

Andricus quercuscalifornicus **(Hymenoptera, Cynipidae), a new species** **for Canada discovered through** **community science**

N. G. EARLEY¹

ABSTRACT

Biodiversity-focused community (a.k.a., citizen) science datasets can be valuable tools for understanding the distribution of species. These data are often generated by the public and curated by experts. While curating the Cynipoidea records on the community science platform iNaturalist.org, I found an observation of the first record of *Andricus quercuscalifornicus* (Bassett) (Hymenoptera: Cynipidae) for Canada. The record was contributed by a hobby naturalist who photographed a gall in her neighbourhood park in Victoria, British Columbia (BC), and uploaded the record to iNaturalist. I visited the park, collected and reared the inhabitants out of the galls, and identified the adults morphologically. At around the same time, another gall was found independently in nearby Saanich, BC. The galls from both Victoria and Saanich were collected from recently planted *Quercus garryana* saplings on municipal land, and the trees may have been transplanted while already infested with *A. quercuscalifornicus*. More research is needed to understand if *A. quercuscalifornicus* arrived in BC naturally or if it was introduced through the horticultural industry. This record provides another example of how community science can contribute valuable information to our understanding of species ranges.

INTRODUCTION

Community (a.k.a., citizen) science platforms that contribute spatiotemporally located records of species occurrences are valuable resources for improving the accuracy of species range estimates (Skvarla and Fisher 2023). The community science platform iNaturalist.org (<https://www.inaturalist.org>) encourages users to upload geolocated photographs and audio recordings of organisms (hereafter referred to as “observations”; Callaghan *et al.* 2022). These observations are identified in three ways: (1) by artificial intelligence, (2) by the user uploading the observation, and (3) by other iNaturalist users who review the provided evidence (Callaghan *et al.* 2022). Data generated by iNaturalist have sometimes been particularly useful for helping to determine species distributions (Jones *et al.* 2019; Nelson and Moffat 2021; Nelson *et al.* 2023), for invasive species surveillance (Crall *et al.* 2011; Wrenkraut *et al.* 2020), and for species descriptions (Zhang *et al.* 2022). Here, I describe another instance of an iNaturalist observation improving our understanding of a species’ range and

¹School of Environmental Studies, University of Victoria, 3800 Finnerty Road, Victoria, BC V8P 5C2; nathan.g.earley@gmail.com

identifying the likely introduction of a species to Canada. I report two records of California gall wasp, *Andricus quercuscalifornicus* (Bassett) (Hymenoptera: Cynipidae), in Canada, found on recently planted saplings of *Quercus garryana* Douglas (Fagaceae) in two neighbouring municipalities on southern Vancouver Island, British Columbia (BC).

The first confirmed record of *A. quercuscalifornicus* in Canada was discovered through community science. Expert identification of iNaturalist observations improves the value of the data contributed to the platform and contributes to collaboration within the community (Callaghan *et al.* 2022). On 9 June 2023, while identifying Cynipoidea observations posted to iNaturalist in BC, I noted an observation of *A. quercuscalifornicus* galls in Summit Park, Victoria, BC (48.4452° N, 123.3556° W). The initial observation (iNaturalist 165024054; <https://inaturalist.org/observations/165024054>) was posted by a local naturalist on 1 June 2023 and was identified to species by iNaturalist's internal artificial intelligence (Saari 2024). I subsequently confirmed the presence of three galls at Summit Park on 11 June 2023 and monitored their development with weekly visits. The galls were developing on two recently planted *Q. garryana* that were less than 5 m tall and less than 5 cm in diameter at breast height. Both trees were surrounded by metal fencing and had plastic labels that indicated that they had recently been planted. The infested trees were two of 13 planted at the site and had been sourced from a nursery in Langley, BC. None of the other young trees planted in the park showed the conspicuous *A. quercuscalifornicus* galls, although they were infested by the introduced pest *Neuroterus saltatorius* (Edwards) (Hymenoptera: Cynipidae, Cynipini) that is established throughout southern Vancouver Island (Duncan 1997), and some had low numbers of the native *Disholcaspis mellifica* (Weld) (Hymenoptera: Cynipidae, Cynipini) twig galls. I was unable to find *A. quercuscalifornicus* galls on any of the larger trees in the park during multiple visits.

