J. Acad. Entomol. Soc. 13: 28-31 (2017)

NOTE

New parasitoid records for the lowbush blueberry pest *Aroga trialbamaculella* (Lepidoptera: Gelechiidae), including new species records for Nova Scotia and the Maritime Provinces

Jillian Kelly, G. Christopher Cutler, and Neil Kirk Hillier

Lowbush blueberry (*Vaccinium angustifolium* Aiton) (Ericaceae) is a plant native to much of eastern North America that is commercially managed and harvested over large acreages. Lowbush blueberries are a significant agricultural commodity in Atlantic Canada and Maine, USA, and are marketed worldwide. The red-striped fireworm, *Aroga trialbamaculella* Chambers (Lepidoptera: Gelechiidae), can be an important pest of lowbush blueberries (Wood 1972). Larvae web together leaves of blueberry shoot tips and feed upon foliage within the cluster of leaves and silk. During heavy infestations, which can result in up to 50—70% foliar damage (leaf ties) in blueberry fields, the pest can significantly reduce fruit production (Wood 1972; Collins et al. 1994; Drummond and Groden 2000). However, outbreaks of *Aroga trialbamaculella* are irregular, which could be a result of suppression by natural enemies, e.g., predators or parasitoids, and environmental disturbances such as field mowing, burning, or pesticide applications (Drummond and Groden 2000). To date, there is limited knowledge of the abundance of natural enemies that might suppress *Aroga trialbamaculella* populations under natural conditions. This study examined parasitoids emerging from field-collected specimens to document the diversity of natural enemies developing in a population of *Aroga trialbamaculella*.

During late summer 2010, leaf ties of *Aroga trialbamaculella* were collected from lowbush blueberry fields located in Earltown, Nova Scotia, Canada (45.5778°N, 63.1379°W) for planned pheromone identification and behavioral studies on reared adults. Leaf ties containing *Aroga triabamaculella* were collected on 27 August, 3 September, and 10 September 2010, examined to remove any other species of insects, and were kept in 2.4 L plastic containers (8—10 stems/container placed on the surface of 3—6 cm potting soil; n = 40 containers total). Containers were stored at ambient temperature from 27 August 2010 to 11 January 2011, in a non-heated garage in Avonport, Nova Scotia, Canada (45.0863°N, 64.2411°W). Containers were then moved to the Biology Building of Acadia University located in Wolfville, Nova Scotia, stored on a bench top at room temperature (~20 °C), and checked daily for emerging insects. Degree-day accumulations were calculated using accumulated degree-days for emergence, and Arnold's formula (Arnold 1960). Pruess (1983) suggests degree-day thresholds should be standardized, i.e., at 5, 10 or 15 °C. As base developmental temperatures for these species are not known, a standardized threshold of 5 °C was selected. Specimens that emerged from leaf ties were pinned and sent to the Canadian National Collection of Insects, Arachnids and Nematodes (CNC) in Ottawa, Ontario, Canada, for cataloguing and identification using standard morphological techniques.

Two hundred sixty-four parasitoid wasps emerged from field collected *Aroga trialbamaculella,* (roughly 360—400 leaf ties) represented by four species of Braconidae (*Bassus binominatus* (Muesebeck), *Bassus acrobasidis* Cushman, *Chelonus (Microchelonus) alius* McComb, *Orgilus indagator* Muesebeck) and one species of Encyrtidae (*Apsilophrys vaga* (Howard) (Table 1) (Figures 1A-E). *Apsilophyrys vaga* was the most prevalent of these species, representing almost 98% of all emerged parasitoids, whilst other parasitoids were relatively rare from this location.

