Seasonal occurrence and parasitism of *Bucculatrix ainsliella* (Lepidoptera: Lyonetiidae) on *Quercus rubra* in Burnaby, British Columbia

E. GELOK[1], R. MCGREGOR, D. HENDERSON

E.S. CROPCONSULT LTD., 3041 33RD AVE WEST, VANCOUVER, BC V6N 2G6

and L. POIRIER

DEPARTMENT OF FOREST SCIENCES, FACULTY OF FORESTRY, UNIVERSITY OF BRITISH COLUMBIA, 3041 - 2424 MAIN MALL, VANCOUVER, BC V6T 1Z4

ABSTRACT

The seasonal occurrence of life-history stages of *Bucculatrix ainsliella* Murtfeldt (Lepidoptera: Lyonetiidae), and the level of attack by parasitoids on larvae and pupae, were determined for a population occurring on red oak trees (*Quercus rubra* L.) in an urban area of Burnaby, BC. *B. ainsliella* completed two generations in Burnaby in 1997, and a substantial increase in population density occurred between the first and second generations. Pupal parasitism reached high levels (>40% parasitism) during the first generation in this population, but larval parasitism occurred at a very low level. Dispersal of large numbers of second-generation larvae on silken threads, and subsequent pupation on parked vehicles on residential streets, cause much of the pest impact of this "nuisance" insect. Attack by pupal parasitoids in the first generation probably reduces the pest impact of these second-generation larvae.

Key words: *Bucculatrix ainsliella*, British Columbia, life history, Lyonetiidae, oak skeletonizer, parasitoids, pest management, red oak, *Quercus rubra*

INTRODUCTION

The oak skeletonizer, *Bucculatrix ainsliella* Murtfeldt (Lepidoptera: Lyonetiidae), is a common pest of oak and chestnut trees in urban areas of eastern North America (Murtfeldt 1905; Gibbons and Butcher 1961; Johnson and Lyon 1991; Dreistadt 1994). This urban tree pest was first recorded in the Vancouver area in 1980, presumably after an accidental introduction (R. Duncan, PFC, Canadian Forest Service, personal communication; Morris and Wood 1980). At present, there is no information available regarding the life history or parasitism of *B. ainsliella* in southwestern British Columbia. Here, we report the results of a sampling program for *B. ainsliella* conducted during the summer of 1997 in an area of infested red oak trees (*Quercus rubra* L.) in Burnaby, BC.

Like many Microlepidoptera, *B. ainsliella* undergo a change of feeding habit during larval development (Gaston *et al.* 1991). During early larval development, *Bucculatrix* spp. feed as leafminers within the leaf tissue of the host. Later in development, the larvae emerge from the leafmines and feed externally on leaves (Hering 1951). It is during this second larval stage that physical damage to urban shade trees can occur, although heavy

[1] Current address: Department of Forest Sciences, Faculty of Forestry, University of British Columbia, 3041 - 2424 Main Mall, Vancouver, BC V6T 1Z4

defoliation is rare (Johnson and Lyon 1991, Dreistadt 1994). After emerging from the leafmine, externally-feeding larvae undergo two molts that occur in silken "tents" spun on the undersurface of the leaf (Gibbons and Butcher 1961). Final-instar larvae pupate in characteristically ribbed cocoons that are spun of silk and usually occur on leaves during summer generations (Murtfeldt 1905; Gibbons and Butcher 1961; Johnson and Lyon 1991; Dreistadt 1994). Larvae of the final generation of the year spin off trees on silken threads ("ballooning" behaviour), build cocoons, and pupate on virtually any sheltered substrate they encounter, where they overwinter in the pupal stage. Larval ballooning behaviour from heavily infested trees, and subsequent pupation in crevices on parked cars, are the causes of most complaints from residents that live near infested oak trees along city streets.

