Redescription of the spider *Robertus arcticus* (Chamberlin & Ivie) (Araneae: Theridiidae), with the first description of the female

J. PINZON[1], K. KENT[1], D. J. BUCKLE[2], AND R. BENNETT[3]

ABSTRACT

The original description of *Robertus arcticus* (Chamberlin and Ivie, 1947) (Araneae: Theridiidae) was based on a single male collected in Alaska, United States of America. The female has remained undescribed, although specimens of both sexes have been collected over the intervening decades. The species occurs in boreal Alaska, and records from Cold Lake, Alberta, Canada and James Bay, Ontario, Canada suggest that it is probably widely distributed in the Canadian boreal. Here we redescribe the male and describe the female for the first time. Most specimens examined in our study were collected from the ground of boreal forest peatlands in northeastern Alberta.

Keywords: *Robertus*, taxonomy, Nearctic, boreal forest

INTRODUCTION

The genus *Robertus* O. Pickard-Cambridge (Araneae: Theridiidae) is widely distributed, with 47 described species. Most of the species are found in the northern hemisphere, and one is known from central Africa (World Spider Catalog 2020). A majority of the species have Palaearctic distributions from Europe and the Caucasus to Russia, China, and Korea; 15 are known from the Nearctic region. Many species of *Robertus* are common ground-dwelling spiders, found mostly in forest litter and moss (Eskov 1987). Kaston (1946) reviewed the genus in North America, describing 15 species, six of which were new. The Nearctic species are found in Canada and the United States of America, from Alaska to Utah in the west to Newfoundland and Florida in the east (Canadian Endangered Species Conservation Council 2016; Kaston 1946).

The northern Nearctic species *Robertus arcticus* (Chamberlin and Ivie, 1947) was first described as *Ctenium arcticum* from a single male collected by J.C. Chamberlin in Fairbanks, Alaska, United States of America in 1943. Holm (1960) reported, but did not describe, a single female collected in Kotzebue, north of Seward Peninsula, near Bering Strait, Alaska in 1958. *Ctenium arcticum* was later listed as a new combination within *Robertus* in Brignoli's spider catalogue (Brignoli 1983), following the revision of the genera of Theridiidae

[1]Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, 5320 122 Street, Edmonton, AB T6H 3S5; jaime.pinzon@canada.ca
[2]16-3415 Calder Crescent, Saskatoon, SK S7J 5A3
[3]Department of Entomology, Natural History Section, Royal British Columbia Museum, 675 Belleville Street, Victoria, BC V8W 9W2

(Levi and Levi 1962), who listed *Ctenium* Menge as a synonym of *Robertus*. Eskov (1987) referred to *R. arcticus* as endemic to Alaska, and the species is known from several localities across the state (GBIF Secretariat 2020). The species, however, is also known to occur in Canada, with records from Alberta, Saskatchewan, Manitoba, and Ontario (Canadian Endangered Species Conservation Council 2016; Paquin et al. 2010). In the present study, the distribution is expanded further south, as it is also known to occur in North Dakota, United States of America.

In an ongoing study of Nearctic boreal spider diversity, we found more than two dozen male and female specimens of *R. arcticus* in pitfall traps set in the ground in boreal forest peatlands in northeastern Alberta. In the present study, we redescribe the male of *R. arcticus* and describe for the first time the female, based primarily upon those specimens. We provide photographs of specimens and new illustrations of male and female characters. We also provide a distribution map, and we discuss the natural history of the species.

