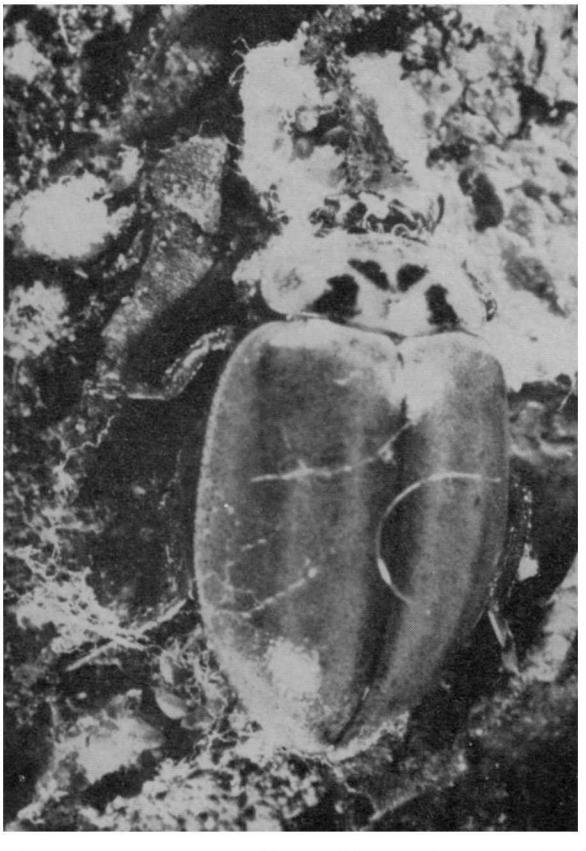

FIG. 1.—The adult *Aphidecta obliterata* is 4.5 mm long and brownish yellow.

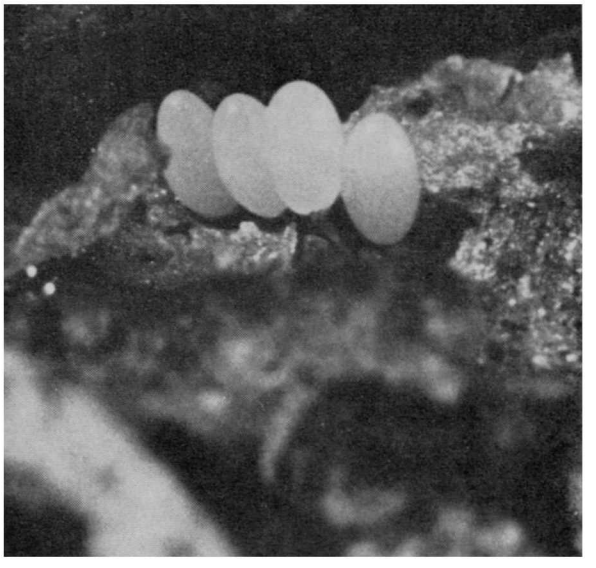

FIG. 2.—*A. obliterata* eggs on bark of Fraser fir.

A shipment of *A. obliterata* was received in 1963, and less than 500 adults were released in a new location near Mt. Mitchell (Amman and Speers 1964). When this site was checked in 1964, *A. obliterata* adults and pupae were recovered, indicating that this insect can be established with the release of relatively small numbers of adults when conditions are favorable.

No attempts have been made to determine the effectiveness of free *A. obliterata* populations in controlling the balsam woolly aphid. However, it greatly reduced aphid populations under caged conditions in the field. In laboratory studies, Smith (1958) showed that it was capable of consuming large numbers of *C. piceae.*

After 4 years of survival, *A. obliterata* appears to be a permanent addition to the predator complex of the balsam woolly aphid in the Mt. Mitchell area of North Carolina.

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Some New Infestations of the Balsam Woolly Aphid in North Carolina, with Possible Modes of Dispersal[1]

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ABSTRACT

Three recent infestations of the balsam woolly aphid, *Chermes piceae* Ratzeburg, were examined to determine approximately when they began and by what means the aphid may have reached the infested areas. Infestations were dated by the numbers of trees involved and by sectioning recently killed trees and examining them for red wood caused by aphid feeding. The aphid reached Mt. Sterling in the Great Smoky Mountains National Park prior to 1958, Roan Mountain in 1958, and Grandfather Mountain in 1959. Of the possible dispersion agents, it is concluded that wind is the most likely.

The balsam woolly aphid, *Chermes piceae* Ratzeburg (Homoptera: Chermidae), was introduced into New England and eastern Canada about 1900 (Balch 1952). Half a century later a species of *Chermes* was detected on Fraser fir, *Abies fraseri* (Pursh) Poir., near Mt. Mitchell, N. C.,[2] when 5 groups of fir varying from 10 to 200 trees each were killed from unknown causes.[3] Subsequently the destructive balsam woolly aphid was found and identified in the Mt. Mitchell area by Speers (1958). Surveys conducted in this area in 1958 showed that more than 11,000 fir trees were killed and the aphid was distributed throughout the 7500 acres of spruce-fir type (Nagel 1959). By 1963 more than 275,000 trees had succumbed to aphid attack.[4]

The first occurrence of the balsam woolly aphid in North Carolina outside the Mt. Mitchell area was reported in 1961, when it was found in a nursery between Mt. Mitchell and Grandfather Mountain. In 1962 infestations were discovered on Roan Mountain by personnel of the U. S. Forest Service, Toecane Ranger District, and on ornamentals and in a nursery near Blowing Rock. The aphid was found on Mt. Sterling in the Great Smoky Mountains National Park and on Grandfather Mountain in 1963. Other discoveries of the aphid in 1963 were on ornamentals near Spruce Pine, Little Switzerland, and Crossnore, and in a nursery near Pineola. It was also reported on ornamentals between Mt. Mitchell and Roan Mountain in 1963. It is believed that all these infestations originated in the Mt. Mitchell area, clearly the oldest center of aphid activity in North Carolina (Fig. 1).

Because the balsam woolly aphid population consists entirely of females which reproduce parthenogenetically, only 1 insect is needed to start a new infestation. Each adult is capable of laying more than 100 eggs on Fraser fir, and there are 2–3 generations/year on Mt. Mitchell (Amman 1962). Winged forms

[1] Accepted for publication November 22, 1965.

[2] J. S. Boyce, Southeast. Forest Exp. Sta., Asheville, N. C. Memorandum to N. C. Nat. Forests, Toecane Dist., Burnsville, N. C., Oct. 7, 1955.

[3] N. C. Nat. Forests, Toccane Dist., Burnsville, N. C., to Forest Supervisor, N. C. Nat. Forests, Asheville, N. C. on Aug. 22, 1955.

[4] R. C. Heller, R. C. Aldrich, and F. P. Weber, Aerial survey research—eastern United States. Beltsville Forest Insect Lab., U. S. Forest Serv., Beltsville, Md., Interim Rep. May 1–July 31, 1964. (Unpublished.)