DISCOVERY OF *AULACIDEA FOLLIOTI* BARBOTIN, 1972 (HYMENOPTERA: CYNIPIDAE: AULACIDEINI) IN CANADA AND THE UNITED STATES

L. F. NASTASI[1*] AND A. R. DEANS[1]

[1]Frost Entomological Museum, The Pennsylvania State University,
University Park, Pennsylvania, USA, 16802
email, slfnastasi@gmail.com

Abstract

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Aulacidea follioti Barbotin, 1972 (Hymenoptera: Cynipidae: Aulacideini) is a species of gall wasp inducing stem galls on *Sonchus asper* (L.) Hill (Asteraceae: Cichorieae). While this species is native to western Europe, we located specimens of this species deposited in several North American collections. The nine specimens we examined suggest that the species is present in several US states and Canadian provinces and has been present in North America since at least 1948. An observation showing the gall and larvae of the species in Oregon (USA) was uploaded to the community science platform iNaturalist in July 2024, confirming that the species is still present in North America.

Introduction

Gall insects are commonly introduced outside their native ranges along with their host plants (Schönrogge *et al*. 2011; Csóka *et al*. 2017). This is frequently the case in herb gall wasps (Hymenoptera: Cynipidae: Aylacini *sensu lato*), several tribes of endophytic wasps inducing galls on herbaceous plants (Buffington *et al*. 2020). Many herb gall wasps have become introduced globally as biocontrol agents or accidentally (Buffington *et al*. 2020; Nastasi and Deans 2021; Nastasi *et al*. 2024a). While at least six species of non-native herb gall wasps are already known in North America (Nastasi and Deans 2021; Nastasi *et al*. 2024a), we here report the herb gall wasp *Aulacidea follioti* Barbotin, 1972 (Aulacideini) from the continent for the first time. This species induces subtle, fusiform stem galls on *Sonchus asper* (L.) Hill (Asteraceae: Cichorieae), a weedy plant found across all of North America and introduced to every continent except Antarctica (Hyatt 2020). The species is native to Europe and has been recorded from France, Spain, and the United Kingdom (Barbotin 1972; Melika 2006).

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* Author to whom all correspondence should be addressed.

Materials and methods

We referenced specimens housed in the following institutions:

- **CNC:** Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada.
- **EMEC:** Essig Museum of Entomology, University of California, Berkeley, California, USA.
- **PSUC:** Frost Entomological Museum, The Pennsylvania State University, University Park, Pennsylvania, USA.
- **USNM:** United States National Museum, Washington, D.C., USA.

We examined external morphology of adult specimens using an Olympus SZX16 stereo microscope (Olympus Life Science, Tokyo, Japan) and took measurements of mounted specimens using an optical micrometer eyepiece. We stacked images using Zerene Stacker LLC (Richland, Washington, USA), and edited images using Adobe Photoshop and/or Adobe Illustrator (San Jose, California, USA). We imaged specimens using a Macroscopic Solutions 'microkit' (Tolland, Connecticut, USA).