For the past several years, a population of *B. ainsliella* has infested a group of red oaks planted as shade trees in a residential area of Burnaby. The infestation has resulted in frequent complaints by residents, particularily in years of high population density. This paper reports the results of a sampling program conducted in the summer of 1997 in which we recorded the seasonal occurrence of life-history stages, and parasitism of larvae and pupae, in this Burnaby population of *B. ainsliella*.

MATERIALS AND METHODS

Study site. The study site was located along six blocks of Ingleton Ave. and five blocks of Cambridge St. near the intersection of these two streets in North Burnaby, BC. Approximately 100 red oak trees are planted along the two streets as shade trees. The trees are between 15 and 20 years old and range between 3 and 12m in height. The site was divided into five sampling sections containing approximately 20 trees each.

Leaf sampling. One tree was randomly selected from each of the five sections, without replacement, on each sampling week for removal of a leaf sample. Leaf samples were taken weekly over a 19 week period from 23 May [Week 1] to 25 September, 1997 [Week 19] except for 18 September [Week 18] when no sample was taken. For each sample, the terminal ends of 20 branches, each with four to five leaves attached, were removed from the lower half of the crown with pole pruners. Branches were bagged separately, labelled, and returned to the laboratory. The leaves were examined under a dissecting microscope and the number of *B. ainsliella* eggs, early-stage larvae [leafminers], late-stage larvae [external feeders] and pupae were counted and recorded for each branch.

Larval and pupal parasitism. Leafmines and molting tents were dissected to determine whether larval ectoparasites were present, and the number of parasitized larvae per branch sample was recorded. Percent larval parasitism was calculated for each branch by dividing the number of parasitized larvae by the total number of larvae and pupae on the branch and multiplying by 100. Pupae from the same generation are included in the estimate of parasitism since they are individuals that escaped larval parasitism and progressed to the next life-history stage. All pupae collected from each sample tree in sampling weeks 6 through 13 were held at ambient temperature in the laboratory and the number of emerging adult *B. ainsliella*, the number of emerging adult parasitoids, and the number of dead pupae were recorded. Percent pupal parasitism per sample tree was calculated by dividing the number of pupae from which parasitoids emerged by the total number of pupae per tree and multiplying by 100. Adult parasitoids reared from pupae were identified to family or superfamily.

Data analysis. Means and standard errors of the numbers of *B. ainsliella* eggs, early larvae, late larvae and pupae, and percent larval parasitism per branch were calculated across all branches taken in all sections of the site on each sample date (n=100 for branches per sample date). Means and standard errors of percent pupal parasitism were calculated per sample tree for weeks 6 through 13 (n=5 for sample trees per sample date). Statistics were calculated using Systat (Wilkinson *et al.* 1992).

RESULTS

Bucculatrix ainsliella completes two generations per year in Burnaby. The phenology of eggs, early larvae, late larvae and pupae through the season is given in Figure 1. A substantial increase in population size occurs in the second generation of the year. Larval parasitism by unidentified hymenopterous ectoparasitoids occurred at a low level (Figure 2). The highest level of larval parasitism by ectoparasitoids was recorded during the first generation in week 11 when mean larval parasitism per branch was 9.4%. Pupal parasitism of first-generation *B. ainsliella* occurred at a much higher level than larval parasitism (Figure 3). The highest level of pupal parasitism during the first generation was recorded in week 10 when mean pupal parasitism per sample tree was 44.4%. Adult parasitoids reared from *B. ainsliella* pupae were either from the family Ichnuemonidae or the superfamily Chalcidoidea (Goulet and Huber 1993). The Ichnuemonidae made up 63% of the recovered parasitoids and the Chalcidoidea made up the remaining 37%.

