

Water-bears from the Rocky Mountains: A First Look at Alberta's Tardigrade Fauna

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There is no information in the published literature regarding Alberta's terrestrial water-bear (Tardigrada) fauna. We surveyed across an elevational gradient (1100 – 1800 ft) on Black Cat Mountain in the Alberta Rocky Mountain range. Ten taxa were identified from 902 specimens, all of which are new records for Alberta and one species is new for Canada: *Macrobiotus* cf. *islandicus* Richters, 1904. There was no clear relationship between elevation and tardigrade distribution, possibly owing to patchiness of these animals in the field and lack of adequate replication at each elevation.

Key Words: Tardigrada, elevation diversity, faunistic survey, Black Cat Mountain, Alberta.

Given the charismatic nature of water-bears (*Tardigrada*) and relative ease of collection, it is remarkable that so little is known about the ecology of Canadian tardigrades (see Boeckner et al. 2005 for a review of studies on Canadian tardigrades). Species lists exist for some Canadian provinces and territories; however, most records were compiled during patchy trans-Canadian surveys conducted in the early 20th century (Richters 1908; Murray 1910). British Columbia, Newfoundland and Labrador, New Brunswick, the Yukon and Northwest Territories have had the largest number of studies, British Columbia leading with five (Boeckner et al., 2005). Alberta, Manitoba, Nova Scotia and Prince Edward Island currently have no records of terrestrial tardigrades; however, a single study identified members of the genus *Hypsibius* in five Albertan lakes (Anderson and DeHenau 1980). Also, Murray (1910) collected tardigrades from the Rocky Mountains; however, it is unclear whether these samples were from Alberta or British Columbia.

The aim of this study was to begin the first of many forays that will result in a comprehensive list of Albertan tardigrade fauna. Additionally, elevation has been investigated as a factor affecting tardigrade assemblages (example: Guidetti et al. 1999). Thus, our data also provide information regarding distribution patterns across an elevational gradient.

Materials and Methods

The study was conducted on Black Cat Mountain (Figure 1) in the Rocky Mountain Foothills (Boule Range) east of Jasper National Park (53°18'N: 117°52'W). Moss samples (~250 ml each) were collected from eight sites along an elevational gradient. The lowest altitude sampled was 1100 m, the highest was 1800 m and samples in between were collected at altitudinal intervals of 100 m. The moss collected was *Pleurozium schreberi* (Brid.) Mitt., which is a widespread species common in dry forested areas (Johnson et al. 1995). Two sub-samples were collected at each altitude. Each of the 16 samples was placed in a separate paper bag for transport from the field.

Tardigrade extraction from the moss was achieved by using a Baermann funnel apparatus (Whitehead and Hemming 1965). This involved placing a sample of moss wrapped in cheesecloth in the cone of a blocked funnel. The funnel was then filled with water to submerge the sample. Live tardigrades migrate through the cheesecloth and collect in the water at the narrow base of the funnel. After 48 hours, the water from the base of the funnel was collected by removing the stopper. Any tardigrades remaining in the moss were separated by agitating the sample repeatedly in water. The water from both of these techniques was then combined and examined under a stereomicroscope (minimum 25×) for tardigrades and their eggs. Specimens were slide-mounted using polyvinyl alcohol medium (commercially available as PVA from BioQuip Products Inc., catalogue number 6371).

Identification of species was facilitated using the work of Ramazzotti and Maucci (1983). Hieronim Dastych (Zoologisches Institut und Zoologisches Museum, Universitaet Hamburg) and Nigel Marley (Faculty of Science, University of Plymouth) provided invaluable assistance by confirming the identities of voucher specimens.

Results

A total of 902 tardigrades representing seven genera and nine identifiable species were extracted from the 16 moss samples. Eighty-seven specimens were in poor condition and unidentifiable. Six of the species identified in this study (denoted by cf.) were from complexes composed of very similar sub-species (H. Dastych, personal communication). Tardigrade eggs are often required to identify sub-species within a complex. The tardigrades found in the greatest abundance were *Ramazzottius* sp. (N=247), *Macrobiotus* cf. *hufelandi* Biserov, 1991 (N=154), *Macrobiotus* cf. *richtersi* Murray, 1911 (N=107) and *Milnesium tardigradum* Doyere, 1840 (N=100). The *Ramazzottius* sp. may represent more than one species; however, without eggs this could not be determined. The remaining species were each represented by fewer than 100 specimens:

Hypsibius cf. convergens Urbanowicz, 1925 (N=79), *Macrobiotus cf. areolatus* Murray, 1907 (N=66), *Macrobiotus cf. islandicus* Richters, 1904 (N=29), *Echiniscus spitsbergensis* Scourfield, 1987 (N=23), *Isohypsibius cf. tuberculatus* Plate, 1888 (N=8) and *Platycrista cheleusis* Kathman, 1990 (N=2).