Results

Aulacidea follioti Barbotin, 1972

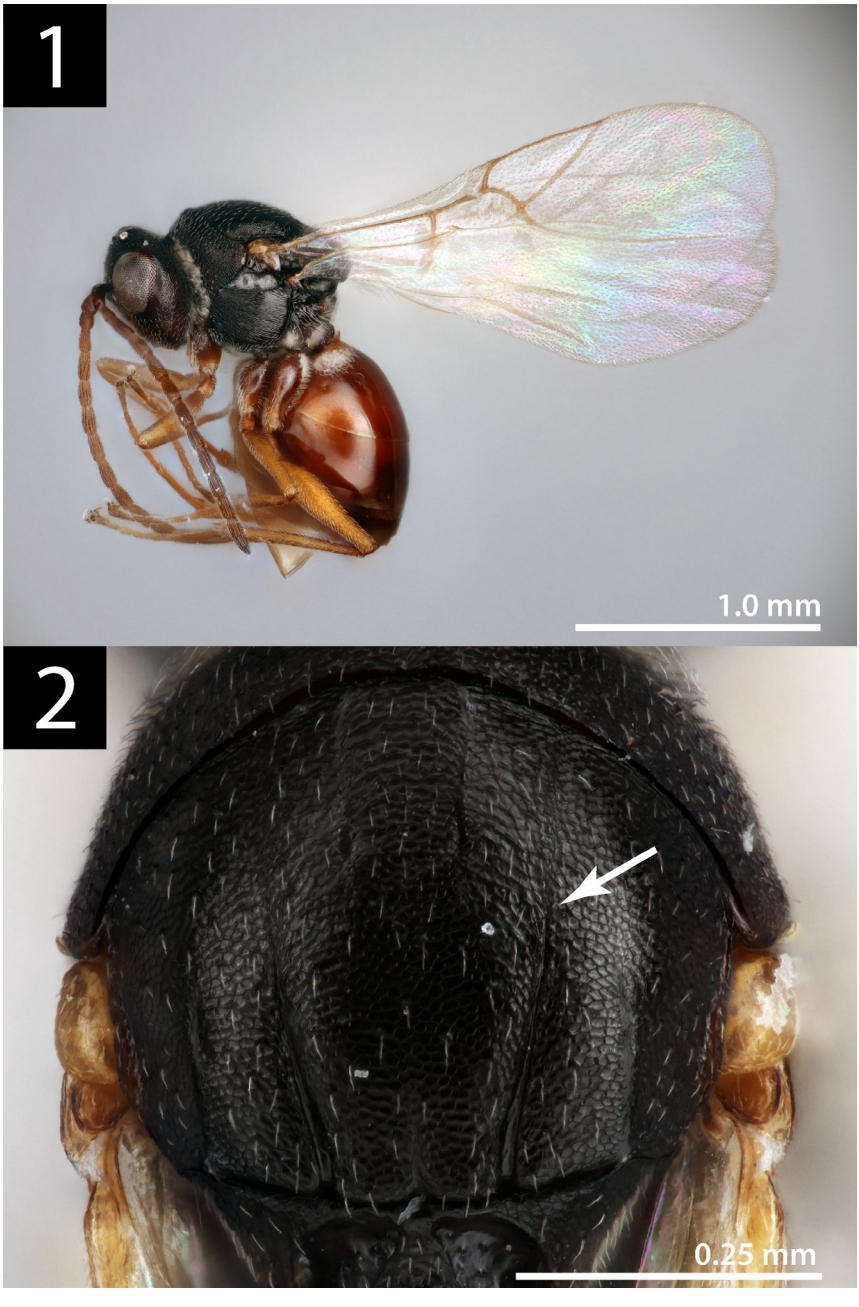
(Figs 1–2)

Material examined: Nine females from North America and six females from Europe.

CANADA: Three females deposited at CNC. **CNC 1942989:** British Columbia, Victoria, Mt. Douglas. 3.vi.1959. E. E. MacDougall leg. **CNC 1942998:** British Columbia, Mission City. 19.vi.1953. G. J. Spencer leg. **CNC 1943048:** Ontario, Guelph. Swept from "Alaska clover." 23.vi.1948. O. Peck leg.

USA: Three females deposited at EMEC. **EMEC 1328286:** California, Humboldt County, 1 mile west of Kneeland. 27.vi.1969. C. Slobodchikoff leg. **EMEC 1328294:** California, Santa Cruz County, 3 miles northeast of Soquel, elevation 130–400 ft. 27.iv.1973. D. Green leg. **EMEC 1328295:** California, Alameda County, Berkeley Hills, residential area. Malaise trap. 3.iv.1985. M. C. Whitmore leg. Three females deposited at USNM. **USNMENT 1557904 and 1557911 (same data):** Idaho, Ada County, Boise. Malaise trap. 28.v.1984. David R. Smith leg. **USNMENT 1823002:** California, Marin County, US Highway 1 @ Walker Creek, 8 miles south of Valley Ford. Swept. 4.vi.2002. Buffington and Munro leg.

UNITED KINGDOM: Six females deposited at PSUC. **PSUC_FEM_253292–253296 (all same data):** England, Essex, south bank of River Stour. Reared from stem galls on *Sonchus asper*, emerging Summer 2013, gall sample # TM090327. Galls collected 28.ix.2012. JP Bowdrey leg.



FIGURES 1, 2. *Aulacidea follioti* Barbotin, 1972, adult female (USNMENT01557904). 1, lateral habitus; 2, dorsal mesoscutum; arrow indicates termination of distinct portion of notaulus.

