

Leptothorax athabasca sp.n. (Hymenoptera: Formicidae) from Alberta, Canada, an ant with an apparently restricted range

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Abstract

Gyne (holotype), worker and male of *Leptothorax athabasca* sp.n. are described from the Athabasca River valley, Jasper National Park, Alberta, Canada. The most characteristic features of gyne and worker are a sharp dorsal crest of the petiolar node, a straight dorsal profile of the mesosoma, acute and straight horizontal propodeal spines, and a comparatively flat dorsal surface of the mesosoma. *Leptothorax athabasca* sp.n. has been found in only one very small plot of a few 100 square meters, upriver of Athabasca Falls south of Jasper. It appears to be a rare, local species with adaptations to dwelling rock crevices. Possible reasons for such a restricted range are discussed. The new species nests in rock crevices, an exception among its congeners which usually are found in dead wood.

Key words: Formicoxenini, *Leptothorax*, new species, Nearctic Region, Canada, Alberta, restricted range, life habits.

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Introduction

The Canadian Rocky Mountains apparently harbour a wealth of undescribed or little known ant species, particularly among the genera with small colonies and secretive life habits such as typical in the tribe Formicoxenini. A couple of species from this area have been described as new during the past three decades: *Leptothorax pocahontas* (BUSCHINGER, 1979), *Leptothorax faberi* BUSCHINGER, 1983, *Temnothorax fragosus* (MACKAY & BUSCHINGER, 2002). Other species described from eastern North America have been recorded there: *Formicoxenus quebecensis* FRANCOEUR, 1985, and *Leptothorax wilsoni* HEINZE, 1989.

In July 1993 the first author, together with Ralf D. Schumann, made another collecting trip, aimed at the study of Formicoxenini, to Jasper National Park, Alberta, Canada. An unforeseen wealth of rare or undescribed species was found. Among them was the species to be described here. A complete differential diagnosis cannot be provided for the new species because a high number of North American species of *Leptothorax* are not or insufficiently described, or only provisionally characterized with enzyme electrophoresis, or treated as "*Leptothorax* sp." in the internet. We hope that the interest in North American *Leptothorax* will increase due to the description of this definitely separate new species.

Materials and Methods

Collecting was done by opening dead twigs lying on the ground, by dissecting slabs of tree bark, by turning over smaller and larger slabs of rock on the ground and by breaking open crevices in the low cliffs along the river. A

few colonies of the new species were brought to Germany for laboratory studies and for rearing their sexuals.

Type material of *Leptothorax athabasca* was deposited in the following collections: AMNH – American Museum of Natural History, New York, USA (holotype gyne; 4 paratype workers; 1 paratype male); NHMW – Natural History Museum Vienna (2 paratype gynes; 3 paratype workers; 2 paratype males); PCAB – personal collection of Alfred Buschinger, Reinheim, Germany (3 paratype gynes; 3 paratype workers; 3 paratype males); PCAS – personal collection of Andreas Schulz, Dormagen, Germany (3 paratype gynes; 3 paratype workers; 2 paratype males); SMNK – Staatliches Museum für Naturkunde Karlsruhe, Karlsruhe, Germany (3 paratype gynes; 3 paratype workers; 2 paratype males).

Measurements were taken using a Zeiss Stemi SR stereomicroscope equipped with an ocular graticule, at a maximum magnification of 250×. The data are presented in µm, as mean ± standard deviation, with minimum and maximum values in parentheses, holotype gyne in square brackets. The following measurements were taken:

- HL Head length. Maximum distance from anteriormost to posteriormost margin along median axis. Both anterior and posterior margin of head must be in focus.
- HW Head width. Maximum head width posterior to eyes.
- HS Head size. Arithmetic mean of HL and HW.
- SL Maximum chord length of scape in dorsal view. Maximum distance from most distal point of dorsal lamella of scape apex to most proximal point of scape shaft near neck of articular condyle.