DISCUSSSION

The increased size of the *B. ainsliella* population in the second generation is responsible for much of the pest impact of this insect. In late summer, ballooning behaviour by large numbers of larvae, and subsequent pupation on parked vehicles, is more disturbing to residents than any damage sustained by the trees. The results of this study show that substantial mortality occurs in the first generation due to pupal parasitism. This indicates the potential for the Burnaby population to be reduced by natural parasitism to a level tolerable to residents. However, second generation populations in 1997 still increased substantially after mortality by pupal parasitoids. Parasitism by larval ectoparasitoids, in contrast, does not cause substantial mortality. No attempt was made, in this study, to quantify larval endoparasitism, although endoparasitoids may have made an additional contribution to larval mortality. Mass-rearing of either larval or pupal parasitoids of *B. ainsliella* for inundative releases is probably impractical because of the expense of raising the plant [oak trees] and host material required for rearing. However, it may be possible to manipulate natural parasitoid populations in order to increase the level of control, for example by using semiochemicals.

Because the population level of late-stage larvae in the second generation is so high, one possible management approach would be to release generalist predators in an attempt to reduce the population before ballooning behaviour commences. On several occasions during the second generation, larvae of green lacewings (Chrysopidae) were observed on leaves in association with late-stage larvae, and on one occasion a lacewing larva was observed feeding on a *B. ainsliella* larva. Because green lacewings are available from commercial insectaries, it is possible that inundative releases of lacewings could reduce the population of second-generation larvae. Spray applications of insecticidal soap or microbial insecticides like *Bacillus thuriengensis* might also be effective in reducing the second-generation larval population. Because early-stage leafmining larvae are sheltered within the leaf tissue, any releases of biological controls like lacewings, or spray applications of soap or *B. thuriengensis*, should be timed to target externally-feeding late-stage larvae.