Remarks

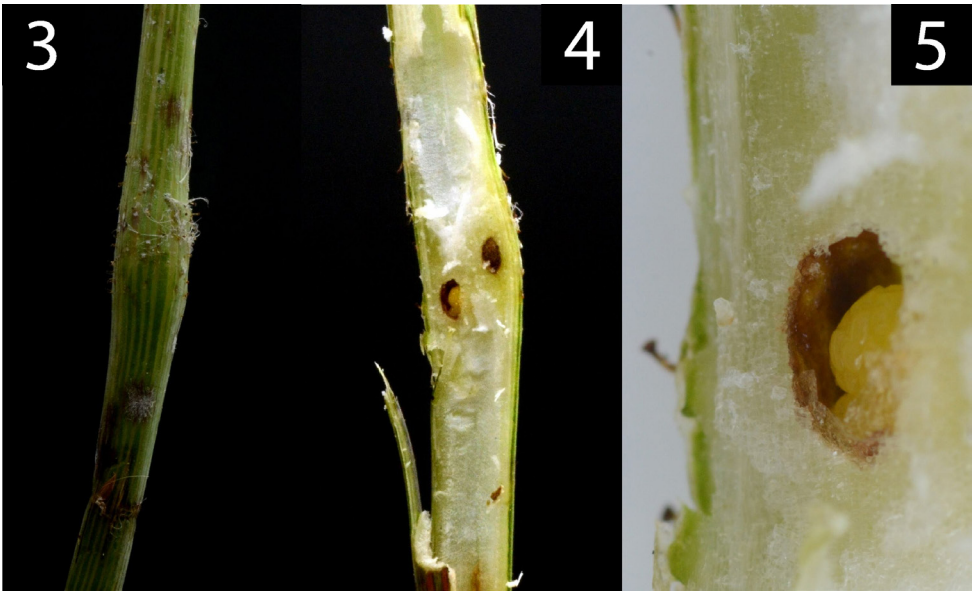
We discovered the North American specimens of *Aulacidea follioti* (Fig. 1) while sorting unidentified cynipoids loaned from several institutions (see Materials and methods). The specimens were immediately of interest given the incomplete notauli (Fig. 2), a character not previously known in any North American *Aulacidea* species. We were already aware of some Palearctic species having incomplete notauli, and thus ran our specimens through the identification key to *Aulacidea* species in Melika (2006). The specimens routed to *Aulacidea follioti* on the basis of the following characters: fore wing margin with marginal cilia; head broader than high in frontal view; female antennae with 13 antennomeres; notauli incomplete in anterior third; F2 longer than F1; median mesoscutal impression more or less absent. While Melika's key did not include the then recently described species *Aulacidea martae* Nieves-Aldrey, 2004, which also has incomplete notauli and is apparently closely related to *A. follioti* (Nieves-Aldrey 2004), *A. martae* has a long median mesoscutal impression, which is not the case in our specimens. Additionally, the host plant of *A. martae*, *Launaea arborescens* (Batt.) Murb. (Asteraceae: Cichorieae), is not known to be present in North America, further suggesting that *A. follioti* is the correct species.

To further validate the identity of our North American specimens, we compared them to material of *A. follioti* reared from galls of the known host plant collected in England (deposited at PSUC). We found them to be morphologically identical, including the dimensions of several structures (F1 and F2, the marginal cell, and the ocellar triangle), thus suggesting that both sets of specimens are conspecific. These characters are known to be consistent for individuals of a given species but usually different between congeners according to recent studies of aulacideine herb gall wasps (Nastasi *et al*. 2024b).

After verifying that our specimens were *Aulacidea follioti*, we informed several colleagues of the likely presence of this species in North America. This led to the discovery of galls and larvae of *A. follioti* on the known host plant (Figs 3–8), found in Lane County, Oregon (USA), which was shared via the community science platform iNaturalist as two observations (https://www.inaturalist.org/observations/229106712; https://www.inaturalist.org/observations/233882261). During the peer review process for this manuscript, one peer reviewer located an additional population of *A. follioti* in Victoria, British Columbia (Canada) and reported that every patch of *S. asper* examined exhibited high levels of gall wasp infestation (https://www.inaturalist.org/observations/235589148; see acknowledgments). The first author examined several small populations of *Sonchus asper* in State College, Pennsylvania (USA) but did not find gall wasps. We provide a GBIF occurrence dataset including the referenced iNaturalist observations indexed at time of submission (https://doi.org/10.15468/dl.jwhgue).