There have been no previous records of *Bassus binominatus*, *Bassus acrobasidis*, *Chelonus alius, Orgilus indagator,* or *Apsilophrys vaga,* documented in three main catalog sites of Nova Scotia: Nova Scotia Museum of Natural History (Halifax, Nova Scotia), Department of Natural Resources (Shubenacadie, Nova Scotia), and Dalhousie

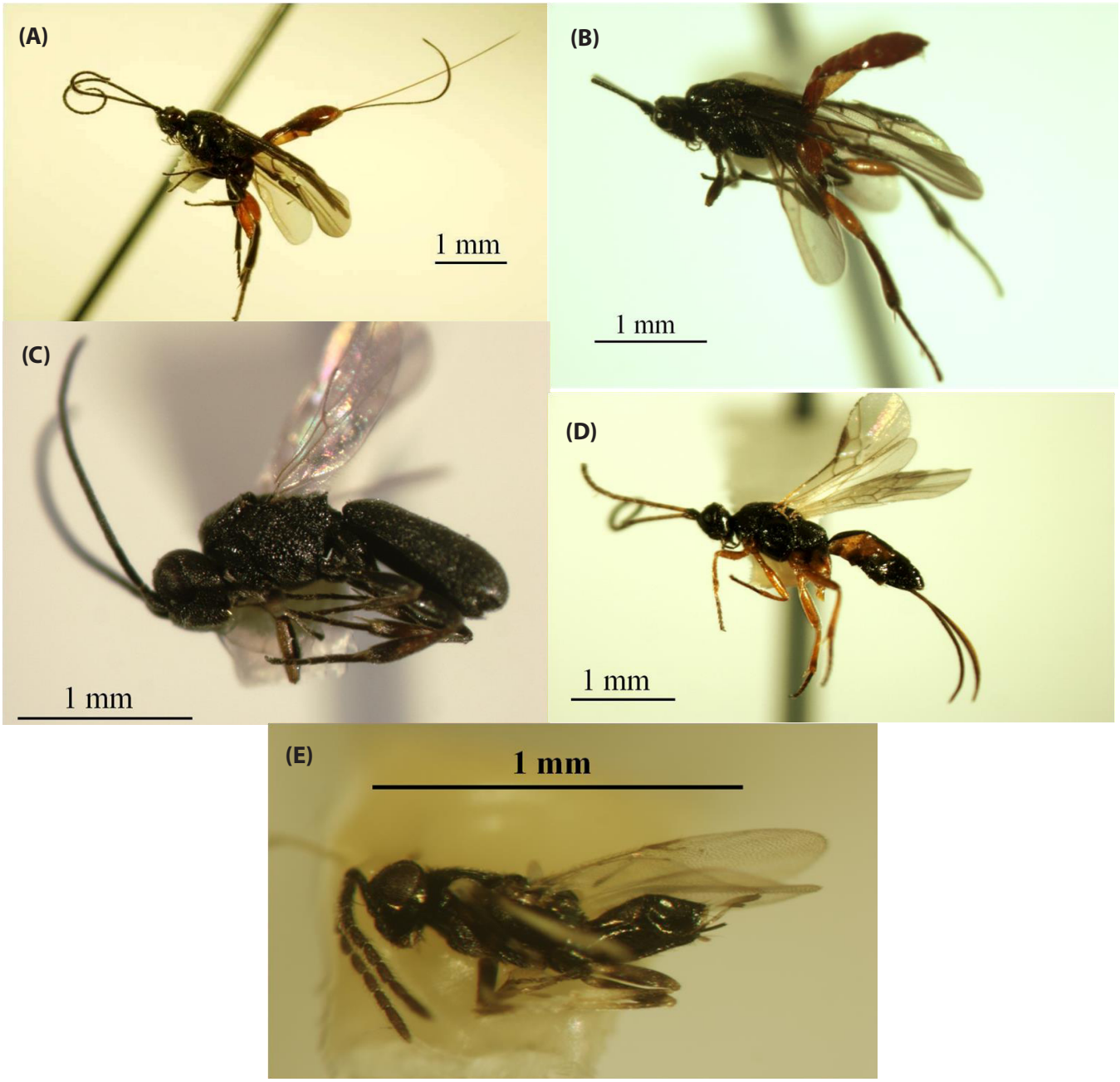
Received 3 April 2017. Accepted for publication 4 June 2017. published on the Acadian Entomological Society website at www.acadianes.ca/journal.php on 2 July 2017.