METHODS

The description here is based on 10 males and 15 females collected in 2017 from pitfall traps as part of a habitat restoration project in the oil sands of northeastern Alberta. Specimens are deposited in the Arthropod Collection at the Northern Forestry Centre (Natural Resources Canada-Canadian Forest Service; NFRC) in Edmonton, Alberta. Specimens are preserved in 75% ethanol, and they were examined, photographed, measured and drawn under a Leica MZ 205C stereomicroscope (Leica, Wetzlar, Germany) equipped with a Dino-Eye AM7025X digital camera (AnMo Electronics Corporation, Taipei, Taiwan). Digital images of both sexes were taken at different focal planes and stacked using *CombineZP* imaging software (Alan Hadley, http://www.hadleyweb.pwp.blueyonder.co.uk/CZP/files.htm). The epigyna of four specimens were removed, cleared in a 10% potassium hydroxide (KOH) solution, washed with distilled water, and transferred to 75% ethanol for inspection. The left palp of four specimens was gently detached from the body and expanded using 10% KOH-distilled water bath. Measurements were taken from five individuals of each sex and are provided in micrometres (average ± standard deviation). Carapace and abdomen widths were taken at the widest point; carapace and abdomen lengths were taken from the anterior to posterior margin. Lengths of leg segments were taken in lateral view. Eye sizes were obtained from the average of the maximum diameter of the lens and the diameter perpendicular to it, on each eye. Height of median ocular area was measured between the centre of the anterior median eyes and posterior median eyes. Clypeus height was measured from the border of the cephalothorax to the anterior edge of the median ocular area. Additional specimens, deposited in other collections, were also examined (DJB: Donald J. Buckle personal spider collection, Saskatoon, Saskatchewan, Canada; UAM: University of Alaska Museum of the North, Fairbanks, Alaska; RSM: Royal Saskatchewan Museum, Regina, Saskatchewan).

Distribution of the species was inferred from specimens examined here and from the label information of other specimens held at the Canadian National Collection, Ottawa, Ontario, Canada and the holotype locality. In such cases in

which coordinates were not provided on the label, these were generated in Google Earth using locality information.

Taxonomy

Robertus arcticus (Chamberlin & Ivie, 1947)
(Figs. 1–20; locations: Fig. 21)
Ctenium arcticum Chamberlin & Ivie, 1947: 25, f. 11–13
Robertus arcticus Brignoli, 1983: 411

Type material

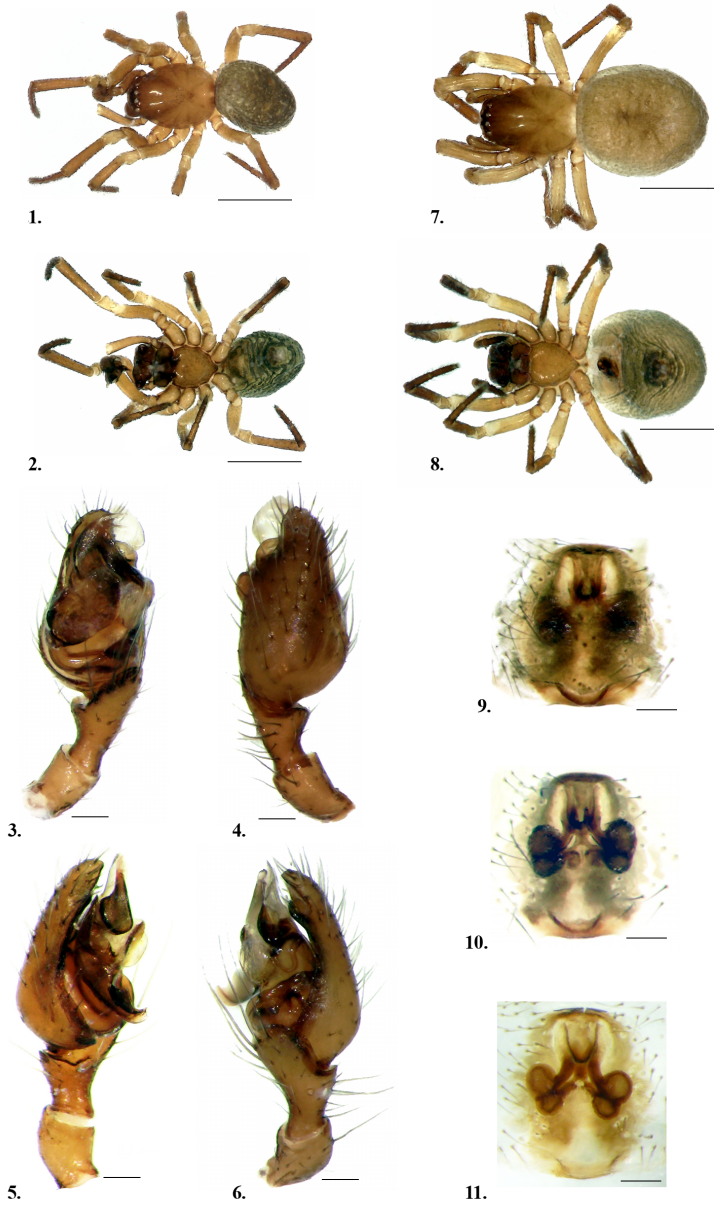
Holotype ♂ **United States of America:** ***Alaska*****:** Fairbanks, 64° N, 147° W, 21–22 September 1943, J.C. Chamberlin (museum depository unknown), not examined. **Note**: Current public health restrictions due to COVID-19 have limited our ability to locate the holotype specimen. We believe it is in the American Museum of Natural History (AMNH; New York City, New York, United States of America), but there is no database record for it, and curatorial staff at that institution are currently unable to access the collection to look for the specimen. We were unable to examine specimens held at the Canadian National Collection for the same reason.