Diagnosis

Aulacidea follioti can be easily distinguished from all known North American *Aulacidea* by the incomplete notauli (Fig. 2). Comprehensive identification keys to North American Aulacideini including *Aulacidea follioti* will be provided in a forthcoming revisionary study (Nastasi *et al*. in prep.).

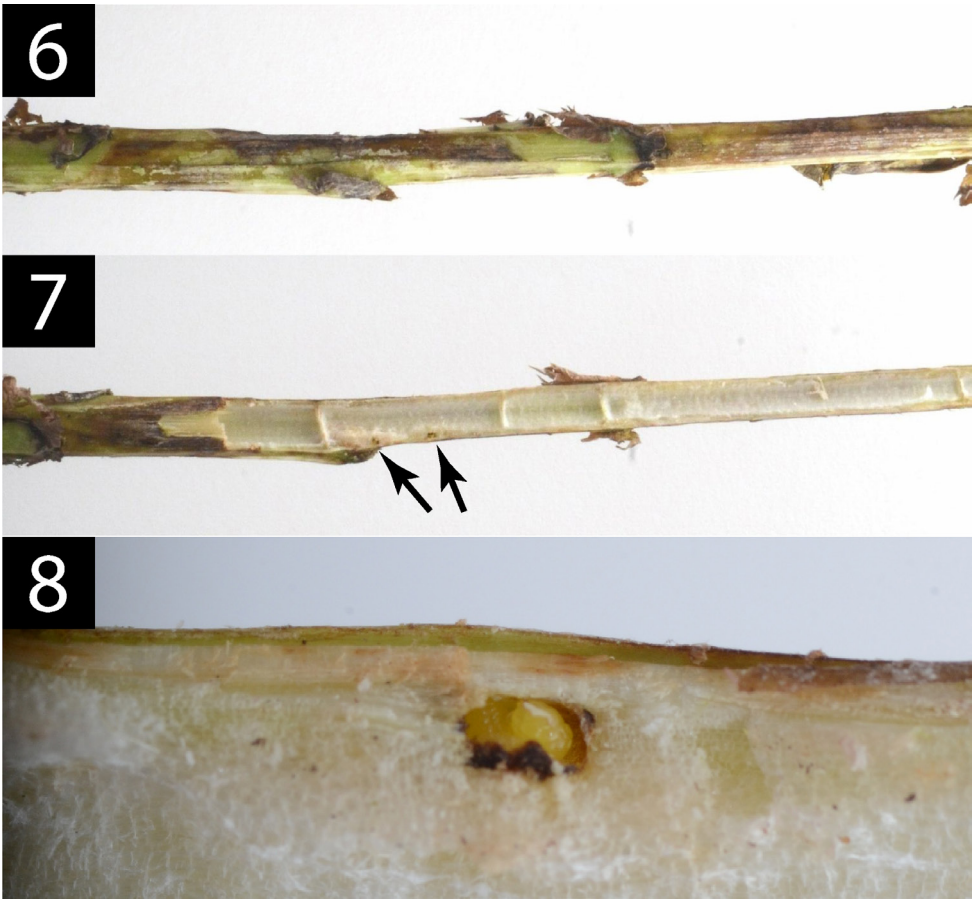


FIGURES 3–5. Galls of *Aulacidea follioti* Barbotin, 1972 on stem of *Sonchus asper* (L.) Hill. 3, gall, external view; 4, gall, cross section; 5, larva and chamber within bisected gall. Photos taken by Michael W. Palmer via iNaturalist (https://www.inaturalist.org/observations/229106712) and reproduced here with permission.

Discussion

The material we examined suggests the presence of *Aulacidea follioti* in both Canada and the United States, including British Columbia, California, Idaho, and Ontario. An observation of a gall and larval *A. follioti* confirms the current presence of the species in Oregon. Additionally, our specimens vary drastically in collection date, ranging from 1948 to 2002. This suggests that the species is broadly distributed at least in northern North America and has been present in the region for over 50 years. The small number of specimens and observations could represent several localized introductions over many decades, but further study would be needed to clarify this.

