

Observations on *Aphidecta obliterata* (L.) (Coleoptera: Coccinellidae), a Predator of Conifer-Infesting Aphidoidea¹

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During 1950 and 1951 the writer collaborated with officers of the Commonwealth Institute of Biological Control in studies of the predators of *Adelges* (*Dreyfusia*) *piceae* (Ratz.) and *Adelges* (*Dreyfusia*) *nüsslini* (Börner) in Europe. These studies preceded the importation of the more important predacious species into Canada and their release against *A. piceae*. Observations on one of these predators, *Aphidecta obliterata* (L.) (Coleoptera: Coccinellidae), are given in this paper.

Nomenclature

This species, first described by Linnaeus (1758, page 367) as *Coccinella obliterata*, was subsequently included in the genus *Adalia*; later Weise (1893) described the genus *Aphideita* and, in 1899, the genus *Aphidecta* for it. The last has been accepted generally and is used in this paper.

Distribution and Prey Species

A. obliterata occurs throughout western Europe, including southern Scandinavia and the British Isles. It is a predator of *Adelges piceae* (Van Dinter, 1951; Delucchi, 1953) and of *Adelges nüsslini* (Hofmann, 1938; Schneider-Orelli, 1939) on fir, *Abies alba* Mill.; of *Cinara pinicola* (Walk.) on larch (Harrison, 1913); and of *Adelges* (*Gilletteella*) *cooleyi* (Gillette) on Douglas fir, *Pseudotsuga taxifolia* (Poir.) Britton, and on Sitka spruce, *Picea sitchensis* (Bong.) Carr. (Laidlaw, 1936; Francke-Grosmann, 1950). Therefore, its prey includes mostly conifer-infesting species.

The present investigation was made in the Vosges Mountains of eastern France, where feeding on *A. nüsslini*, *A. piceae*, and *A. cooleyi* was observed. Unless otherwise stated, all observations were of specimens that had been associated with *A. nüsslini*. Details of the life-history of this adelgid in the Vosges are being published elsewhere (Wylie, in press).

Description of Stages

Detailed descriptions of the adult were published by Weise (1892), Portevin (1931), and other European authors. Among the adults collected in the present study there was a continuous gradation in color from specimens with uniformly light-brown elytra to others with elytra deep brown except for lighter areas at the base and along the costa. No specimens with uniformly dark-brown elytra were observed, though these have been noted (Weise, 1892; Nicholson, 1912). The significance and inheritance of the different color forms were not investigated.

The eggs are oval and bright yellow-orange. They are laid singly or linearly in groups of up to 10 in an upright position on the infested bark or needles. The four larval instars were described by Van Emden (1949) and Van Dinter (1951). The posterior end of the pupa is attached to the bark or needles by a sticky fluid secreted by the last-instar larva immediately before it pupates. The pupal morphology was described by Van Dinter (1951).

Annual Cycle

There is one generation of *A. obliterata* each year in the Vosges. Gravid females appear on infested trees early in April and feed on developing adelgids.

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Egg-laying begins shortly after April 15, reaches a peak early in May, and ends about June 15. Duration of the egg stage is influenced by weather conditions and averages about seven days. Larvae are present in late April, May, and June. Pupation begins early in June, and the duration of the pupal stage averages about seven days. Adults begin emerging in mid-June, mate, and in early July disperse from infested firs; thereafter, none was observed on trees infested by *Adelges nüsslini*, *Adelges piceae*, or *Adelges cooleyi* until the following spring. It is unlikely that there is a second generation on another host later in the summer; however, an egg of this species that subsequently hatched was discovered on July 4 on a fir infested by *Adelges nüsslini*, but this probably represented abnormally late oviposition by an over-wintered female. Several hundred mated females that emerged in June and July and were held in the laboratory and in field cages did not oviposit during the summer.

The behaviour of the adults after they leave infested trees in July is not known. Nicholson (1912), Murray (1931), and Buck (1955) collected specimens in autumn from a variety of conifers in Britain. The adults may hibernate gregariously, for Murray (1931) observed large numbers on Scots pine, *Pinus sylvestris* L., in Scotland in autumn.

Durations of Immature Stages

The duration of each immature stage was determined by isolating freshly laid eggs individually in two-inch vials. An abundant supply of adelgid-infested twigs was supplied in each vial during larval development. Tests were made in a room where the temperature ranged from 15°C. to 19°C. Fifteen progeny of one beetle were studied simultaneously.