MATERIALS AND METHODS

I collected all three *A. quercuscalifornicus* galls (Fig. 1) from Summit Park on 30 June 2023, dried them at room temperature, and sprayed the surface of the galls with a 1:20 bleach:water mixture to reduce mould growth. I reared the galls in individual mason jars in an unheated shed in Victoria until all wasps had emerged from the galls in the fall of 2023. A total of 25 *A. quercuscalifornicus* adult females developed and successfully emerged from two of the three galls in September and early October 2023. No other insects were found among the emerged *A. quercuscalifornicus*, despite the fairly diverse component community of parasitoids and inquilines in their native range (Joseph *et al.* 2011). I deposited three adult specimens reared from the Summit Park galls in each of the following entomology collections: the Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada; the Pacific Forestry Centre Arthropod Reference Collection, Pacific Forestry Centre, Canadian Forest Service, Natural Resources Canada, Victoria, BC, Canada; the Royal BC Museum entomology collections, Victoria, BC, Canada; and the Spencer Entomological Collection, University of BC, Vancouver, BC, Canada.

Independently, in early October 2023, a municipal worker found a single *A. quercuscalifornicus* gall beneath one of five *Q. garryana* saplings planted in the spring of 2023 near Saanich Municipal Hall, Saanich, BC (48.4579° N, 123.3740° W). The trees were sourced from a nursery in Saanichton, BC. The municipal worker gave the gall to D. Copley (Royal BC Museum), who reared it in a glass jar in his Saanich yard; the gall had no emergence holes when placed in the jar (D. Copley, personal communication). Five adult *A. quercuscalifornicus* emerged from the Saanich Municipal Hall gall and died in the jar. The Saanich gall and its emerged wasps are deposited in the Royal BC Museum.