- 2FL Maximum length of second funiculus segment after antennal scape, measured only in males.
- ED Eye diameter: Largest measurable line across compound eye including all structurally visible ommatidia, measured in lateral view.
- ML Mesosoma length. Measured in lateral view from frontalmost point of anterior pronotal slope to caudalmost portion of propodeum ("Weber's length").
- MW Maximum mesosoma width. Measured in dorsal view at widest part of mesosoma
- PSL Propodeal spine length. Measured in workers and gynes. In dorsal to anterodorsal view, tip of measured spine, its base, and center of concavity between spines must all be in focus. Always the right spine was measured (cf. GÜSTEN & al. 2006).
- PEL Petiole length. Maximum length of petiolar node measured in dorsal view from anterior notch close to propodeum to articulation with postpetiole, with both points in focus.
- PEW Petiole width. Maximal measured width of petiole in dorsal view.
- PEH Petiole height. Maximum height of petiolar node, measured in lateral view from highest (median) point of node to ventral margin. The ventral margin always has a short concave portion, which marks the ventral measuring point.
- PPW Postpetiole width. Maximal measured width of postpetiole in dorsal view.
- PSI Propodeal spine index (BUSCHINGER 1966) measured in a few gynes and workers only.

Photography. The photographic images (Figs. 1 - 8) were taken using a digital camera (JVC KY-70B) attached to a Leica Z6 APO stereomicroscope. The microscope was equipped with a Z-stepper (Syncroscopy, Synoptics Ltd.) to enable the generation of usually 100 images in different focus layers from which a montage image was computed using AutoMontage Pro 5.02.0096, Synoptics Ltd. (cf. GÜSTEN & al. 2006).

Taxonomy of *Leptothorax athabasca* sp.n.

Etymology. The name refers to the type locality. The specific epithet is to be treated as a noun in apposition.

Type locality. On 27 July 1993, seven colonies have been collected in rock crevices on the south-exposed river bank just upriver Athabasca Falls of Athabasca River, Jasper National Park. The site is at 52° 39' 55" N, 117° 52' 58" W, at an elevation of c. 1200 m a.s.l. (as indicated by Google Earth).

The habitat is the river bank that sometimes is evidently flooded. A horizontally split, schist-like sandstone cliff is exposed there. The ants were exclusively found in rock crevices, whereas above the flood line a number of related species of *Leptothorax* were dwelling dead wood, or a layer of conifer needles and debris beneath small flat rocks. Mainly *Leptothorax retractus* FRANCOEUR, 1986 could be found there. Close to the river and in the collecting site the coniferous forest was comparatively open.

Type material. Holotype gyne, 11 paratype gynes, 16 paratype workers, 10 paratype males.

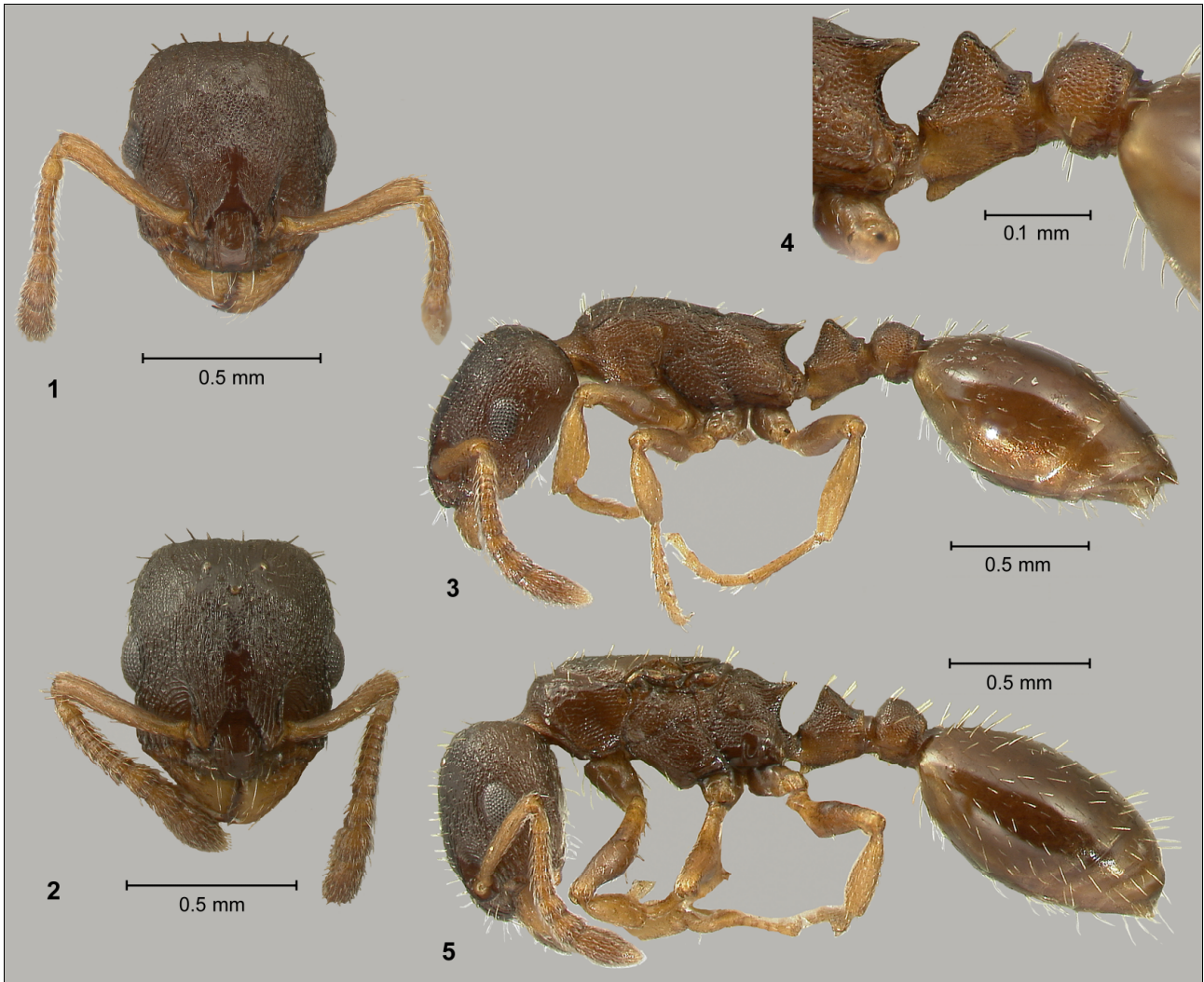
Measurements of worker (n = 13). HL 697 ± 30 (656 - 760); HW 598 ± 23 (570 - 637); SL 457 ± 14 (437 - 475); MW 416 ± 23 (390 - 456); PSL 119 ± 15 (95 - 143); PEL 239 ± 13 (219 - 257); PEW 180 ± 10 (162 -