Minimum and maximum durations, in days, of each immature stage were: egg, seven and eight; first-instar larva, four and five; second-instar larva, three and four; third-instar larva, three and four; fourth-instar larva and prepupa, nine and 12; pupa, 10 and 12. Total developmental time for the 15 specimens ranged from 38 to 41 days.

The effect of temperature on the durations of the immature stages is evident when the present results are compared with those of Van Dinter (1951) and Delucchi (1953), who reared specimens at constant temperatures of 20°C. or higher. The present results would probably be modified in nature by wider temperature fluctuations and, in some cases, by low host population densities that would increase the time spent by the beetle larvae searching for food.

Fecundity

Ten *A. obliterata* females, collected from April 6 to 9 before there was any oviposition by the species in nature, were isolated individually in screened vials at 15°C. to 19°C. and 65 per cent to 85 per cent relative humidity. Each was provided continuously with infested bark, and eggs were removed frequently to limit cannibalism. The number of eggs laid per female ranged from 153 to 293 and the oviposition periods from 40 to 53 days. The daily oviposition rate of each adult increased until early May, then decreased; the peaks coincided approximately with the maximum number of unhatched adelgid eggs, and oviposition ceased when this food supply was nearly exhausted. To determine whether the duration of the oviposition period was correlated with food intake by the female, four of the beetles that had stopped laying late in May were confined singly after June 6 with adults and eggs of *Adelges cooleyi*, which were then numerous on needles of Douglas fir; the other six beetles were, as before, supplied with bark infested with *Adelges nüsslini*, which then was mostly in the non-edible, neosistens stage. None of these six females laid any eggs, whereas those that fed on *Adelges cooleyi* laid 15 to 49 eggs each. The food

eaten by the female apparently influenced the number of eggs laid. A similar result with *Chilocorus bipustulatus* (L.) was recorded by Hecht (1936). The maximum number of eggs laid by a female in the present test was 342, (293 while the adult was feeding on *Adelges nüsslini* and 49 while on *Adelges cooleyi*). This total contrasts with the maximum of 98 recorded in laboratory studies by Van Dinter (1951). Natural reproductive capacity is probably less than that observed experimentally, where time loss by females searching for food was negligible.

Repeated copulation during the oviposition period was reported by Palmer (1914) and Putman (1955) as essential to maintain egg-laying by *Adalia frigida* (Schönh.) (= *melanopleura* Lec.) and *Stethorus punctillum* Weise, respectively. With *A. obliterata* there is, apparently, no interim copulation, as only females were found in nature during the egg-laying period.

Adult Longevity

The females mate soon after emerging, in June and July, and do not oviposit until the following spring. Longevity after egg-laying was determined for the 10 females studied in the previous experiment: they were held in a field cage throughout the summer and fed adults and eggs of *Adelges cooleyi* and *Adelges piceae* when available, water, and a 10 per cent sugar solution. Eight adults died during July and August, and two were alive when the experiment ended on September 13. Overwintered adults were observed in decreasing numbers until mid-July on trees infested with *Adelges nüsslini*. It is unlikely that any females overwinter a second time.

Male longevity was not investigated; however, no males were found in April or May, and as freshly emerged specimens mate in June and July and as copulation during oviposition is not required for egg production, it is probable that none overwinter.

Feeding Habits

Sessile neosistens of *Adelges nüsslini* are not attacked. Adults, eggs, and second- and third-instar sistentes are eaten by the adult beetles and by all larval instars; and first-instar "crawlers", progredientes, and sexuparae by the large larvae, especially those of the fourth instar. First- and second-instar larvae of *A. obliterata* pierce the egg chorion with their mandibles and draw out the contents, leaving the empty shell on the bark; third and fourth instars ingest the whole egg. "Crawlers" are completely consumed, whereas adults and developing larvae are pierced and sucked, the empty skin remaining on the bark.

Cannibalism was observed in laboratory rearings: eggs were attacked occasionally by freshly hatched larvae and, less often, by female beetles; and mature, inactive larvae were occasionally eaten by third or early-fourth instars. Egg destruction in nature is probably negligible as those in each egg mass usually hatch almost simultaneously, and larvae do not feed for at least an hour after they have hatched; in addition, most of the eggs are laid on the needles, and searching for food by larvae is limited largely to the bark.