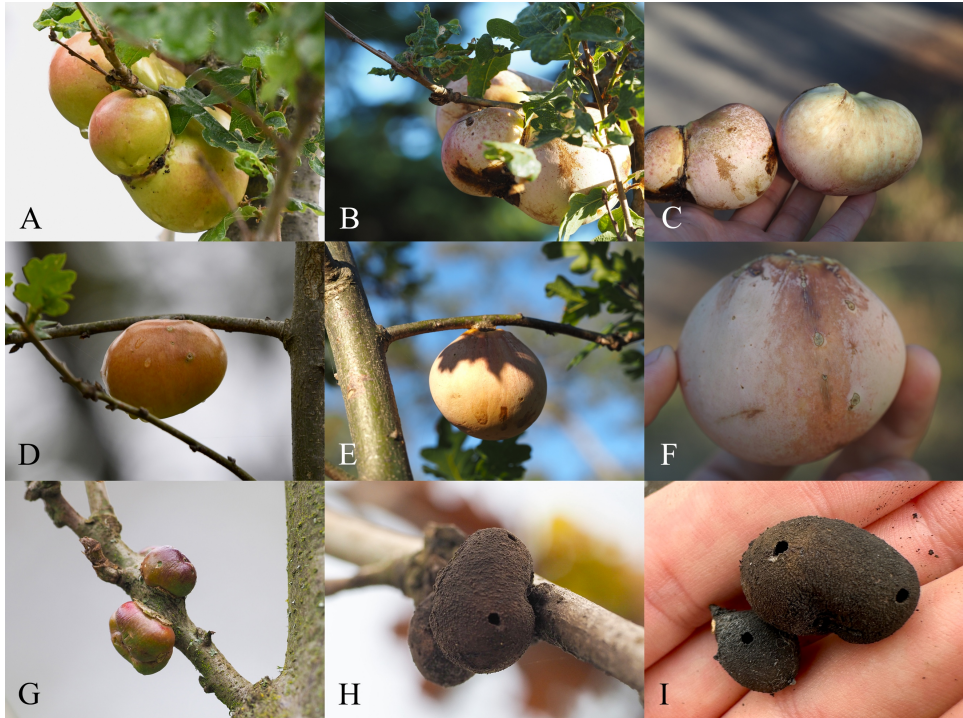


Figure 1. *Andricus quercuscalifornicus* galls collected from branches of *Quercus garryana* in Summit Park, Victoria, BC, Canada (A–G); small, approximately one-year-old galls with emergence holes that have degraded on the tree from Saanich Municipal Hall, Saanich, BC, Canada (H–I); two large galls (A–C) growing together and a smaller gall growing alone (D–F). Fully developed young galls (A and D; B. Starzomski); the same galls further along in development and ready for collection (B, C, E, and F); early gall growth (G).

On 27 April 2024, I visited the infected trees at Summit Park and at Saanich Municipal Hall to look for new gall growth. I found new gall growth on two branches of one of the previously infected Summit Park *Q. garryana* (Fig. 1G). I found no sign of new gall growth on any of the other recently planted trees nor on any of the established *Q. garryana* that I examined in the park. Although it is possible that the new galls were induced by *A. quercuscalifornicus* adults from galls that I did not detect, these galls may also be the result of an extended dormancy of the *A. quercuscalifornicus* eggs in the branches — a phenomenon known in other *Andricus* species near the northern extent of their range (e.g.,

Schönrogge *et al.* 1999). On a later visit, I found that these smaller galls had been removed from the tree. On the Saanich Municipal Hall trees, I found two small *A. quercuscalifornicus* galls that had likely been induced the previous year, both of which had emergence holes (Fig. 1H–I). I collected these galls and deposited them in the Royal BC Museum. I could not find any signs of new gall development on the Saanich Municipal Hall trees.

Description of gall and wasp.

Andricus quercuscalifornicus forms large, conspicuous, irregular, smooth, multilocular galls exclusively on young branches of white oaks, *Quercus* (Linnaeus) section *Quercus* in the western United States of America and northwestern Mexico (Kinsey 1922; Russo 2021). The wasp is parthenogenic and univoltine. Adults lay eggs into oak branches in the fall, eggs hatch, and gall formation occurs rapidly in the spring, with galls growing to 5–250 cm³ in several weeks (Joseph *et al.* 2011). After *A. quercuscalifornicus* galls have fully developed, they begin to degrade and become rough and dark brown (Fig. 1H–I). More than 20 species of Cynipidae that gall *Q. garryana* are presumed to be native to BC (Evans 1985), but the size and shape of *A. quercuscalifornicus* galls make them unmistakable and easily distinguishable from other Cynipoidea galls in the province. The only insect galls of comparable size in the province — *Diplolepis rosae* (Linnaeus) and *D. radicum* (Osten Sacken) (Hymenoptera: Diplolepididae) — form mossy leaf galls and bumpy root galls, respectively, on *Rosa* (Linnaeus) (Rosaceae) hosts.

Although *A. quercuscalifornicus* are most easily identified by gall morphology and host species, I also identified the emergent adults (Fig. 2) to species morphologically. I used the higher-level key to world Cynipoidea in Buffington *et al.* (2020) to identify the adult wasps as Cynipini. The state of cynipid taxonomy, and of *Andricus* in particular, is unstable. In the past decade, six Nearctic genera that had previously been synonymised with *Andricus* have been re-established, and a further three new genera have been established from species previously considered *Andricus* (see overview in Cuesta-Porta *et al.* 2023). This instability has complicated the identification of adult Cynipini using keys. Fortunately, because the emergent adults are asexual, have acute basal teeth on their tarsal claws, and have a straight and complete transscutal articulation, I could use the key in Melika *et al.* (2021) to assign these wasps to *Andricus*. Adult *A. quercuscalifornicus* are described in detail in Bassett (1881) and Kinsey (1922): Adult large (3.0–5.0 mm); body red–brown; antenna with 14 or 15 segments, the first flagellomere longer than the second; prosoma narrower than mesosoma; prosoma and mesosoma punctate and setose; notauli indistinct in anterior 1/3 of mesoscutum; second metasomal tergum glabrous distally and < 1/2 the metasoma length; remaining terga glabrous; hypopygium with ventral spine long, with sparse short setae.