190); PPW 255 ± 14 (228 - 285); ML 864 ± 41 (808 - 931); PEH 264 ± 14 (247 - 290); HS 647 ± 26 (613 - 698); SL / HS 0.706 ± 0.019 (0.676 - 0.737); HW / HL 0.858 ± 0.020 (0.822 - 0.884); MW / ML 0.482 ± 0.008 (0.466 - 0.495); PSL / ML 0.138 ± 0.013 (0.113 - 0.158); PEH / PEL 1.107 ± 0.057 (1.000 - 1.217); PEW / PEL 0.755 ± 0.047 (0.667 - 0.833); PEW / PPW 0.707 ± 0.028 (0.667 - 0.760). PSI 1.3 - 1.6 (n = 3).

Description of worker. Total length 3.2 - 3.3 mm; 11 antennomeres, as characteristic for the genus. Head (Fig. 1) subrectangular, with evenly rounded occipital corners. Head width equal in front of and behind the eyes. Eyes comparatively small, situated at midpoint of head. Frontal triangle distinctly delimited and well depressed. Scapes short, not reaching occipital corners. Mesosoma flat, outline in lateral view over a long distance straight, with shallow mesometanotal depression. Mesonotum at place where wings of alate would insert with slight, but in dorsal and lateral aspect well visible crests; more prominent than in congeners. Propodeal spines broadly attached, longer than broad, in lateral view more or less straight caudad oriented, with pointed tips. In dorsal view, spines slightly convex, distally only minimally divergent. Propodeal spine index (cf. BUSCHINGER 1966) 1.3 - 1.6, the spines thus being comparatively short. Petiole short and high, node triangular, its anterior face markedly concave (Figs. 3, 4, 6) in lateral view, its posterior face also slightly concave, straight, or appearing a little bit convex with straight or slightly concave outlines. Top of node acute. In dorsocaudal view, upper part of node distinctly convergent, with sharp, medially distinctly impressed ridge. Anterior part of dorsal petiolar outline with prominent corners, well visible in dorsal or lateral view. Subpetiolar process well developed, pointing anteroventrad. Postpetiole rounded and lacking any conspicuous ventral appendage. Erect hairs relatively short (60 - 80 µm). Scapes only with subdecumbent, not erect hairs. Tips of hairs blunt. Petiole with a total of c. 8, postpetiole with c. 10 erect setae. Sculpture of head, mesosoma and waist mainly densely reticulate, without any stronger rugae or other sculpture elements. Color of body evenly dark brown, without any lighter spots, appendages distinctly lighter, mainly light brown to orange-brown.