Additionally, one of the iNaturalist observations from Oregon depicting *Aulacidea follioti* (https://www.inaturalist.org/observations/233882261) showed larvae within the stem of *S. asper* but without obvious external deformation of the plant tissue (Figs 6–8). These individuals were found at the same location as the other Oregon observation (https://www.inaturalist.org/observations/229106712). This suggests that galls of *A. follioti* can be present as either a weak, fusiform swelling or entirely cryptic. The potential for cryptic galls may contribute to the lack of prior detection of this species in North America.



FIGURES 6–8. Galls of *Aulacidea follioti* Barbotin, 1972 on stem of *Sonchus asper* (L.) Hill. 6, stem, external view without apparent modification; 7, stem, cross section; arrows indicate gall chambers with cynipid larvae; 8, larva and chamber within bisected gall. Photos taken by Michael W. Palmer via iNaturalist (https://www.inaturalist.org/observations/233882261) and reproduced here with permission.

Acknowledgements

Michael Skvarla provided valuable advice on journal selection for this study. Jerry Bowdrey sent us specimens of *Aulacidea follioti* collected in England. Michael W. Palmer kindly examined local populations of *Sonchus* in his area and allowed us to use his photos of *Aulacidea follioti*. Nathan Earley also provided a useful review of our manuscript and located an additional population of *Aulacidea follioti*.

References

Barbotin, F. 1972. Sur quelques Cynipinae nouveaux cycles, nouvelles galles, nouvelles especes. *Marcellia*, **37**: 539–551.

Buffington, M.L., Forshage, M., Liljeblad, J., Tang, C.T., and van Noort, S. 2020. World Cynipoidea (Hymenoptera): a key to higher-level groups. *Insect Systematics and Diversity*, **4**: 1. doi: 10.1093/isd/ixaa003.

Global Biodiversity Inventory Facility (GBIF) 2024. GBIF Occurrence Download. [online]. GBIF.org [accessed 15 September 2024]. doi: 10.15468/dl.jwhgue.

Csóka, G., Stone, G.N., and Melika, G. 2017. Not-native gall-inducing insects on forest trees: a global review. *Biological Invasions*, **19**: 3161–3181. doi: 10.1007/s10530-017-1466-5.

Hyatt, P.E. 2020. *Sonchus asper*. P. 273 In Flora of North America Editorial Committee (eds.) (1993+) Flora of North America North of Mexico [online]. New York and Oxford. Vol. 19. http://floranorthamerica.org [accessed 15 September 2024].

Melika, G. 2006. *Gall wasps of Ukraine, Volume 1.* Vestnik zoologii, The Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, Kyiv, Ukraine.

Nastasi, L.F. and Deans, A.R. 2021. Catalogue of Rose Gall, Herb Gall, and Inquiline Gall Wasps (Hymenoptera: Cynipidae) of the United States, Canada and Mexico. *Biodiversity Data Journal*, **9**. doi: 10.3897/BDJ.9.e68558.

Nastasi, L.F., Buffington, M.L., Davis, C.K., and Deans, A.R. 2024a. Key to the North American tribes and genera of herb, rose, bramble, and inquiline gall wasps (Hymenoptera, Cynipoidea, Cynipidae sensu lato). *ZooKeys*, **1196**: 177–207. doi: 10.3897/zookeys.1196.118460.

Nastasi, L.F., Tooker, J.F., Davis, C.K., Smith, C.N., Frey, T.S., Hatfield, M.J., Presnall, T.M., Hines, H.M., and Deans, A.R. 2024b. Cryptic or underworked? Taxonomic revision of the *Antistrophus rufus* species complex (Cynipoidea, Aulacideini). *Journal of Hymenoptera Research*, **97**: 399–439. doi: 10.3897/jhr.97.121918.

Nieves-Aldrey, J.L. 2004. A new *Aulacidea* species (Hymenoptera, Cynipidae) from Cabo de Gata Nature Park (Spain) inducing galls on *Launaea arborescens*, including description of its terminal instar larva. *Graellsia*, **60**: 175–184.

Schönrogge, K., Begg, T., Williams, R., Melika, G., Randle, Z. and Stone, G.N. 2011. Range expansion and enemy recruitment by eight alien gall wasp species in Britain. *Insect Conservation and Diversity*, **5**: 298–311. doi: 10.1111/j.1752-4598.2011.00161.x.