Material examined

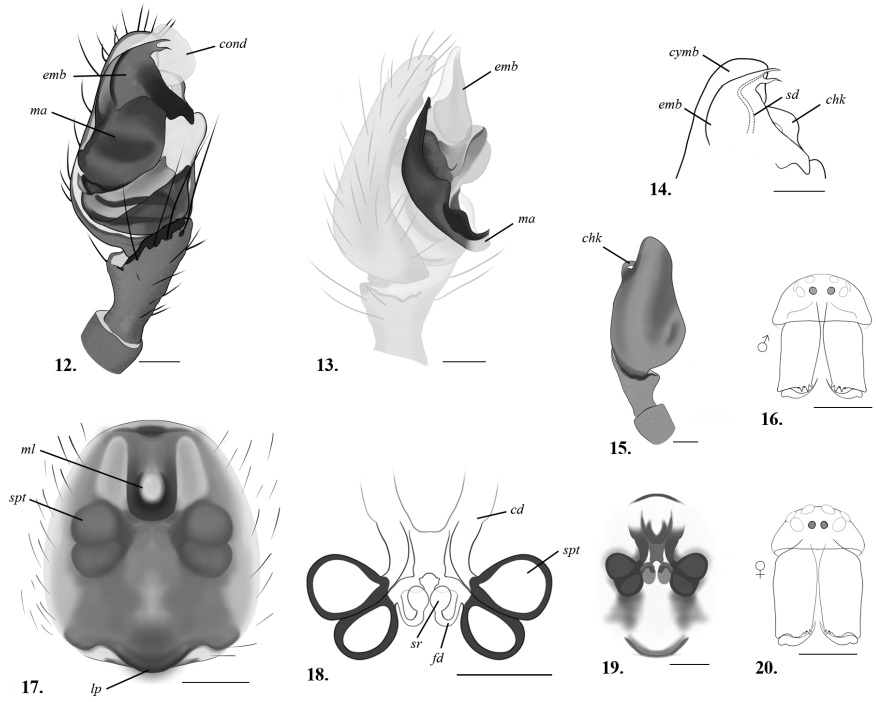
Canada. ***Alberta*****:** 10 ♂, 15 ♀, Cold Lake region, S of McDougall Lake, 54° 34' 59" N, 110° 28' 15" W, 14.vi–01.ix.2017, treed peatlands, in pitfall traps, J. Hammond & P. Hoffman leg (NFRC-2018-04393, NFRC-2018-04397, NFRC-2018-04407, NFRC-2018-04412, NFRC-2018-04416, NFRC-2018-04420, NFRC-2018-04421, NFRC-2018-04423, NFRC-2018-04432, NFRC-2018-04438, NFRC-2018-04452, NFRC-2018-04455, NFRC-2018-04456, NFRC-2018-04475, NFRC-2018-04607, NFRC-2018-04610, NFRC-2018-04623); 1 ♀, Wagner Natural Area, Acheson, 6 km W of Edmonton, 12–25.vi.1985, Finnamore & Thormin (DJB-14844). ***Saskatchewan***. 1 ♀, Dr. Mainprize Park, Mainprize Regional Park, Red Earth Creek, 03.vi.1987, K. Roney (RSM); 3 ♀, Englefeld, 27.vi.1966, D.J. Buckle (DJB-02391); 4 ♂, Hanley, 09.v–5.vii.1995, K. Pivnick (DJB-02392, DJB-02393, DJB-02394); 4 ♂, Hodgeville, 14.v–01.vi.1995, K. Pivnick (DJB-02395); 1 ♀, Lady Lake, 03–30.ix.1970, D.J. Buckle (DJB-02396); 1 ♀, Saskatoon, 25.v.1995, D.J. Buckle (DJB-02397); 1 ♀, Saskatoon, 5 mi NE, 13–20-vii, E. Gorin (DJB-02398); 1 ♀, Dundurn, 9 mi SSW, 22.vii.1972, D.J. Buckle & J.G. Buckle (DJB-02399); 2 ♂, St. Denis, 4–31.v.1995, 4–24.v.1996, K. Pivnick (DJB-02400, DJB-02401).

