

NATURAL HISTORY AND OBSERVATIONS

A dance on the snow: the mating of *Chionea alexandriana* (Diptera: Limoniidae)

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Four species of the unusual micropterous crane fly genus *Chionea* (Diptera: Limoniidae) are recorded in British Columbia (BC). Adults are typically winter-active on snow, so they are infrequently collected and little is known of their life histories and behaviour. Most of the information known about the 16 North American species is detailed in the superb monograph of George Byers (1983); information attributed to Byers herein comes from this work. This note presents photographs and some natural history observations related to the mating of *Chionea alexandriana* Garrett, the most common and widespread of the BC and western North American species.

The following general BC distributions and ranges outside the province are based on records cited by Byers, data from the Royal BC Museum (Victoria, BC) collections, and the Internet sites iNaturalist (inaturalist.ca) and BugGuide (bugguide.net). *Chionea alexandriana* lives from the Coast Mountains around Vancouver, east to the Rocky Mountains and north to the southern Yukon; it ranges south to the mountains of Utah and northern California in the United States of America. *Chionea macnabeana* Alexander, mainly a species of the Coast and Cascade mountains of Oregon and Washington, in Canada is known only from Manning Provincial Park, BC (Cannings 1987). *Chionea albertensis* Alexander has a similar distribution to *C. alexandriana* in southern BC and the Rocky Mountains of Alberta but is not recorded north of the Prince George region (inaturalist.ca/observations/39220140). It lives as far south as Oregon, Idaho and Montana, United States of America. *Chionea obtusa* Byers is recorded in southeastern BC from Cranbrook north to Glacier National Park; it also ranges into western Alberta and south to Idaho and Montana. Although not yet known from Canada, *Chionea nivicola* Doane should be looked for in extreme southeastern BC, especially in the Flathead region.

Byers thoroughly describes, illustrates, and keys all the Nearctic species; *Chionea alexandriana* (Figures 1 and 2) is readily differentiated from its two relatives that live in the southern Canadian Rockies by several characters in both sexes, most of them genitalic. By far the simplest way to distinguish the three sympatric species is by the number of antennal flagellomeres. The antenna of *C. alexandriana* usually has only three flagellomeres, occasionally four. All those examined in the Royal BC Museum collection and in the photographs taken in this study have three. *Chionea albertensis* (Figure 3) and *C. obtusa* have longer

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antennae: the former has eight or nine flagellomeres; the latter has five to seven. *Chionea alexandriana* is variable in size: the body length of both adult males and females (without antennae) ranges from about 4 to 8 mm.

One of us (BK-M) observed and photographed *C. alexandriana* near Moberly (51.4534° N, 117.0811° W), 19 km northwest of Golden, BC. The site is wooded benchland below Willowbank Mountain at an elevation of 926 m on the lower western slopes of the Central Continental Ranges of the Rocky Mountains, which are predominantly limestone, resulting in alkaline soils. Although Byers reports that many collection localities contain rocky outcrops and suggests that these might be an important habitat component for *Chionea*, the study area lacks them. The site is generally forested but for roadways and small clearings around the dwelling and, although some observations were made on snow near the house, most were from forest-edge habitat, similar to that of the adjacent natural forest.



Figure 1. *Chionea alexandriana* female, dorsal view. Note the short antennae, the distinctive pattern on the abdominal tergites, and the dorsal, medially appressed cerci at the apex of the abdomen. Photo (©): Bryan Kelly-McArthur.

The biogeoclimatic zones in the Rocky Mountain Trench are complex (MacKillop *et al.* 2018). The study site is Interior Cedar–Hemlock (mk5 variant), but the Montane Spruce Zone (dk variant) comes within 300 m of the southern edge of the site. Byers asserts that *Chionea* is only found in areas forested to some extent but that the distribution of species is not determined by forest type. Nevertheless, we prefer to document the predominant trees at the site: the forest consists of mixed conifers, mainly *Picea engelmannii* Parry ex Engelmann, *Pinus contorta* Douglas ex Loudon, *Pseudotsuga menziesii* (Mirbel) Franco, and *Thuja plicata* Donn ex D. Don, and hardwoods such as *Betula papyrifera* Marshall, *Populus balsamifera* Linnaeus, and *P. tremuloides* Michaux. The mean annual precipitation is 55 cm, with a mean snow accumulation of 230 cm.



Figure 2. *Chionea alexandriana* male, lateral view. Note the large abdominal segment nine composed of the dorsal epandrium (with acute dorsal projection) fused with the ventral hypandrium with the apical, roughly triangular gonocoxite and its attached hook-like gonostylus curving forward. Photo (©): Bryan Kelly-McArthur.