All 10 taxa are new records for Alberta. One species was a new record for Canada (McInnes 1994; Boeckner et al., 2005): *M. cf. islandicus*. *Platycrista cheleusis* has only ever been recorded previously in British Columbia (Kathman 1990). Table 1 shows the distribution patterns of the nine tardigrades identified to species and locations in Canada where they have been previously recorded.

An analysis of the distribution of species across an altitudinal gradient revealed only a few minor patterns. The third (1300 m) and fifth (1500 m) elevations contained the majority of specimens, 41% and 32%, respectively. Within these two altitudes *Ramazzottius* sp. dominated but was not found again within the other elevations. *Milnesium tardigradum* was relatively abundant in the third elevation but was not recorded elsewhere. Similarly, *M. cf. islandicus* and the one heterotardigrade identified, *E. spitsbergensis*, were found only in the lower elevations (1100 to 1300 m). *M. cf. hufelandi* exhibited the most even distribution across the gradient.

Discussion

All 10 of the tardigrade taxa identified within this study were new records for Alberta and one species was a new record for Canada. The discovery of *M. cf. islandicus* was surprising given the limited distribution of this species reported in previous studies (Table 1). Ramazzotti and Maucci (1983) describe this species as neither frequently found nor hard to find suggesting that it may have a widespread distribution but generally low abundance. *Platycrista cheleusis* has previously found only on Vancouver Island, British Columbia (Kathman 1990). The remaining seven species are



FIGURE 1. Location of Black Cat Mountain (X) in the Rocky Mountain foothills just outside of Jasper National Park.

reported to have widespread to cosmopolitan distributions and therefore it is not surprising to identify them from Alberta mosses. It is important to note that although species designations are given here for most taxa, the lack of tardigrade eggs within the samples made some identification possible only to complexes of sub-species (denoted by cf.). Voucher specimens of each species were submitted to the University of Alberta freshwater invertebrate collection and are available upon request.

Table 1. Nine species of tardigrades new to Alberta and where previously recorded in Canada (adapted with permission from Bateman and Collins 2001). Distribution patterns as noted by Ramazzotti and Maucci (1983) and McInnes (1994). Locations: BC, British Columbia; L, Labrador; NB, New Brunswick; NF, Insular Newfoundland; NWT, Northwest Territories; ON, Ontario; PQ, Province du Quebec. Recorded by: A, Argue (1971, 1972, 1974); B&C, Bateman and Collins (2001); B, Boeckner et al. (2005); I, Iharos (1973); K, Kathman (1990); M, Murray (1910); P, Pilato (1977); R, Richters (1908); VR¹, Van Rompu et al. (1991); VR², Van Rompu et al. (1992).

Species	Canadian Records	Distribution
<i>Echiniscus spitsbergensis</i>	NB (A), NWT (VR ^{1,2})	widespread
<i>Macrobiotus cf. areolatus</i>	BC(M,K), NB(A), ON(M), RM(M), SK(P)	cosmopolitan
<i>M. cf. hufelandi</i>	BC(R,M,K), L (B), NB(A), NF(B&C), ON(M), PQ(I), RM(M)	cosmopolitan
<i>M. cf. islandicus</i>	new Canadian record	Europe-Iceland
<i>M. cf. richtersi</i>	BC(K), NB(A), PQ(I),	cosmopolitan
<i>Hypsibius cf. convergens</i>	BC(K), L (B), NB(A), NF(B&C), NWT(VR ^{1,2})	cosmopolitan
<i>Isohypsibius cf. tuberculatus</i>	BC(M), NB(A)	widespread
<i>Platycrista cheleusis</i>	BC(K)	Canada-BC
<i>Milnesium tardigradum</i>	BC (R, K), L (B), NB (A), NF(B&C), ON(M), PQ(I)	cosmopolitan

The analysis of tardigrade distributions across an elevational gradient produced only weak patterns. This was likely owing to lack of adequate replication at each elevation and natural variation in tardigrade abundance and distribution (patchiness). Furthermore, sample sites were likely variable in more ways than elevation alone (i.e., exposure, substrate type, moisture, etc.). Generally, *M. cf. hufelandi* tended to have a more uniform distribution throughout most elevations when compared with the other species. Additionally, *Echiniscus spitsbergensis* and *M. cf. islandicus* had distributions limited to lower elevations. It remains to be determined whether these general trends are indicative of actual altitude-constrained distributions.

Although this study has identified a fair number of Albertan tardigrades there are vast areas of the province that have yet to be surveyed. Until such investigations are made it is impossible to comment confidently on species ranges.

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