United States of America. ***Alaska*****:** 1 ♂, Denali N.P.P., Wickersham Dome, 63° 33' 23" N, 150° 58' 39" W, 13.vii.2017, A. Haberski, D. Sikes, J. Rykkim (UAM-100051597); 1 ♂, Fairbanks, 930 Fitz Ct., 280 m, 64° 54' 05" N, 147° 31' 45" W, 29.iv–29.v.2008, D.S. Sikes (UAM-100032770); 1 ♀, Fairbanks, Georgeson Botanical Garden, 64° 51' 22" N, 147° 51' 20" W, 7.v.2008, S. Emmert (UAM-100033792); 2 ♂, 4 ♀, Delta Junction, SE Fairbanks, Conservation Reserve Program Land, Site #26, 63° 57' 55" N, 145° 08' 29" W, 18.v–28.ix.2007, A.M. Hagerty & S. Emmert (UAM-100033907, UAM-100033908, UAM-100033909, UAM-100033910, UAM-100033911, UAM-100033979); 2 ♂, 1 ♀, Delta Junction, SE Fairbanks, Conservation

Reserve Program Land, Site #25, 63° 58' 03" N, 145° 08' 13" W, 10–29.viii.2007, A.M. Hagerty & S. Emmert (UAM-100033912, UAM-100033975, UAM-100033978). ***North Dakota*:** 1 ♂, Cass County, 9–15.vii.1966, unknown collector (DJB-02447); 1 ♂, Inkster, Grand Forks County, 1.v.1959, R.L. Post (DJB-02448).



Figures 1–11. *Robertus arcticus*. **1,** habitus of male, dorsal view; **2,** habitus of male, ventral view; **3,** palp, ventral view; **4,** palp, dorsal view; **5,** palp, prolateral view; **6,** palp, retrolateral view; **7,** habitus of female, dorsal view; **8,** habitus of female, ventral view; **9,** epigynum, ventral view; **10,** cleared epigynum, ventral view; **11,** spermathecae, dorsal view. Scale lines = 100 µm (Figs. 3–6, Figs. 9–11), 1000 µm (Figs. 1, 2, 7, 8).



Figures 12–20. *Robertus arcticus*. **12,** palp, ventral view; **13,** palp, prolateral view; **14,** embolus, ventral view; **15,** palp, dorsal view; **16,** face of the male; **17,** epigynum, ventral view; **18,** spermathecae, dorsal view; **19,** cleared epigynum, ventral view; **20,** face of the female. Abbreviations: *cd*, copulatory duct; *chk*, cymbial hook; *cond*, conductor; *cymb*, cymbium; *emb*, embolus; *fd,* fertilisation duct; *lp*, sclerotised lip; *ma*, median apophysis; *ml*, median lobe; *sd*, sperm duct; *sr*, seminal receptacle; *spt*, spermathecae. Scale lines = 100 μm (Figs. 12–15, Figs. 17–19), 500 μm (Figs. 16, 20).

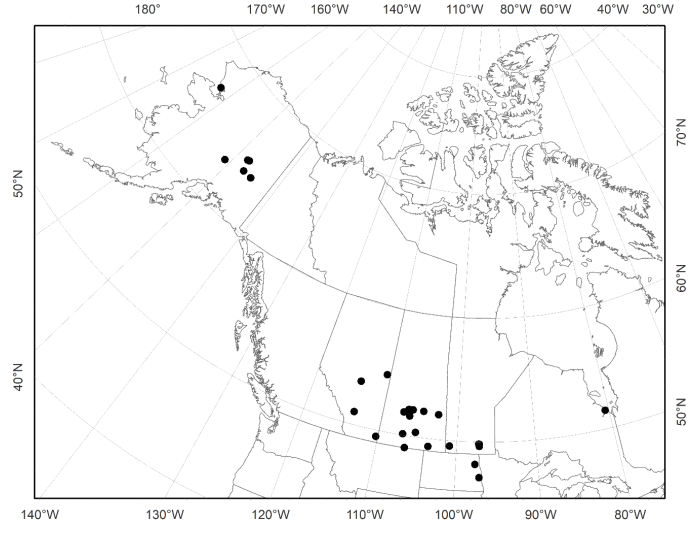


Figure 21. Localities of *Robertus arcticus* in North America.