Measurements of gyne (n = 10. Holotype in square brackets). HL 713 ± 18 (675 - 732) [675]; HW 600 ± 19 (570 - 618) [570]; SL 457 ± 13 (437 - 475) [447]; ED 166 ± 19 (133 - 190) [147]; MW 495 ± 13 (475 - 513) [475]; PSL 114 ± 8 (105 - 124) [109]; PEL 264 ± 16 (233 - 285) [233]; PEW 184 ± 9 (171 - 200) [171]; PPW 267 ± 16 (238 - 285) [238]; ML 1009 ± 31 (944 - 1042) [944]; PEH 279 ± 9 (266 - 295) [266]; HS 656 ± 17 (622 - 670) [622]; SL / HS 0.696 ± 0.015 (0.667 - 0.718) [0.718]; ED / HS 0.253 ± 0.028 (0.199 - 0.286) [0.237]; HW / HL 0.843 ± 0.016 (0.818 - 0.867) [0.845]; MW / ML 0.491 ± 0.011 (0.474 - 0.507) [0.503]; PSL / ML 0.113 ± 0.008 (0.100 - 0.122) [0.116]; PEH / PEL 1.060 ± 0.040 (1.033 - 1.143) [1.143]; PEW / PEL 0.698 ± 0.022 (0.655 - 0.735) [0.735]; PEW / PPW 0.689 ± 0.033 (0.650 - 0.750) [0.720]. PSI 1.3 - 1.6 (n = 4).

Description of gyne. Total length 3.0 - 3.8 mm; head (Fig. 2) as in worker, outline below eyes more parallel sided than in worker. Occipital corners distinctly rounded. Mesosoma (Figs. 5, 7) slender, not bulky, particularly flat as compared to other congeners. Dorsal outline straight. Pro-



Figs. 1 - 5: *Leptothorax athabasca* sp.n. (1) Head of worker, frontal view; (2) head of gyne (holotype), frontal view; (3) worker, lateral view; (4) waist of worker, lateral view; (5) gyne, lateral view.

podeal spines as in worker. Petiole and postpetiole similar to worker, but in dorsocaudal view ridge medially only slightly impressed. General sculpture as in worker; but frons of head with many fine striae, only with scattered reticulate ground sculpture. Occipital corners nearly unsculptured and shining. Mesonotum longitudinally diffusely striate, with some reticulation and larger unsculptured parts. Scutellum reticulate, unsculptured and shining in medial part. Color and hairs as in worker.

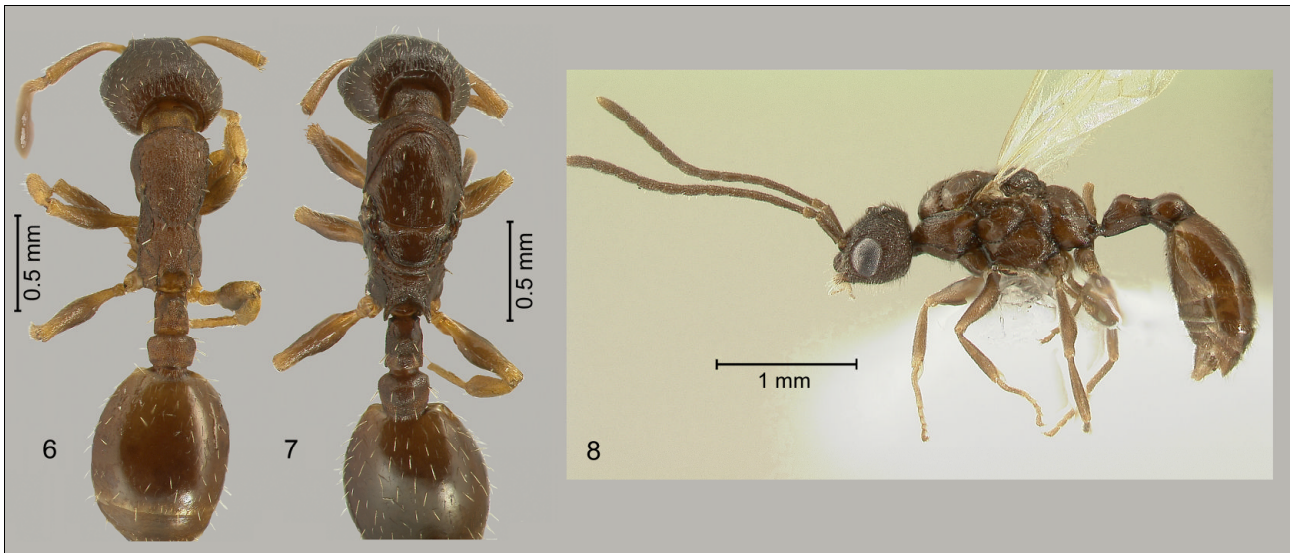
Measurements of male ($n = 7$). HL 609 ± 28 (570 - 656); HW 633 ± 29 (589 - 675); SL 238 ± 11 (219 - 247); 2FL 221 ± 9 (209 - 238); ED 249 ± 24 (209 - 276); MW 677 ± 58 (580 - 732); PEW 214 ± 19 (190 - 238); PPW 269 ± 23 (238 - 304); ML 1250 ± 96 (1102 - 1359); HS 621 ± 28 (580 - 665); HW / HL 1.039 ± 0.023 (1.015 - 1.077); SL / 2FL 1.079 ± 0.076 (0.960 - 1.182); SL / HS 0.383 ± 0.026 (0.329 - 0.410); PEW / HS 0.345 ± 0.032 (0.286 - 0.378); PPW / HS 0.433 ± 0.041 (0.371 - 0.474); MW / ML 0.543 ± 0.048 (0.441 - 0.579); PEW / PPW 0.797 ± 0.059 (0.741 - 0.920).

