AGGREGATION SITES AND BEHAVIOR OF TWO SPECIES OF *HIPPODAMIA* (COLEOPTERA: COCCINELLIDAE) IN SOUTH-CENTRAL BRITISH COLUMBIA

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ABSTRACT

Hippodamia caseyi Johnson and **H. oregonensis** Crotch overwinter in aggregation sites on mountain tops in south-central British Columbia. Each species selects distinctive overwintering sites. During the summer, **H. caseyi** is distributed mainly in the valleys and lower mountain elevations, particularly in irrigated alfalfa fields. **H. oregonensis** is restricted to subalpine and alpine areas during the summer. Availability of suitable overwintering sites may be a limiting factor in the abundance of **H. caseyi.**

INTRODUCTION

Many species of Coccinellidae are recognized as important and valuable predators of insect and mite pests throughout the world. However, in the Okanagan region of British Columbia this group of insects has received only passing attention from economic entomologists.

Successful pest control through the pest management concept depends largely upon manipulation of crop ecosystems, making maximum use of natural enemies of pests. To this end, it is essential to attain a more complete knowledge of the life histories and factors affecting the abundance and efficiency of beneficial species. The object of this investigation was to study the life histories and habits of two species of *Hippodamia* that form hibernation aggregations on mountain tops in south-central British Columbia.

METHODS

From the last week of May through October 1970, various agricultural crops, native plants and mountain top aggregation sites were examined periodically for the presence of coccinellids. The sweep net and beating tray methods were used to sample vegetation for beetles. Intensive sampling from the valley to the tops of the mountains was done during periods of dispersal and assembly of the beetles at the aggregation sites.

The area examined was the Okanagan Valley from Osoyoos north to Summerland including the highest mountains immediately to the east and west. The elevation of the valley in this area varies from 278 m in the south to 343 m in the north. The elevation of the highest mountain in the area is 2303 m. Annual precipitation at Osoyoos and Summerland averages approximately 20 and 27 cm respectively. At higher elevations the annual precipitation is much greater and occurs mostly as snow. The climax vegetation of the valley is yellow pine, sage brush and antelope brush. However, much of the valley bottom has been modified by irrigated farming. The major crops are pome fruits, stone fruits, grapes, corn, alfalfa and vegetables. With increasing elevation, east and west, the climax vegetation changes to Dry Forest with yellow pine, Douglas fir and western larch; to Subalpine Forest with lodgepole pine, aspen, Englemann spruce and alpine fir; to Alpine Arctic at the highest elevations with dwarf willows, saxifrages and false heathers.

OBSERVATIONS AND DISCUSSION

Aggregation Sites. Overwintering aggregation sites of *Hippodamia caseyi* Johnson were identified on five mountains: Baldy Mountain (2303 m), Mount Kobau (1975 m), Beaconsfield Mountain (2196 m), Apex Mountain (2248 m) and Sheep Rock (2200 m). Overwintering aggregations of *Hippodamia oregonensis* Crotch were also found on all of these mountains except Mount Kobau. *H. caseyi* was the most abundant species on each of the mountains except on Sheep Rock.

The aggregation sites of the two species differed both in physical features and location. Typically, the sites occupied by *H. caseyi* were located on the south facing upper-most slopes of the mountains, among fractured boulders covered with lichens. The beetles clustered in crevices between the rocks. The crevices were, in almost all cases, free of soil and vegetation.

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Rocks lying on, or partially buried in soil, but with cavities under them were never found to shelter beetles. The aggregation sites become free of snow earlier in the spring than most other parts of the mountain tops because of their southerly exposure and the combined effects of topography and wind which result in shallow snow packs.

H. oregonensis aggregation sites were located in all quadrants on the upper-most slopes of the mountains. Typical sites were beneath rock slabs lying on, or partially buried in soil but with crevices beneath them and with grasses and sedges growing immediately around them. The aggregation sites were always in areas where exposure to winds result in relatively shallow snow packs.

In most instances both species were present in any one aggregation, but the minority species usually represented less than one percent of the total. Only the two above-mentioned species were found in aggregations on the mountain tops.

Observations of the aggregation sites in early June, when large snowfields were still present and in mid-October when the first permanent snow had fallen, indicated that both species remain in the aggregation sites through the winter. In western Washington, Edwards (1957) described large swarms of *H. oregonensis* near the summits of Pinnacle Peak in June, 1952, and on Yakima Peak in September, 1952. He also noted large numbers of dead beetles beneath slabs of rock. He assumed that these had been trapped and killed by cold weather and that the beetles normally returned to lower elevations to hibernate. Chapman (1954) and Chapman *et al.* (1955) reported large aggregations of ladybird beetles, including *H. caseyi* and *H. oregonensis* near the summits of several mountains in western Montana. Indirect evidence was noted that the beetles remained at these aggregation sites through the winter.