DIAGNOSIS

Male palp similar to *Robertus banksi* (Kaston, 1946), both having a subtriangular embolus, broad basally and ending in two fine points bent into the transparent conductor, and a median apophysis of reasonable size (about half of bulb width in ventral view; Figs. 3, 5, 12, 13; Figs. 6–7 in Kaston 1946). It resembles *Robertus borealis* (Kaston, 1946), both having a similar position of the cymbial hook, arising close to the distal end of the cymbium, and lacking stout setae distally on the cymbium (Figs. 4–5; Fig. 43 in Kaston 1946). From *R. banksi*, the male of *R. arcticus* can be distinguished by its lack of a proximal short, thick spur on the median apophysis (Figs. 5, 13). From *R. borealis*, the male of *R. arcticus* can be distinguished by its cymbial hook being bent almost 90 degrees (Figs. 4, 6, 15) and its median apophysis lacking a proximal subdivided ramus (Figs. 5, 13). The epigynum of the female of *R. arcticus* resembles *R. banksi*, both having a broad U-shaped median lobe (Figs. 9, 10, 17; Fig. 49 in Kaston 1946). From *R. banski*, the female of *R. arcticus* can be distinguished by its narrower posterior sclerotised lip of the epigynum (Figs. 9, 10, 17) and spermathecae constricted medially (Figs. 10, 11, 17–19).

Description

Male (Figs. 1–6, 12–16; Table 1) (n=5). Total length (sum of the lengths of carapace and abdomen): 2119.0 ± 80.29. Carapace glabrous, glossy brown with lighter side margins; oval, longer (1141.4 ± 23.82) than wide (897.0 ± 21.41), widest at coxae II, with thoracic furrow in the shape of a shallow oval pit. Anterior eye row slightly recurved, with anterior median eyes separated by their diameter and closer to anterior lateral eyes by two-thirds of their diameter. Posterior eye row straight, slightly longer than anterior row, with eyes equidistant separated by their diameter. Anterior median eyes dark and nearly circular (49.8 ± 5.59), posterior median eyes pearly white and nearly circular (62.7 ± 2.57). Lateral eyes irregularly shaped and pearly white, with anterior lateral eyes (63.4 ± 2.27) and posterior lateral eyes (62.5 ± 5.96) contiguous on a low tubercle. Median ocular area narrower anteriorly (height: 101.2 ± 5.50). Clypeus, 192.2 ± 15.51, high. Chelicerae dark reddish brown, robust but more slender than in female. Promargin of fang furrow with three teeth, and retromargin with two smaller teeth. Cheliceral fangs longer than cheliceral width, crossing at tips. Labium dusky brown, wider than long, extending to half the way of the endites; endites dusky brown with dark brown at the base. Sternum lighter, yellowish brown, almost as wide as long, widest between coxae I and coxae II, with anterior margin narrowing towards the base of the endites and posterior margin ending in a round triangular point separating coxae IV. Legs without spines but covered with fine hairs; yellowish brown at the base (coxa, trochanter, femur, patella) and reddish dark distally (tibia, tarsus, metatarsus). Leg I the longest (3489.1 ± 98.80), followed by leg IV (3470.4 ± 79.54), leg II (3021.0 ± 88.04) and leg III (2610.4 ± 64.05). Abdomen oval, longer (1222.0 ± 96.94) than wide (841.2 ± 51.40), moderately flat, overhanging the cephalothorax by one-fifth of its length and covered with short fine hairs. Colouration mostly dark grey, with no evident markings dorsally, dark area anterior to spinnerets ventrally, and lighter epigastric plates. Spinnerets light brown, not visible from above.