DISCUSSION

The presence of both the Summit Park galls and the Saanich Municipal Hall galls exclusively on *Q. garryana* planted in the spring of 2023 suggests that these galls were introduced to southern Vancouver Island on imported trees. Trees from the same nursery stock as those planted in Summit Park were also planted

in Victoria's Stadacona Park and Mt. Stephen Park in 2023 and in Beacon Hill Park and Arm Street Park in 2024. I plan to visit these Victoria parks in the coming years to monitor for *A. quercuscalifornicus* where the trees were planted, and I will also continue to monitor the Saanich Municipal Hall trees for sign of the wasp.

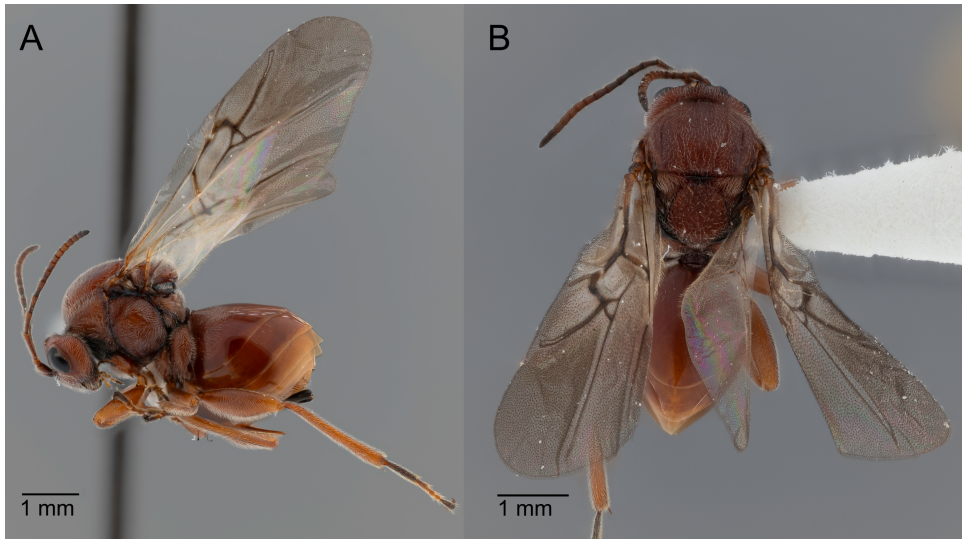


Figure 2. Lateral (A) and dorsal (B) habitus of *Andricus quercuscalifornicus* adult reared from galls collected on 30 June 2023 from *Quercus garryana* in Summit Park, Victoria, BC, Canada.

Andricus quercuscalifornicus is not anticipated to be a pest of regulatory concern in Canada because its galls apparently cause low levels of harm to oaks, their natural range extends to Tacoma, Washington, United States of America, and their range is suspected to expand northwards with warming global temperatures (T. Kimoto, personal communication). However, the absence of past records of *A. quercuscalifornicus* in Canada does beg the question: is the northern dispersal ability of the species limited by the Salish Sea? The only native *Quercus* in BC is *Q. garryana*, a species that is common on Vancouver Island from Victoria to Courtenay, with few disjunct populations in mainland BC along the lower Fraser River. For *A. quercuscalifornicus* to reach BC naturally, its range would likely have to extend north to the San Juan Islands before crossing the Haro Strait to southeastern Vancouver Island or the Gulf Islands in Canada. Because *A. quercuscalifornicus* is the most observed cynipid on iNaturalist in North America – perhaps due to the large size of their galls – iNaturalist may be a valuable tool for understanding those possible routes for natural dispersal. Discovery of the introduction of *A. quercuscalifornicus* to Canada through iNaturalist offers another example of the value of photography-based community science platforms for invasive species surveillance and for describing species distributions.

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