Description of male (Fig. 8). Total length 3.7 - 4.1 mm; 12 antennomeres, as characteristic for the genus. Head wide, behind eyes distinctly wider than anterior. Eyes large and

slightly oval. Mesosoma dorsally rounded, pronotum low and small. Mesonotum and scutellum strongly vaulted, metanotum short, propodeum rounded, without any angles or spines. Petiole variable, mainly flat and long, sometimes higher and shorter, node evenly rounded. Postpetiole shorter than petiole, with rounded semicircular dorsal outline. Waist segments without ventral appendages. Color of body totally dark brown to black, antennae dark brown, legs light brown to orange-brown. Body surface mostly smooth and shining except for head being roughly and irregularly rugoreticulate; scutellum and dorsal surface of propodeum slightly reticulate, with shiny parts; in general, lateral surfaces of mesosoma very diffusely reticulate, but always shiny.

Differential diagnosis. A detailed differential diagnosis cannot be provided because of the desolate condition of *Leptothorax* taxonomy in North America (see Discussion). A comparison is possible only with a few well-known species and with the sympatric forms in the vicinity of the type locality.

The measured values are by no means unusual among related *Leptothorax* species. *Leptothorax athabasca* is a bit larger than the European *L. muscorum* (NYLANDER, 1846), and the syntopic *L. retractus*, but smaller than *L. acer-*



Figs. 6 - 8: *Leptothorax athabasca* sp.n. (6) Worker, dorsal view; (7) gyne, dorsal view; (8) male, lateral view.

vorum (FABRICIUS, 1793) and the North American *Leptothorax* "sp. B" sensu HEINZE & BUSCHINGER (1987), HEINZE (1989b) and LOISELLE & al. (1990).

Propodeal spine length (PSL, GÜSTEN & al. 2006) has not been measured in other species of *Leptothorax*. The propodeal spine index (PSI; Epinotal Spine Index in BUSCHINGER 1966) can be compared among a few species. In *L. athabasca* gynes it is 1.3 - 1.6; in *L. acervorum* (Europe) 1.87 ± 0.06 (BUSCHINGER 1966); in *L. muscorum* (Europe) 1.73 ± 0.09 (BUSCHINGER 1966); in *L. gredleri* MAYR, 1855 (Europe) 1.48 ± 0.06 (BUSCHINGER 1966); in *L. scamni* RUZSKY, 1905 (Caucasus and northern Turkey) c. 2.0 (HEINZE & al. 1993); in *L. pocahontas* (Canada) 1.7 - 1.8 (BUSCHINGER 1979); and in *L. faberi* (Canada) 1.5 - 1.8 (BUSCHINGER 1983).

The color of *L. athabasca* gynes and workers is evenly dark brown (see Figs. 1 - 7), similar to *L. acervorum* (but lacking the lighter areas on the body of that species), lighter than in the sympatric *Leptothorax* "sp. B", and darker than in *L. retractus* from the same site.