Palp (Figs. 3–6, 12–15). Cymbium lacking stout setae distally. Cymbial hook closer to the distal end of the cymbium, bent about 90 degrees towards the cymbium, partially visible through the broad, round, and transparent conductor in ventral view. Embolus subtriangular, ending anteriorly in two fine points bent into the conductor. Sperm duct bent sideways halfway between the base and the anterior fine point of the embolus. Median apophysis longer than wide with undivided proximal ramus. In ventral view, basal lobe broad and slightly concave, with lateral-posterior tip of proximal ramus ending in a keeled semitransparent concave structure. In prolateral view, median apophysis is narrow apically, partially hidden by the embolus, and with a broad ramus with two lobes, with anterior lobe round and posterior lobe pointed distally.

Table 1. Mean length (μm) of leg segments of the male (± standard deviation) (*n*=5). Abbreviations: *cx*, coxa; *tr*, trochanter; *f*, femur; *pt*, patella; *tb*, tibia; *mt*, metatarsus; *ta*, tarsus.

Segment	Leg I	Leg II	Leg III	Leg IV
cx	246.0 (42.00)	234.3 (21.39)	222.0 (40.73)	246.0 (28.21)
tr	130.7 (32.87)	136.0 (39.89)	108.3 (3.21)	140.0 (21.66)
f	918.1 (34.61)	740.3 (26.41)	637.7 (49.91)	886.8 (42.61)
pt	409.3 (22.05)	379.0 (17.69)	315.0 (10.44)	360.0 (16.52)
tb	780.3 (29.57)	646.7 (10.69)	514.0 (9.64)	804.3 (23.51)
ta	551.7 (22.81)	468.0 (21.93)	426.7 (14.98)	580.0 (24.58)
mt	453.0 (15.39)	416.7 (22.37)	386.7 (22.85)	453.3 (11.15)

Female (Figs. 7–11, 17–20; Table 2) (n=5). Total length: 2415.0 ± 102.75. Similar to male in general appearance and structure, but slightly larger body and shorter legs. General colouration variable, with some specimens lighter than males. Carapace 1184.6 ± 79.02 long, 904.0 ± 62.68 wide. Anterior median eyes 53.5 ± 5.59; anterior lateral eyes 65.4 ± 1.95; posterior median eyes 67.1 ± 2.57; posterior median eyes 66.7 ± 8.76. Median ocular area 101.0 ± 10.46 high. Clypeus 204.0 ± 24.38 high. Legs I 3394.5 ± 206.30 long; Legs II 2911.3 ± 117.77 long; Legs III 2559.8 ± 99.81 long; Legs IV 3432.1 ± 79.51 long. Abdomen 1538.0 ± 122.18 long and 1092.0 ± 85.35 wide.

Epigynum (Figs. 9–11, 17–19). U-shaped anterior median lobe longer than wide, round, and darker at the posterior end. Median lobe over a pair of lighter receptacles on each side. Anterior border of epigynum with a short sclerotised straight edge. Posterior border of epigynum with a procurved sclerotised narrow lip, two-thirds the width of the vulva, that slightly extends distally. Spermathecae faintly seen through the epigynal plate in ventral view. Spermathecae constricted medially, with anterior section round and larger than posterior section. Copulatory openings very difficult to see, located below the median lobe, from which copulatory ducts are connected to anterior section of the spermathecae. Fertilisation ducts connected to posterior section of the spermathecae and to seminal receptacles, located medially in between spermathecae.

Table 2. Mean length (μm) of leg segments of the female (± standard deviation) (*n*=5). Abbreviations: *cx*, coxa; *tr*, trochanter; *f*, femur; *pt*, patella; *tb*, tibia; *mt*, metatarsus; *ta*, tarsus.

Segment	Leg I	Leg II	Leg III	Leg IV
cx	260.3 (20.76)	210.3 (51.98)	229.8 (30.26)	240.0 (23.45)
tr	134.3 (23.06)	111.0 (4.32)	108.5 (20.14)	139.0 (25.23)
f	888.0 (54.43)	734.1 (46.01)	610.4 (39.09)	875.0 (53.85)
pt	411.8 (21.19)	377.5 (19.84)	313.3 (15.52)	369.3 (11.50)
tb	736.3 (63.15)	618.3 (28.25)	489.8 (31.40)	788.0 (19.48)
ta	519.5 (48.28)	451.3 (17.06)	412.0 (18.78)	557.0 (31.14)
mt	444.3 (21.84)	408.8 (23.47)	386.0 (18.46)	463.8 (14.01)

