

**NOTE****Verification of the occurrence of *Bombus affinis* (Hymenoptera: Apidae) in New Brunswick, Canada**

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Bombus affinis Cresson, the Rusty-patched Bumble Bee (Hymenoptera: Apidae), is a bee species of conservation concern, recently listed as Endangered in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and under the Species at Risk Act (Species at Risk Public Registry 2015). It was once common through most of its range, which includes the eastern United States as far south as Georgia and as far west as the Dakotas, and southern Ontario and southern Quebec (Milliron 1971; Lavery and Harder 1988; Williams et al. 2014). Dramatic declines in its populations were noticed in the mid-1990s (National Research Council 2007). Surveys conducted in southern Ontario from 1971 to 1973 found that approximately 13% of all *Bombus* collected were *Bombus affinis* (Macfarlane 1974), whereas from 2004 to 2010 only three specimens were collected in southern Ontario despite 600 hours of targeted surveying (COSEWIC 2010; Colla and Packer 2008), evidencing the decline in Canada. The decline of *Bombus affinis* was concurrent with the decline of two closely related species, *Bombus terricola* Kirby and *Bombus occidentalis* Greene (Evans et al. 2008), and with the likely social parasite of all three species, *Bombus bohemicus* Seidl. Causes of these declines, at least for the non-parasitic species, remain unclear. Szabo et al. (2012) were unable to find evidence that any of the three threats identified by COSEWIC (2010), pathogen spillover, habitat loss, and pesticides, caused the decline of *Bombus affinis*, although they demonstrated a statistically significant but weak relationship between pathogen spillover and the declines of *Bombus terricola* and *Bombus occidentalis*.

As a result of the observed declines in *Bombus affinis* populations, the species was designated Endangered by COSEWIC in 2010. In the COSEWIC assessment for this species, Ontario and Quebec are listed as the only two provinces where the species is (or was) known to occur (COSEWIC 2010). A single mention of this species being in New Brunswick is given in the assessment: Mitchell (1962) indicated the Canadian range of *Bombus affinis* as being from Ontario to New Brunswick. However, given that no locality data was provided by Mitchell (1962), no New Brunswick specimens were known to the COSEWIC assessment author, and that numerous studies published ranges of *Bombus affinis* that included only Ontario and Quebec in Canada (e.g., Milliron 1971; Lavery and Harder 1988; Evans et al. 2008), Mitchell's report was discounted, and it was posited that a specimen from New Brunswick, New Jersey, in the Cornell University Insect Collection, was the likely cause of the erroneous report.

J. Klymko examined the bee material at the New Brunswick Museum (NBM) in December 2013. Among the unidentified material was a single queen *Bombus affinis* specimen collected by W.E. Cawthray on 3 October 1949, at Fredericton (specimen NBM-035767, Figure 1). This represents the only known specimen of *Bombus affinis* collected in New Brunswick.

There is good evidence to suggest that this specimen was collected in New Brunswick and from the wild. The label indicates that it was collected from a *Papaver* (Papaveraceae) species, evidence that the specimen was collected from the outdoors, presumably a flower garden, and not from a lab colony or the like. Weather data from Fredericton in 1949 shows that prior to 3 October there had been three nights where the temperature reached or fell below 0°C: the low on 11 September and 2 October was -1.1°C, and on 12 September the temperature was 0.0°C (weather data available at www.weather.gc.ca). It is our experience that *Bombus* can still be seen in New Brunswick after similar moderately cold weather events. For example, despite morning low temperatures falling to or below freezing in Fredericton

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Figure 1. The *Bombus affinis* Cresson specimen collected 3 October 1949, at Fredericton by W.E. Cawthray (New Brunswick Museum, NBM-035767).



on 5, 9, and 12-14 October 2013, a number of *Bombus* specimens (queens, workers and males) were collected by D. Sabine in the area on 5, 8, 15, and 27 October 2013.

Furthermore, a William E. Cawthray, presumably the specimen collector, graduated with a BSc in forestry from the University of New Brunswick in 1950 (*The Ottawa Journal*, 25 May 1950, p. 17), indicating that he very likely was in Fredericton in early October 1949. There are just four other insect specimens that were collected by W.E. Cawthray in the databased portion of the NBM collection (M. Sollows, NBM, personal communication), including another collected in early October in Fredericton in 1949: *Ctenophthalmus pseudagyrtes* Baker (Siphonaptera; collected at Black Sturgeon Lake, Graydon, ON, 6 June 1949), *Ctenocephalides felis* (Bouché) (Siphonaptera; collected at Fredericton NB, 10 October 1949), and two unidentified hymenoptera (both collected in August 1949 at Black Sturgeon Lake, Graydon, ON). These four specimens, plus the *Bombus affinis* specimen, may have been part of his student collection.