Jillian Kelly and Neil Kirk Hillier: Department of Biology, Acadia University, Wolfville, NS, Canada, B4P 2R6.

G. Christopher Cutler: Department Plant, Food, and Environmental Sciences, Faculty of Agriculture, Dalhousie University, PO Box 550, Truro, NS, Canada, B2N 5E3.

Corresponding author (email kirk.hillier@acadiau.ca)

Figure 1. Parasitoids emerged from *Aroga trialbamaculella* larvae collected in Earltown, NS, lowbush blueberry fields: *Bassus binominatus* (A); *Bassus acrobasidis* (B); *Chelonus* (*Microchelonus*) *alius* (C); *Orgilus indagator* (D); *Apsilophrys vaga* (E).



University Agricultural Campus A.D. Pickett Entomology Museum (Bible Hill, Nova Scotia). *Bassus binominatus* is widespread in the Nearctic Region and has been previously recorded parasitizing *Choristoneura* spp. (Lepidoptera: Tortricidae) (Fernandez-Triana and Huber 2010). *Bassus binominatus* is a new record for Nova Scotia and a new parasitoid record for *Aroga trialbamaculella* (J. Fernandez-Triana, Canadian National Collection (CNC), personal communication). Peak emergence for *Bassus binominatus* occurred during ~700—800 degree days.

Bassus acrobasidis was first recorded in Canada, in 2010 from Ontario (Fernandez-Triana and Huber 2010), and is a

Table 1. Dates of emergence and degree-day accumulations of parasitoid wasps from *Aroga trialbamaculella* larvae collected from a lowbush blueberry field in summer 2010, in Earltown, NS.

Species	Date of emergence	Number emerged	Degree day accumulations*
Braconidae			
Orgilus indagator	17 Feb	1	540
	18 Feb	1	555
Bassus acrobasidis	23 Feb	1	630
Bassus binominatus	28 Feb	1	705
	6 Mar	1	810
Chelonus alius	24 Feb	1	645
Encrytidae			
Apsilophrys vaga	23 Feb	14	630
	28 Feb	97	705
	7 Mar	35	825
	10 Mar	35	870

*Base temperature of 5 °C, commencing with 20 °C on 11 January 2011

new record for the Maritime Provinces. *Bassus acrobasidis* is a new parasitoid record for *Aroga trialbamaculella* and is also the first record being reared from a gelechiid (J. Fernandez-Triana, CNC, personal communication). The only previous host known for this species is the pecan nut casebearer, *Acrobasis nuxvorella* Neunzig (Lepidoptera: Pyralidae) (Cushman 1920). Its life history on this host in Texas is described as a larval parasitoid, with adults active from July–September (Nickels and Pinkey 1950).

Chelonus (Microchelonus) alius has been previously recorded from Ontario and eastern United States, and is a new record for Nova Scotia and the Maritime Provinces (Papp 2014; J. Fernandez-Triana, CNC, personal communication). *Aroga trialbamaculella* is the first recorded host of *Chelonus (Microchelonus) alius.* Other members of the genus *Microchelonus* described to date are koinobiont egg parasitoids of microlepidoptera with relatively cosmopolitan distributions (Shaw 1997; Nascimento and Penteado-Dias 2011).

Orgilus indagator is a new parasitoid record for *Aroga trialbamaculella* (J. Fernandez-Triana, CNC, personal communication) and a new record for the Maritimes. This braconid was previously collected from Quebec (Muesebeck 1970), as well as from Minnesota, USA, from a different host, the aster leaf tier moth, *Trichotaphe levisella* Fyles (Gelechiidae, Lepidoptera) (Balduf 1969). It was described as a primary, solitary, and endogenic larval parasitoid of *Trichotaphe levisella* with one generation per year in Minnesota (Balduf 1969).