Distribution and natural history

Alaska, North Dakota, United States of America, and Alberta, Saskatchewan, Manitoba, and Ontario, Canada (Fig. 21; Chamberlin and Ivie 1947; Holm 1960; Aitchison 1984; Paquin et al. 2010; Cárcamo et al. 2014). *Robertus arcticus* has been found in a variety of prairie and parkland habitats in Canada, including under riverside rocks, pond margins, hedgerow by fields, railway lines, willow–sedge marshes, marshy lakebeds, tall grass, low bushes above marshy ground, cultivated field and wetlands, moss at spring, and extracted from *Rana sylvatica* stomach contents. Specimens in southern Manitoba have been collected from grasslands (Aitchison and Dondale 1990). Specimens in eastern Alberta (described here) were collected from boreal forest peatlands, together with males and females of *R. borealis*. Overall, moist situations appear to predominate. In southern Manitoba, the species appears to be eurychronous as well as winter-active (Aitchison 1984), with both sexes having been collected with pitfall traps between April and November. In our study in northeastern Alberta, males and females were collected from June through September. In Alaska, specimens have been found in alpine tundra habitats, pineapple weed, and in birch–poplar forests and have been collected with pitfall traps between April and September.

ACKNOWLEDGEMENTS

We are grateful to James Hammond and Philip Hoffman, who led the fieldwork that resulted in the collection of the specimens that prompted this paper and were supported by Imperial Oil and Natural Resources Canada, Office of Energy Research Development – Program for Energy Research Development (OERD-PERD). Thanks to Brandi Fleshman and Derek Sikes, who loaned specimens held at the University of Alaska Museum of the North, and Owen Lonsdale and Michelle Locke, who provided relevant information from museum specimens held at the Canadian National Collection, Ottawa, Ontario, Canada.

REFERENCES

Aitchison, C.W. 1984. The phenology of winter-active spiders. Journal of Arachnology, **12**: 249–271.

Aitchison, C.W. and Dondale, C.D. 1990. A checklist of Manitoba spiders (Araneae) with notes on geographic relationships. Naturaliste Canadien, **117**: 215–237.

Brignoli, P.M. 1983. A catalogue of the Araneae described between 1940 and 1981. Manchester University Press, Manchester, United Kingdom.

Canadian Endangered Species Conservation Council. 2016. Wild Species 2015: The general status of species in canada [online]. National General Status Working Group. Available from http://wildspecies.ca/reports [accessed 23 July 2020].

Cárcamo, H.A., Pinzón, J., Leech, R., and Spence, J.R. 2014. Spiders (Arachnida: Araneae) of the Canadian prairies. *In* Arthropods of Canadian grasslands. Volume. 3. *Edited by* H.A. Cárcamo and D.J. Giberson. Biological Survey of Canada, Ottawa, Ontario, Canada. Pp. 75–137.

Chamberlin, R.V. and Ivie, W. 1947. The spiders of Alaska. Bulletin of the University of Utah, **37**: 1–103.

Eskov, K.Y. 1987. The spider genus *Robertus* O. Pickard-Cambridge in the USSR, with an analysis of its distribution (Arachnida: Araneae: Theridiidae). Senckenbergiana Biologica, **67**: 279–296.

GBIF Secretariat. 2020. Global biodiversity information facility: occurrence download *Robertus arcticus* [online]. Available from https://doi.org/10.15468/dl.sxrsvq [accessed 30 May 2020].

Holm, Å. 1960. On a collection of spiders from Alaska. Zoologiska Bidrag från Uppsala, Bd, **33**: 109–138.

Kaston, B.J. 1946. North American spiders of the genus *Ctenium*. American Museum Novitates, **1306**: 1–19.

Levi, H.W. and Levi, L.R. 1962. The genera of the spider family Theridiidae. Bulletin of the Museum of Comparative Zoology, **127**: 1–71.

Paquin, P., Buckle, D.J., Dupérré, N., and Dondale, C.D. 2010. Checklist of the spiders (Araneae) from Alaska and Canada. Zootaxa, **2461**: 1–170. https://doi.org/10.11646/zootaxa.2461.1.1.

World Spider Catalog. 2020. World Spider Catalog. Version 21.0 [online]. Natural History Museum Bern. Available from http://wsc.nmbe.ch [accessed 20 May 2020].