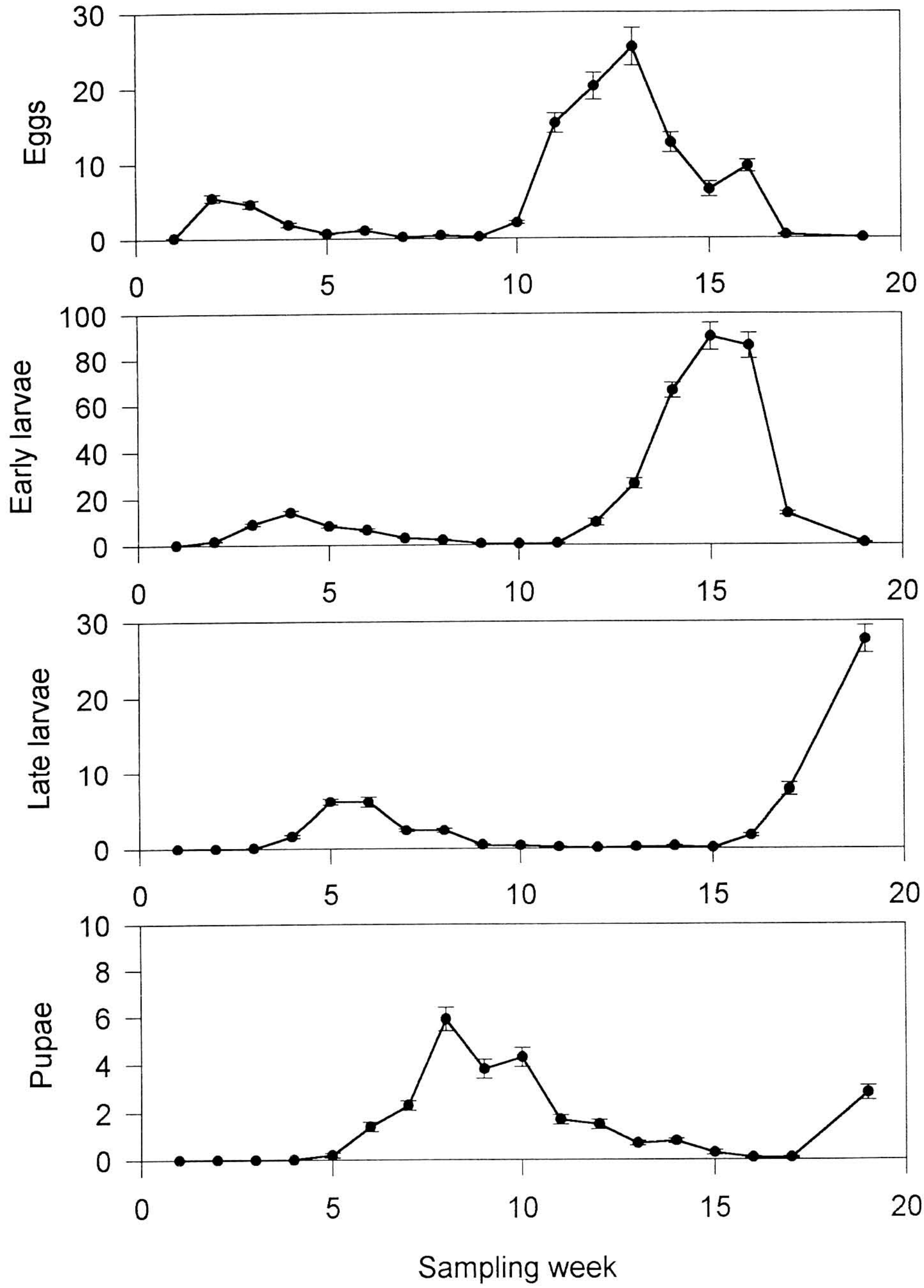

Figure 1. Seasonal abundance of *B. ainsliella* eggs, early larvae, late larvae and pupae in consecutive sampling weeks in North Burnaby in 1997. Closed circles and error bars show means per branch sample ± SE.

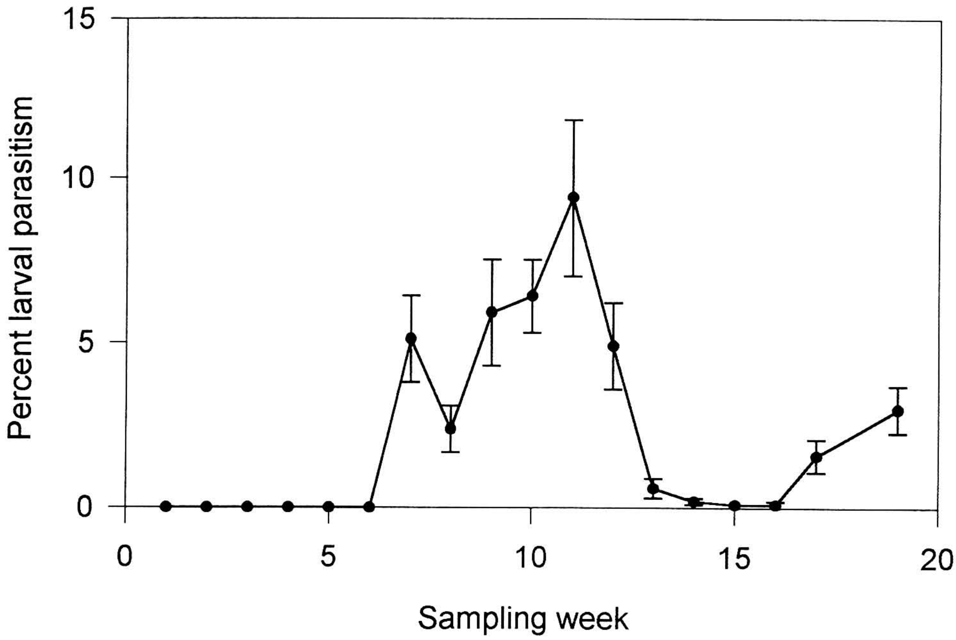

Figure 2. Percent parasitism of *B. ainsliella* by larval ectoparasitoids in consecutive sample weeks in North Burnaby in 1997. Closed circles and error bars show means per branch sample ± SE.