Figure 3. *Chionea albertensis* female, dorsal view. The light yellow–brown colour, long antennae, and long slender cerci (in female) help distinguish this species from *C. alexandriana*. Photo (©): Bryan Kelly-McArthur.

Byers notes that *C. alexandriana* is generally a montane species but occurs from near sea level to 3000 m elevation. He also states that there are records from some part of its extensive range for every 10-day period from 1 October to 20 April but that concentrated local collections such as those made by C.D.B. Garrett near Cranbrook, BC and John Woods near Revelstoke, BC show a peak in adult abundance from November to December and from February to March. Byers suggests that there may be two generations per year.

Chionea alexandriana was recorded from 06 February 2013 to 01 January 2021 on 12 days – two in December, eight in January, and two in February, with 29 December being the earliest date recorded in the season. During this period, males were seen eight times, and females, six. Observations were not made systematically but were the result of chance encounters. The flies usually walked on snow when the air temperature was $-4\text{ }^{\circ}\text{C}$ to $-5\text{ }^{\circ}\text{C}$, but once at $-6\text{ }^{\circ}\text{C}$. This compares well to the temperatures measured during the snow walking of the European *C. araneoides* Dalman by Hågvar (1971): mostly $-4\text{ }^{\circ}\text{C}$ to $-5\text{ }^{\circ}\text{C}$ and sometimes as low as $-6\text{ }^{\circ}\text{C}$. Chapman (1954) found *C. alexandriana* and other species active on snow mainly between $0\text{ }^{\circ}\text{C}$ and $-4\text{ }^{\circ}\text{C}$. All our observations were made on overcast days, agreeing with Byers and many observers he cites, who emphasise that *Chionea* is almost always seen late in the day, in the evening, or on cloudy days, and appears to avoid strong light.

The single mating episode of *C. alexandriana* at Moberly was recorded on a snow-covered driveway on 29 December 2020 at 14:00 MST ($-4\text{ }^{\circ}\text{C}$). The mating lasted for about 42 minutes from discovery (they had been mating for an unknown length of time before this) to the point where the pair crawled below the snow surface down an opening alongside a shrub branch emerging from the snow. The copulating pair resolutely moved forward, the female leading and dragging the male, while he propped himself up and walked with his hind legs (Figure 4). In addition, two other single males at this mating site showed interesting leaping behaviour, jumping vertically 2 to 3 cm. There were no other *Chionea* individuals present and BK-M believes that the jumping may have been in response to the insect being scooped up on a handful of snow for closer observation. Byers reported only males jumping and only in response to alarm, such as when touched.

In the male's strongly sclerotised ninth abdominal segment, the tergite (epandrium) and sternite (hypandrium) are solidly fused; from the latter, heavy lateral gonocoxites arise, each bearing a finger-like gonostylus (basistyle and dististyle of Byers, respectively). The most obvious female genitalic structures are the hypogynial valves (ovipositor) of the eighth sternite and the blade-like cerci. During copulation, as seen in Figure 4, the male approaches the female from behind, supported mainly by the hind legs; his abdomen is curved forward, ventral side up; the gonocoxites grasp the female's hypogynial valves, which slide under the epandrium, and the gonostyli grip the pleural membrane of segment 7. The female's blade-like cerci project up between the gonocoxites.

All but one of the individuals recorded at Moberly were *C. alexandriana*. The exception was a female *C. albertensis*, photographed on 4 December 2017 (Figure 3) and readily recognised by the light yellow–brown colour; the long antennae with nine flagellomeres; and the long, curved, slender, and acute cerci.

Byers notes that when snow is absent, most records of *Chionea* come from cool underground sites such as caves, rodent burrows and nests, and other soil cavities where temperature and humidity are relatively stable. He suggests that *Chionea* larvae may feed on the accumulations of organic material in rodent burrows. In one instance in Kansas, he found *C. stoneana* Alexander adults and larvae in debris in a nest of *Microtus ochrogaster* Wagner. In winter, adults appear to be subniveal, emerging onto snow surfaces only when temperature and light conditions are optimal. Byers regards the strong snow-walking of *Chionea* as critical to the dispersal of the flies into new microhabitats.



Figure 4. Two images of a *Chionea alexandriana* male and female mating, 29 December 2020, Moberly, BC. The female is the smaller insect on left. The males' abdomen is ventral side up, showing the massive hypandrium and lateral claspings gonocoxites with the curved, knife-like cercus of the female protruding between them. Photos (©): Bryan Kelly-McArthur.

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