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(Received May 14, 1959)

Studies of Predators of the Balsam Woolly Aphid, *Adelges piceae* (Ratz.) (Homoptera: Adelgidae) VI. *Aphidecta obliterata* (L.) (Coleoptera: Coccinellidae), an Introduced Predator in Eastern Canada^{1, 2}

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Aphidecta obliterata (L.) is a common predator on conifer-infesting adelgids and aphids in Western Europe, including Scandinavia and the British Isles (Wylie, 1958b). The life cycle in Europe and descriptions of the various stages have been published (Weise, 1892; Portevin, 1931; Van Emden, 1949; Van Dinther, 1951; Wylie, 1958a). Beginning in 1941 several attempts have been made to introduce this species into Eastern Canada against the balsam woolly aphid, *Adelges piceae* (Ratz.). The initial liberations from England and Germany were apparently unsuccessful due to the inability of the insect to survive the Canadian winter conditions. Later collections were made in Sweden, Czechoslovakia, and Switzerland (Table I) from areas where the winter conditions more closely resemble those in Canada. These liberations also proved unsuccessful. The present paper brings together all available information on the liberations and related experiments obtained during the liberation years.

Liberations

Adults were released in areas of heavy *A. piceae* infestations, either in cages on infested trunks or as free releases at the bases of infested trees (see Clark

¹Contribution No. 549, Forest Biology Division, Research Branch, Department of Agriculture, Ottawa, Canada.

²Joint Project of Forest Biology Laboratory, Fredericton, N.B. and Department of Lands and Mines of New Brunswick, financed in part by a grant from the Provincial Department.

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TABLE I.
A. obliterata liberations in New Brunswick and Newfoundland, 1941-1953

Locality	Origin in Europe	No. released	Year
NEW BRUNSWICK			
O'Dell Forest, Fredericton	England	1800	1941
Area 8, U.N.B. Forest, Fredericton	Germany	271	1951
Area 8, U.N.B. Forest, Fredericton	Europe*	2035	1952
Area 14, Wilsey Road, Fredericton	Switzerland	69	1955
Area 5, U.N.B. Forest, Fredericton	Sweden	222	1956
Area 18, Doak Road, Fredericton	Sweden	350	1957
3 locations, Fredericton	Sweden	601	1957
Oak Bay, Charlotte Co.	Switzerland	78	1955
Rexton, Westmorland Co.	Switzerland	67	1955
NEWFOUNDLAND			
John's Beach	Czechoslovakia	16	1957
Frenchman's Cove	Sweden	22	1958

*Germany, Switzerland, France.

and Brown, 1958 for description and photographs of cages). The majority of liberations were made in the vicinity of Fredericton at locations at least $\frac{3}{4}$ mile apart. Releases were also made in the southern part of New Brunswick and in the southwestern part of Newfoundland (Table I).

Establishment

Although this predator has been introduced into New Brunswick in six different years over the past 17 years and has been observed to complete a generation during the year of release, it has never been recovered in subsequent years. As the origin of the insects in Europe has ranged from continental areas to more maritime regions, and as they have been liberated in New Brunswick both inland and in coastal areas, it would appear that this species has been given every opportunity to become established and that it is incapable of surviving New Brunswick winter conditions. Also, no recoveries were made in Newfoundland in 1958 from the release of the previous year.

Life History and Habits

Adults have been released in the field in New Brunswick at the following times: 1941—April 26; 1951—August 8; 1952—June 19 to June 27; 1955—May 6 to May 27; 1956—June 4 to June 15; 1957—May 31 to June 6.

No recoveries were made following the 1941 release from England. In 1951, adults from Germany were held in cool storage at Belleville for slightly over one month and one-half were released at Fredericton in early August. The remainder were wintered in storage at Belleville for release in the early spring. The latter died during the winter and this is not surprising since the adults liberated in August were already sluggish and apparently unhealthy. When these were released some flew for distances up to 30 feet but most of them were observed to crawl up the trunk of the release tree to a maximum height of 10 feet. One pair was observed *in copula* for 25 minutes. One adult was seen on August 9; subsequent to this none were observed. Of 100 adults caged on August 8, 59 were still living on September 11. These were transferred to an over-wintering cage built of wire screening in the form of a cone around the base of a tree. No adults emerged from hibernation to the base of this tree in the spring of 1952.