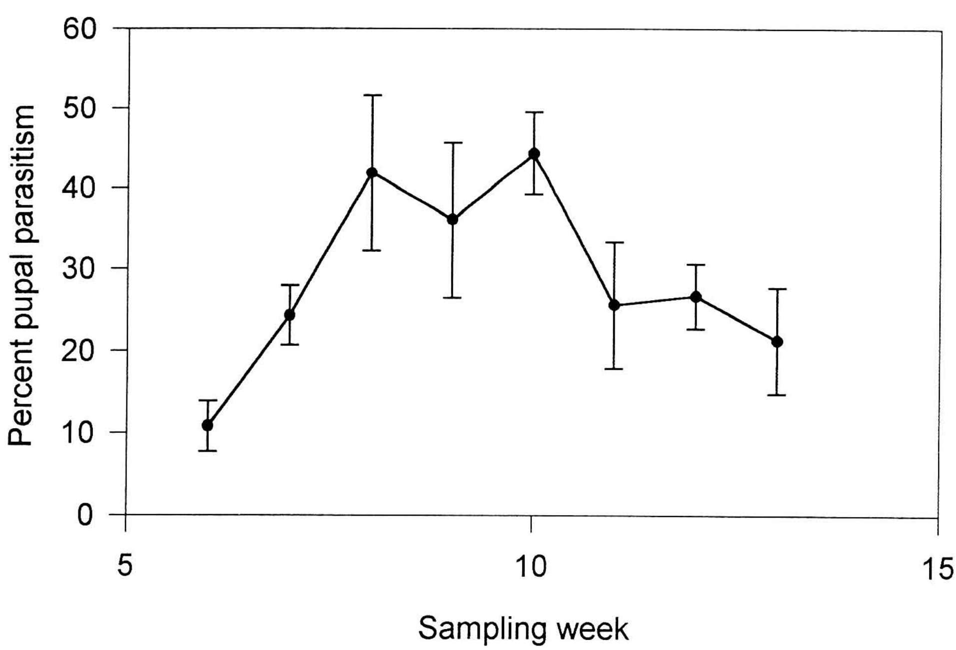

Figure 3. Percent pupal parasitism of *B. ainsliella* in consecutive sample weeks in North Burnaby in 1997. Closed circles and error bars show means per sample tree ± SE.

The pest status of this insect depends directly on the location and density of a given population. When a high density population of *B. ainsliella* occurs in an urban area, this insect can create a nuisance for residents. This study has shown that natural parasitism of *B. ainsliella* pupae may contribute to reducing the impact of this pest. Further assessment of the role of parasitoids in regulating *B. ainsliella* populations would require longer-term monitoring of the host and parasitioid populations.

ACKNOWLEDGEMENTS

Many thanks to Brent Robertson of the Forestry Department at the City of Burnaby for getting us involved in this project, and to the City of Burnaby, the Science Council of British Columbia, and the BC Summerworks Program for providing financial support.

REFERENCES

Dreistadt, S.H. 1994. Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide. University of California Press, Berkeley, CA.

Gaston, K.J., D. Reavey and G.R. Valladares. 1991. Changes in feeding habit as caterpillars grow. Ecological Entomology 16:339-344.

Gibbons, C.F. and J.W. Butcher. 1961. The oak skeletonizer, *Bucculatrix ainsliella*, in a Michigan woodlot. Journal of Economic Entomology 54: 681-684.

Goulet, H. and J.T. Huber. 1993. Hymenoptera of the world: An identification guide to families. Agriculture Canada, Ottawa, ON.

Hering, E.M. 1951. Biology of the Leafminers. W. Junk, 's-Gravenhage.

Johnson, W.T. and H.H. Lyon. 1991. Insects that feed on trees and shrubs. Cornell University Press.

Morris, E.V. and R.O. Wood. 1980. 1980 Forest insect and disease conditions: Vancouver forest region. Canadian Forest Service, Environment Canada.

Murtfeldt, M.E. 1905. A new species of *Bucculatrix*. The Canadian Entomologist 37: 218-219.

Wilkinson, L., M. Hill, J. P. Welna, and G. K Birkenbeuel. 1992. "SYSTAT for Windows". Version 5. SYSTAT Inc., Evanston, IL.