Habitat Preference

Habitat selection by *A. obliterata* and other insect predators was discussed in a previous paper (Wylie, in press). The apparent preference of *A. obliterata* for a twig rather than a stem habitat indicates its adaptation as a predator of *Adelges nüsslini* rather than of *Adelges piceae*, though it was found occasionally in pure stem infestations of the latter adelgid.

Relation to Other Adelgid Predators

A. obliterata was one of several insect predators of *Adelges nüsslini* found in this study. On infested twigs, where *A. obliterata* was most abundant, larvae of *Leucopis griseola* (Fall.) (Diptera: Chamaemyiidae) were also numerous; and on infested stems larvae of *Pullus impexus* (Muls.) (Coleoptera: Coccinellidae), *Laricobius erichsonii* Rosenh. (Coleoptera: Derodontidae), and *Neoleucopis obscura* (Hal.) (Diptera: Chamaemyiidae) were occasionally abundant. Experimentally, larvae of each of these species were occasionally attacked by those of *A. obliterata*; however, little evidence of this in nature was observed. *Anatis ocellata* (L.) and *Exochomus quadripustulatus* (L.) (Coleoptera: Coccinellidae) occasionally destroyed the larvae and pupae, respectively, of *A. obliterata*; however, because of their scarcity on most adelgid-infested trees, neither of these greatly influenced populations of *A. obliterata*.

Parasites

Two parasites of *A. obliterata* were reared: a phorid, *Phalacrotophora berolinensis* Schmitz, and a mermithid of the genus *Hexameris*.

P. berolinensis was recorded in England by Colyer (1952) and in Switzerland by Delucchi (1953) as a gregarious internal pupal parasite of *A. obliterata*. The phorid eggs are laid externally on the ventral surface beneath the host wing pads. They hatch within 24 hours, and the larvae enter the host near the site of eclosion, molt twice, emerge ventrally between the head and thorax, drop to the ground, and pupate, usually within an inch of the surface. Delucchi (1953) reported that the total larval period averaged three weeks; however, in the present study mature phorid larvae emerged five days after they had hatched. An equally short larval period was recorded by Colyer (1952). The phorid adults emerge in July and August. Over half of the beetle pupae collected were parasitized by this species. Usually, two or three phorid larvae matured in each host, though as many as seven emerged occasionally. Sucking by the phorid adults of *A. obliterata* pupae, reported by Colyer (1952), was also observed though its significance was not investigated.

Hexameris sp. emerged from fourth-instar larvae of *A. obliterata* and entered the soil. Apparently only this instar was attacked, as no mermithids were obtained from younger field-collected larvae. Approximately 10 per cent of the fourth-instar larvae were parasitized. Though one beetle larva dissected contained two small mermithids, only one worm per host emerged in all rearings.

Summary

Aphidecta obliterata (L.), a predator of *Adelges nüsslini* (Börner), has one generation each year in eastern France. The gravid female lays up to about 300 eggs on the bark and needles of infested trees, and the larvae hatch in about seven days and feed on all stages of *A. nüsslini* except the sessile neosistens. Pupae form on the bark and needles and adults emerge in about a week, i.e., usually late in June. The adults soon mate and disperse from the infested trees and do not return until the following spring. The population density of *A. obliterata* was not appreciably affected by other predators with which it was associated, but over half of the pupae were parasitized by the phorid *Phalacrotophora berolinensis* Schmitz and a smaller proportion by a mermithid of the genus *Hexameris*.

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Additions to Official List of Common Names of Insects

Of the 56 common names proposed in No. 4 of Vol. 3 of the *Bulletin of the Entomological Society of America* as additions to the official list of common names of insects of the Entomological Society of America the following ten were submitted by the Committee on Common Names of Insects of the Entomological Society of Canada:

- Apion longirostre* Olivier, hollyhock weevil;
Galerucella decora (Say), gray willow leaf beetle;
Saperda bipunctata R. Hopping, Saskatoon borer;
Eumerus strigatus (Fallen), onion bulb fly;
Pleuroneura borealis Felt, balsam shoot-boring sawfly;
Anisota virginiana (Drury), pink-striped oakworm;
Archips feroxidana (Clemens), oak webworm;
Endrosis sarcitrella (Linnaeus), white-shouldered house moth;
Hofmannophila pseudospretella (Stainton), brown house moth;
Lampronia rubiella (Bjerkand), raspberry bud moth.