In 1952, adults from Germany, Switzerland, and France were released between June 19 and 27. They were observed in small numbers as late as August 19 but none were subsequently seen and they were not recovered in the spring of 1953.

Wylie (1958b) states that in the Vosges Mountains of Europe there is one generation of *A. obliterated* each year and that emergence of the new adults begins in mid June. It is to be supposed that the adults released in New Brunswick in 1952 were adults that had just emerged and so would not oviposit until the following spring. This is supported by the fact that no eggs were observed in either of these years, even when the adults were caged. The adults released in 1955, 1956, and 1957 were received earlier in the summer and were probably individuals that had overwintered and were ready to oviposit.

In 1955, all 69 adults from Switzerland were released in a sleeve cage as they were received (May 6 to 27). On June 14 the cage was removed and the adults still living were allowed to disperse. Eggs were first seen on the bark under the cage on May 16 and on June 24, 56 eggs in small scattered groups were observed on the trunk. First-instar larvae were first noted on June 24 and a few were present up to July 5. After this no stages were seen on the release trees. One pupa was found on a nearby tree on July 13 from which an adult emerged in the laboratory on July 18.

In 1956, adults from Sweden were released both in the open and in cages from June 4 to 15. Adults were observed to July 3, and many small groups of eggs were noted on the release trees from June 13 to 24, with counts as high as 90 eggs being made. Larvae were first seen on June 29 although some eggs had probably hatched a few days previous to this date. Last-instar larvae were last seen on July 18, and pupae were present on July 18. Adults from these pupae were not seen and the species was not found in the release area in the following year.

Releases were made in 1957 at several locations near Fredericton and in Newfoundland. Those released near Fredericton were from Sweden; those in Newfoundland from Czechoslovakia. As in previous years adults were observed for a short time following release and eggs and a few larvae were present on one tree.

In 1958, 22 adults from Sweden were released in Newfoundland. No recoveries have been made.

It is not possible to describe a natural seasonal history for this insect in Canada. Wylie (1958b) describes the life cycle in the Vosges Mountains of Europe as beginning with adult female appearance in April, oviposition from about mid April to mid June, larval activity from late April to June, pupation beginning in early June and adults first emerging in mid June. Total developmental time was 38 to 41 days.

According to Smith (1958), *A. obliterated* adults will feed on all stages of *A. piceae* except the settled neosistens. Smith also reports that all larval instars eat eggs and adults of the prey, the third- and fourth-instar larvae being capable of consuming from 200 to 350 eggs in each instar. Prey eggs, crawlers, intermediate stages and adults were present in the field at Fredericton when released adults and their larval progeny were feeding and these stages were all eaten.

Wylie (1958b) noted cannibalism in laboratory rearings. We have observed newly-hatched larvae in the laboratory and in field cages feeding on one another as well as on unhatched eggs. We have not seen larvae feeding on other predacious larvae nor being fed upon by them, although Wylie stated that both occur under experimental conditions and in the field in Europe.

Control Value

Since the predator has not become established at Fredericton, control value is not known. An example of its potential control value has, however, been witnessed. In 1952, large numbers of adults (up to 525) were released on individual heavily-infested trees. During the week following, reduction of intermediate stages and adults of the prey *A. piceae* ranged from 52 to 92 per cent. A similar reduction did not occur on other infested trees adjacent to these and the reduction is attributed directly to predation by the adult beetles released on the trees. Apparently the adults fed actively following liberation and, after eliminating a large part of the prey population, left the release trees and scattered throughout the surrounding forest in search of additional food.

Summary

1. *Aphidecta obliterata* adults have been released at Fredericton on six occasions, and at two other locations in New Brunswick. Releases have been made in Newfoundland in two successive years.
2. When the adults were liberated early in the summer a complete generation has been observed in the field during the year of release.
3. Recoveries have not been made in any locality in the year following release, even when adults had been observed late in the previous summer, prior to hibernation.
4. The reason advanced for the lack of establishment is the inability of the adults to survive winter conditions in central New Brunswick.
5. Observations by Smith (1958) and Wylie (1958b) on feeding habits of larvae and adults have been corroborated.
6. Since the species did not become established it was impossible to obtain information on control value except for that resulting from extensive feeding by adults immediately following release in large numbers on individual heavily-infested trees.

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