

In Plain Sight Discovering Insect Herbivores of Orchids

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Our long term studies of terrestrial orchids in Gatineau Park, Québec, Canada, have provided insight into the incidence and diversity of indigenous insect herbivores including the leafmining fly, *Parallelomma vittatum* Meigen (Diptera: Scathophagidae) that uses *Cypripedium parviflorum* var. *pubescens* (Willdenow) Knight, *C. reginae* Walter, and *Epipactis helleborine* (L.) Crantz (Orchidaceae) as hosts (Light and MacConaill 2011). This leafminer is holarctic in distribution: it can be found in north temperate regions of Asia, Europe, and North America (McAlpine 1987; Pitkin et al. 2011a). In Europe, including the British Isles, *P. vittatum* has been reported to infest several orchid genera including *Cypripedium*, *Epipactis*, and *Neottia* (syn. *Listera*) (Pitkin et al. 2011b). As far as we are aware, our 2011 article was the first report of *P. vittatum* using orchids as hosts in Canada.



The first available orchid host for this leafminer in our study area is the May-flowering *C. parviflorum* var. *pubescens* followed by *C. reginae* and *E. helleborine*, from mid June and mid July, respec-



Figure 1 (upper). Typical leaf mine with back lighting to show larvae on *C. parviflorum* var. *pubescens*.

Figure 2. Field view of a developing blotch mine on *C. reginae*.



Figure 3. Developing mine on leaf of *E. helleborine*.

tively. No infestations have been seen with other orchids that grow in the general vicinity including *C. acaule*, *Platanthera aquilonis* and *P. clavellata*. Despite the infestations being sparse and patchy, we can easily spot communal blotch mines while conducting field work (Figures 1–4). The white eggs, 1-2mm long, adhere tightly to the leaf under-surface, hatching within five days (Figure 5). Mature larvae have distinctive mouthparts (cephalopharangeal skeleton), and a pair of prominent respiratory openings (posterior spiracles) (Figure 6). These structures as well as

aspects of the life history such as site of oviposition and larval stage duration, help to distinguish infestations by *P. vittatum* from that of other miners that might be found infesting plants that share the orchid habitat in Gatineau Park, including *Maianthemum canadense*, *M. racemosum*, and *Polygonatum pubescens* (Smith 1989). Larvae of *P. vittatum* feed actively for about 10 days. Then they leave the mine, dropping to the ground to pupate in litter. The puparia are

Figure 4. Detail view of eggs and mine on *E. helleborine*





Figure 5 (upper left. Clutch of leafminer eggs that have recently hatched and begun feeding within a leaf of *C. reginae*.

Figure 6. Backlighting to reveal two larvae feeding within a leaf of *C. reginae*.

Figure 7. Mature larva of *P. vittatum* after clearing to show structural details including the pair of posterior spiracles that are characteristic of this insect.

Figure 8. Lateral and dorsal views of a puparium of *P. vittatum* reared from *E. helleborine*.

reddish brown with a pair of distinctive posterior spiracles similar to that seen with mature larvae (Figures 7, 8). Adult flies, (Figure 9), hatch about two weeks after pupation but since most larvae have already been parasitized by a small, as yet undescribed, host-specific wasp, *Utetes* sp. (Hymenoptera: Braconidae), (Wharton, personal communication), a wasp emerges in place of a fly (Figure 10). Attrition from parasites and other causes can be as high as 90%.

In 2007, we were able to rear an unparasitized larva to obtain an adult fly, which was identified as *P. vittatum* and deposited as a voucher specimen in the Canadian National Collection (Ottawa). In that same collection, we discovered

some specimens with labels revealing that they had been reared from *Neottia* (syn. *Listera*) *cordata* (Linnaeus) Richard by Dr. G. C. D. Griffith who had collected in the Yukon and Alaska in 1969. This information led us to examine herbarium specimens for evidence of leafminer activity in *Neottia* species including *N. cordata*. We examined specimens of six *Neottia* species in three major Canadian herbaria: the National Herbarium of Canada, Canadian Museum of Nature (CAN), Agriculture and Agri-Food Canada Vascular Plant Herbarium (DAO), and the Herbarium Marie-Victorin, Université de Montréal (MT): *N. auriculata* (Weigand) Szlachetko (syn. *L. auriculata*), *N. banksiana* (Lindley) Reichenbach (syn. *L. caurina*), *N. bifolia* (Rafinesque) Baumbach (syn. *L. australis*), *N. borealis* (Morong) Szlachetko (syn. *L. borealis*), *N. convallarioides* (Swartz) Richard (syn. *L. convallarioides*), and *N. cordata*. Eggs, mines, or larvae present in leaf mines were found with specimens of *N. auriculata* (4/33 specimens, NF, ON; Figure 11), *N. banksiana*, (7/52 specimens, BC;



Figure 9 (upper left). *Parallelomma vittatum* adult.

Figure 10 (lower left). The wasp, *Utetes* sp., is a parasite of *P. vittatum*.

Figure 11. Part of an herbarium specimen of *N. auriculata*, CAN 16759, Algoma District, ON, showing a mine with one larva.



Figure 12 (upper left). Part of a herbarium specimen of *N. banksiana*, CAN 363199, Glacier National Park, BC, showing an unhatched clutch of eggs.

Figure 13. A detailed view of the clutch of seven eggs seen in Figure 12.

Figure 14. Part of a herbarium specimen of *N. cordata*, CAN 287299, Kenora District, ON, showing two unhatched eggs on a leaf undersurface.

Figures 12, 13), *N. borealis* (3/167 specimens, AB, NWT), and *N. cordata* (12/308 specimens, BC, NF, ON, QC; Figure 14) including an infested specimen with a larva *in situ*, DAO 691482, collected by Joyce and Allan Reddoch on June 11, 1978, approximately 35 km from our study site in Gatineau Park (Reddoch and Reddoch 1997). No eggs or mines were found with specimens of *N. bifolia* (0/32), or with *N. convallarioides* (0/247) but absence of infestation should not be taken as proof that these taxa are never infested by the leaf-miner.

Can we use a variety of data sources to establish host use by an insect herbivore? Reared specimen data in the Canadian National Collection (Ottawa) led to the confirmation of *Neottia cordata* as a host of *P. vittatum* in North America while examination of *Neottia* specimens in three herbaria has revealed a further three species of *Neottia* as hosts in Canada. Funk (2004) noted that herbaria “provide insect collections that have been incidentally collected along with the plant”. Herbarium and entomological records together can provide biological and historical evidence of leafminer incidence and range. Herbaria are an emerging tool to study biogeographical patterns (Lavoie 2013). Larvae within pressed herbarium specimens are available for further examination including molecular analysis (Lees *et al.* 2011), but rarely do we see mention or even images of insects associated with living orchids except if they are flower visitors/pollinators or pests of economic importance (Light and MacConaill 2011). The leafminer that is subject of this article is heavily controlled by parasites but host use and infestation dynamics are providing us with insight to yet another aspect of orchid-related biodiversity and ultimately, conservation. Those observing wild orchids are encouraged to photograph, record, and share their discoveries of easily detected insect herbivores such as the leafminer discussed in this paper.

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