The polyembryonic species *Apsilophyrs vaga* (Gibson et al. 1997) is a new record for Nova Scotia and new parasitoid record for *Aroga trialbamaculella* (J. Fernandez-Triana, CNC, personal communication). It has been previously reported from *Filatima pseudoacaciella* Chambers (Lepidoptera: Gelechiidae), a common species feeding on black locust (*Robinia pseudoacacia* L.) (Fabaceae) (Peck 1963; Gordh 1979). Members of the genus *Apsilophrys* De Santis (proposed as synonym of *Copidosoma* Ratzeburg by Zolnerowich (1995)) are primary parasitoids of larval Lepidoptera (Yu et al. 2014). Similar to *Bassus binominatus*, peak emergence of *Apsilophyrs vaga* occurred from ~705–810 degree days.

Natural enemies and other environmental factors may provide important population suppression under natural conditions. In the case of lowbush blueberry integrated pest management, recent studies have demonstrated diverse parasitoid and natural enemy populations which may impact other pest species. Specifically, high rates of parasitism have been documented from blueberry spanworm, *Itame (Macaria) argillacearia* (Packard) (Lepidoptera: Geometridae) by several species of Ichneumonidae and Tachnidae (Cutler et al. 2015; Loureiro and Cutler, 2016). Cutler et al. (2012) also investigated an array of carabid beetles (Carabidae) present in lowbush blueberry fields, demonstrating variation in preference for key habitats such as forest edge or open field, as well as differences in seasonal abundance. Predation rates of pests by carabid beetles are subsequently linked to key species and pest densities in the field (Renkema et al. 2013; Renkema et al. 2014). There are, however, no current recommended biological pest management practices for *Aroga trialbamaculella.* Identification of multiple parasitoid species, along with coinciding developmental degree-day data, provides new opportunities for examining their impact on sporadic outbreaks of *Aroga trialbamaculella*. The current study provides important data of the natural enemy community attacking *Aroga trialbamaculella*, and emphasizes their potential for inhibiting outbreaks through biological control.

ACKNOWLEDGEMENTS

The authors thank R. Ishigami for technical assistance, and José Fernandez-Triana, Canadian National Collection, Ottawa, ON for identification of specimens. Many thanks to Allen Bonneyman for permission to use his site for field work. Funding support was provided by the Nova Scotia Department of Agriculture Technology Development

2000 program, Wild Blueberry Producers Association of Nova Scotia, Canadian Wild Blueberry Institute Research and Development Initiative, and NSERC (NKH).

REFERENCES

Arnold, C.Y. 1960. Maximum-minimum temperatures as a basis for computing heat units. American Society for Horticultural Science **76:** 682-693.

Balduf, W.V. 1969. Observations on the parasites (Hymenoptera, Diptera) of *Trichotaphe levisella* Fyles (Gelechiidae, Lepidoptera) with notes on the host. The Ohio Journal of Science **69:** 36-52.

Collins, J.A., Forsyth, H.Y., and Yarborough, D. 1994. Red-striped fireworm. Blueberry Fact Sheet No. 205. University of Maine Cooperative Extension, Orono.

Cushman, R.A. 1920. North American ichneumon-flies, new and described, with taxonomic and nomenclatorial notes. United States National Museum Proceedings **58:** 289-290.

Cutler, G.C., Gariepy, T.D., De Silva, E.C.A., and Hillier, N.K. 2015. High rates of parasitism of blueberry spanworm (Lepidoptera: Geometridae) by Ichneumonidae and Tachinidae in commercial lowbush blueberry fields. Journal of Pest Science **88:** 219-223.

Cutler, G.C., Renkema, J.M., Majka, C.G., and Sproule, J.M. 2012. Carabidae (Coleoptera) in Nova Scotia, Canada wild blueberry fields: prospects for biological control. The Canadian Entomologist **144:** 779-791.