Dispersal from Aggregation Sites. Dispersal of beetles of both species from the aggregation sites began in early June when there were still extensive snow fields on the upper mountain slopes but the aggregation sites were free from snow. The vigor and rapidity of dispersal of the two species differed. Adult *H. caseyi* flew strongly in a downhill direction at low elevations above the ground. Within a week of the first flights a few *H. caseyi* were collected in the valley. However, samples taken from the valley to the mountain tops indicated that the rate of dispersal of the main body of beetles from the aggregation sites was slow. Dispersal of *H. caseyi* from Mount Kobau, the lowest peak, was complete by mid-June and from Baldy Mountain, the highest peak, by the end of June. On Baldy Mountain, however, a few aggregations of from about 50 to 500 beetles remained *in situ* through the summer. During July and August, *H. caseyi* adults and immature stages were found at all elevations from the valley to the upper slopes of the mountain but with the greatest population densities occurring at or near the valley bottom, particularly in alfalfa fields.

Dispersal activity by *H. oregonensis* began at the same time as *H. caseyi* but the rate of dispersal was slower. Flights by beetles leaving the mountain top were random in direction and of short duration which resulted in a gradual spread downward from the upper slopes. For a few weeks after dispersal began, adults of *H. oregonensis* were most commonly found feeding on the pollen of wild flowers, particularly *Ranunculus* spp., from near the tops of the mountains down to about 1800 m. Reproduction occurred on a number of species of shrubs and herbs through July and August. *H. oregonensis* apparently is a subalpine to alpine species because it was not found at elevations lower than 1700 m.

Formation of Aggregations. The movement of beetles to the mountain top aggregation sites was gradual, beginning in early September and ending by mid-October when the first permanent snow occurred. During early September, adults of *H. caseyi* were most commoly observed feeding on aphids on plants between the elevations of 400 m to 900 m but rarely at higher elevations. Through September to mid-October, numbers at the lower elevations decreased to nil while the numbers seeking shelter in aggregation sites on the tops of the mountains gradually increased.

No attempt was made, during this study, to estimate absolute numbers of each species in the aggregation sites. This was partly due to the physical impossibility of moving sufficient rock and partly because of the fear of disturbing too much of the aggregation sites and thus destroying their attractiveness for the beetles. On the five mountain tops, *H. caseyi* was on the average about one thousand times more abundant than *H. oregonensis*. *H. caseyi* was more abundant on Baldy Mountain than any of the others. On this mountain top a very rough estimate of the volume of beetles present in the third week of June was 5000 cm^3.

It is apprent from this investigation that *H. oregonensis* is of no value as a predator of aphids on cultivated crops because of its restricted distribution. It may be important in the natural control of aphids on subalpine and alpine ranges. *H. caseyi* may be of value, however, as a predator of aphids on cultivated crops, particularly alfalfa.

This investigation also suggests that the availability of suitable aggregation sites may be a limiting factor in the natural abundance of *H. caseyi*. The number of mountains of sufficient altitude and with features suitable for aggregation sites for *H. caseyi* are limited and the area comprising the five mountain top aggregation sites is very small compared with the total of the whole study area. It is hoped that this report will stimulate further investigation into the feasibility of manipulating *H. caseyi* populations to benefit aphid control on agricultural crops in south-central British Columbia.

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INNERVATION OF THE STYLETS OF THE PEAR PSYLLA, *PSYLLA PYRICOLA* (HOMOPTERA: PSYLLIDAE), AND THE GREENHOUSE WHITEFLY, *TRIALEURODES VAPORARIORUM* (HOMOPTERA: ALEYRODIDAE)[1]

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ABSTRACT

The fine structure of the stylets of the pear psylla, **Psylla pyricola** Foerster, and the greenhouse whitefly, **Trialeurodes vaporariorum** (Westwood), is described from sections studied in the electron microscope. Their mandibular stylets are innervated, each containing two dendrites.

INTRODUCTION

The discovery of nerves in the stylets of aphids (Forbes, 1966, 1969; Parrish, 1967; Saxena and Chada, 1971), an adelgid (Forbes and Mullick, 1970), a leafhopper (Forbes and Raine, in press), and in *Rhodnius* (Pinet, 1963, 1968) suggested that the stylets of all the Hemiptera-Homoptera may be innervated. The present paper demonstrates nerves in the stylets of a representative of each of the Psylloidea and Aleyrodoidea, two superfamilies of the Homoptera in which innervation of the stylets has not previously been shown.

The pear psylla, *Psylla pyricola* Foerster, and the greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood), are the subjects of the present report.

MATERIALS AND METHODS

Adult pear psylla were from pear and adult greenhouse whiteflies were from fuschia. The heads were dissected from the insects, fixed in 5% glutaraldehyde, post-fixed in 1% osmium tetroxide, and dehydrated in a graded series of ethanol. The pear psylla heads were embedded in Spurr Low-Viscosity Embedding Medium (Polysciences, Inc., Warrington, Penna.). The whitefly heads were embedded in Epon 812 by the method of Luft (1961). Sections were cut with glass knives on an LKB Ultrotome III, mounted on grids with carbon-colloidion supporting films, and subsequently stained

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