The NBM specimen was originally housed at the Atlantic Forestry Centre (AFC) in Fredericton, New Brunswick, and it was transferred to the NBM along with many other insect specimens (D. McAlpine, NBM, personal communication). The insect collection at the AFC has two other *Bombus affinis* specimens, but neither of these is labelled. It is likely that these specimens, along with several

other *Bombus* specimens at the AFC lacking locality labels, originated outside of New Brunswick, and that they were given to the AFC collection as expert-verified reference materials, as this was common museum practice in the past (D. McAlpine, NBM, personal communication).

In addition to the specimen in the NBM, there is further supportive evidence for the historic occurrence of *Bombus affinis* in New Brunswick in a technical report that listed *B. affinis* as being collected during blueberry (*Vaccinium* spp.) pollinator surveys in New Brunswick from 1961 to 1965 (Boulanger et al. 1967). This report detailed the results of surveys conducted in Maine, New Brunswick, Nova Scotia, Quebec, and Newfoundland by researchers from the University of Maine's Agricultural Experiment Station and the Canada Agriculture Research Station at Fredericton, New Brunswick. This report was not considered in the COSEWIC assessment of *Bombus affinis* as the whereabouts of any *Bombus* specimens associated with this pollinator study are unknown, and it is possible they have been lost. Specimens could not be found at the NBM, AFC (J. Sweeney, AFC, personal communication.), the collections at Agriculture and Agri-Food Canada in Fredericton (C. Maund, New Brunswick Department of Agriculture, Aquaculture and Fisheries (NBDAAF), personal communication), the New Brunswick Department of Agriculture, Aquaculture and Fisheries in Fredericton (C. Maund, NBDAAF, personal communication), the Potato Research Centre in Fredericton (C. Maund, NBDAAF, personal communication), the Maine State Museum, which houses the University of Maine (UM) insect collection (F. Drummond, UM, personal communication.), or the Canadian National Collection of Insects (CNCI) (S. Cardinal, CNCI, personal communication). The Illinois Natural History Survey (INHS) and the North Carolina State University Insect Museum (NCSUIM) were also checked without success (D. Dmitriev, INHS, and R. Blinn, NCSUIM, respectively, personal communication). These two institutions were home to Wallace LeBerge and T.B. Mitchell, respectively, who identified most of specimens from the Boulanger et al. (1967) study.

Given the *Bombus affinis* specimen in the NBM reported here, and the additional non-verified mention of the species from New Brunswick by Boulanger et al. (1967), it is certain *Bombus affinis* occurred in New Brunswick in the past. The predictive maps of Williams et al. (2014) support this. Their maps use maximum entropy (see Phillips et al. 2006) to infer potential range by identifying areas that are climatically suitable for a species where climatic suitability is derived from the environmental conditions at known

specimen localities. Their *Bombus affinis* map predicts climatically suitable habitat as occurring throughout the southern half of New Brunswick, as well as all of Prince Edward Island, most of mainland Nova Scotia, and much of Cape Breton. Indeed, the area immediately around Fredericton, the Grand Lake Lowlands, showed the greatest level of probability of occurrence of any area in the Maritimes. Nevertheless, *Bombus affinis* was clearly never common in the province. Amongst collections material Williams et al. (2014) databased for their book, there are 448 *Bombus* specimens from New Brunswick collected before 1990 (a period which presumably predates any declines that might have occurred), and none of them are *Bombus affinis* (L. Richardson, University of Vermont (UV), personal communication). At the NBM, only one of the 186 *Bombus* collected in the province before 1990 is *Bombus affinis*.

If *Bombus affinis* persists in New Brunswick then it does so in very low numbers. There are no *Bombus affinis* records for New Brunswick since 1965, despite an unprecedented level of collecting, particularly since 1990 (data sources are the NBM (69 specimens), the Williams et al. (2014) dataset (185 specimens), Dwayne Sabine's (2,290 specimens), and J. Klymko's (245 specimens) personal collections). This recent data does show that some *Bombus* species occurring in the province go almost entirely undetected, giving hope that *Bombus affinis* may one day be rediscovered in New Brunswick. For example, the provincial occurrence of *Bombus griseocollis* was only known from a single specimen collected in 1979 near Sussex (specimen deposited at Illinois Natural History Survey) until D. Sabine, M. Sabine, and S. Makepeace collected seven specimens between 2012 and 2014 from the Fredericton and Jemseg areas of southern New Brunswick (specimens deposited in D. Sabine's personal collection and in the NBM collection: specimen NBM-045156). Similarly, *Bombus frigidus* is only known from a 1914 specimen collected near Moncton (specimen deposited at Canadian National Collection), a published record in central New Brunswick (see map in Lavery and Harder 1988, year of record not reported), and from three specimens collected in 2011 by J. Klymko and S. L. Robinson near Williamstown Lake (specimens deposited in the NBM).

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