Drummond, F.A., and Groden, E. 2000. Evaluation of entomopathogens for biological control of insect pests of lowbush (wild) blueberry. Department of Biological Sciences, Deering Hall, University of Maine.

Fernandez-Triana, J.L., and Huber, J.T. 2010. Braconid parasitoids (Hymenoptera: Braconidae) of Nearctic *Choristoneura* species (Lepidoptera: Tortricidae), with a summary of other parasitoid families attacking *Choristoneura*. The Canadian Entomologist **142:** 295-343.

Gibson, G.A.P., Huber, J.T., and Woolley, J.B. 1997. Annotated keys to the genera of Nearctic Chalcidoidea (Hymenoptera). National Research Council of Canada, Ottawa, Ontario, Canada.

Gordh, G. 1979. Family Encyrtidae. *In* Catalog of Hymenoptera in America North of Mexico 1:939. *Edited by* K.V. Krombein, P.D. Hurd, Jr, D.R. Smith, and B.D. Burks. Washington, D.C.

Loureiro, A.M.M.C., and Cutler, G.C. 2016. Parasitism of blueberry spanworm (Lepidoptera: Geometridae) by Ichneumonidae and Tachinidae in Nova Scotia blueberry fields. Journal of the Acadian Entomological Society **12:** 31-34.

Muesebeck, C.F.W. 1970. The Nearctic Species of *Orgilus* Haliday (Hymenoptera: Braconidae). Smithsonian Contributions to Zoology **30:** 1-104.

Nascimento, A.R., and Penteado-Dias, A.M. 2011. New species of *Chelonus* (*Microchelonus*) Szépligeti, 1908 (Hymenoptera: Braconidae: Cheloninae) from Brazil. Brazilian Journal of Biology **71:** 511-515.

Nickels, C.B., and Pinkey, C.C. 1950. Parasites of the pecan nut casebearer in Texas. U.S. Department of Agriculture. 21 pp.

Papp, J. 2014. *Microchelonus deplanes* sp. n. from Canada and checklists of the Nearctic and Palearctic species of the genus *Microcheonus* Szépligeti, 1908 (Hymenoptera, Braconidae: Cheloninae). Natura Somo **25:** 115-140.

Peck, O. 1963. A catalogue of the Nearctic Chalcidoidea (Insecta: Hymenoptera). The Memoirs of the Entomological Society of Canada **95:** 5-1092.

Pruess, K.P. 1983. Degree-day methods for pest management. Environmental Entomology **12:** 613-19.

Renkema, J.M., Cutler, G.C., and Rutherford, K. 2014. Molecular analysis reveals lowbush blueberry pest predation rates depend on ground beetle (Coleoptera: Carabidae) species and pest density. Biocontrol **59:** 749-760.

Renkema, J.M., Manning, P., and Cutler, G.C. 2013. Predation of lowbush blueberry insect pests by ground beetles (Coleoptera: Carabidae) in the laboratory. Journal of Pest Science **86:** 525-532.

Shaw, S.R. 1997. Subfamily Cheloninae. *In* Manual of the New World Genera of the Family Braconidae (Hymenoptera). *Edited by* R.A. Wharton, P.M. Marsh, and M. Sharkey. Special Publication No.1. International Society of Hymenopterists. Washington, D.C. pp. 197-206.

Wood, G.W. 1972. Effects of feeding by the red-striped fireworm on lowbush blueberry production. Canadian Journal of Plant Science **52:** 397-398.

Yu, F., Chen, F.Q., Yen, S.H., Tu, L.H., Zhu, C.D., Guerrieri, E., and Zhang, Y.Z. 2014. Preliminary phylogeny of the genus *Copidosoma* (Hymenoptera, Encyrtidae), polyembryonic parasitoids of Lepidoptera. Systematic Entomology **39:** 325-334.

Zolnerowich, G. 1995. Systematics of the Copidosomatini: polyembryonic parasites (Hymenoptera: Encyrtidae). PhD Thesis, Texas A&M University, College Station, Texas.