Sculpture and pilosity are quite similar to other North American species of *Leptothorax*. Some negative characters may be helpful for identification, though:

Leptothorax pocahontas has long, tapering hairs and, in the typical case, a smooth and shiny surface (however, "dull" gynes with shorter hairs have been found and provisionally attributed to this species, cf. BUSCHINGER & HEINZE 1993).

Leptothorax retractus is characterized by a small but clearly visible notch in the anterior margin of the clypeus. This notch lacks in *L. athabasca*.

Leptothorax sp. C (sensu HEINZE & BUSCHINGER 1987, HEINZE 1989b and LOISELLE & al. 1990), supposed to be the host species of *L. pocahontas*, is much lighter in coloration. HIGGINS (year unknown) suggested that *Leptothorax* sp. C from Jasper NP is identical to *Leptothorax muscorum* var. *septentrionalis* WHEELER, 1917, though this taxon still is considered a junior synonym of *L. muscorum* according to antbase.org and BOLTON & al. (2007).

What remains as characteristic for *L. athabasca* is the very sharp crest on top of the petiole (Fig. 4), the flat meso-

soma in the female castes (Figs. 3, 5), and the dorsolateral small outgrowths of the worker mesonotum.

Life history data of *Leptothorax athabasca* sp.n.

Two among the seven colonies that were collected were polygynous with two and four reproductive queens (checked by dissection; spermathecae full of sperm and ovaries well developed, yolky oocytes present); the species thus is probably facultatively polygynous like most other congeners. The colonies collected on 27 July 1993 had sexual pupae in various states of pigmentation, and a few adult males. Colony size was about 50 to 100 adults.

Records of other interesting Formicoxenini from Jasper National Park

In addition to *L. athabasca* the visit in Jasper NP in July 1993 revealed a couple of colonies of very rare, unexpected or recently described species. *Leptothorax faberi*, an inquiline that had been described from Mt. Edith Cavell, could not be rediscovered. However, the inquiline ant, *L. wilsoni* was found, which as yet had been known only from eastern USA, and *Formicoxenus quebecensis*, a guest ant of *Myrmica alaskensis* WHEELER, 1917, also as yet only known from eastern North America (Québec).

Discussion

Leptothorax athabasca is described here because among the many samples that Buschinger and collaborators have collected in several sites in Canada and in the USA, and among the described species as well as a few unnamed ones depicted on internet-sites (e.g., ANTWEB.ORG year unknown, LONGINO 2005) none could be found with the very characteristic acute petiolar profile and the flat mesosoma of *L. athabasca*.

Our differential diagnosis is provisional, but at present it is impossible to thoroughly compare *L. athabasca* with all the more or less well or insufficiently described species and especially with the many undescribed forms, nor the subspecies of the "*Leptothorax muscorum* complex" listed by CREIGHTON (1950) that all had been synonym-

ized with *Leptothorax muscorum* by BROWN (1955). The genus evidently comprises many more species in North America than in Europe where only three *Leptothorax* species are known that lack erect hairs in femora and antennal scapes, i.e., the "true" *L. muscorum*, *Leptothorax gredleri*, and *Leptothorax scamni*. All three species apparently do not occur in North America. HEINZE (1989b) gives an impression of the variety of North American species with respect to biochemical markers: apart from *L. crassipilis* WHEELER, 1917 and *L. retractus* he had studied eight forms named "*Leptothorax muscorum* A" through "*Leptothorax muscorum* H" plus "*L. muscorum* A×B?", finally suggesting that the complex in addition to these eight or nine forms should consist of at least three or four further taxa. LOISELLE & al. (1990), studying karyotypes of a number of taxa, also have failed to disentangle the group; the forms described until then as species could be confirmed (including the European species *L. muscorum* and *L. gredleri*), but a number of other, morphologically different samples and populations still remained under the name "*L. muscorum*".

The flat and slender mesosoma in the female castes probably represents an adaptation to life in narrow rock crevices. This character corresponds well with the fact that practically all other *Leptothorax* species both in Europe and in North America preferably are nesting in dead wood or bark (*L. acervorum* in some places also in rock crevices), where nest entrances and galleries usually are tubular.

The new species seems to have an extremely limited range as far as is known, a phenomenon, however, that appears to be not unusual among the Formicoxenini. Intensive search in Alberta did not reveal any other site where *L. athabasca* would occur.

We point out that quite a number of ant species in fact are extremely rare, or better to say, inhabit very restricted ranges, or the ranges may be subdivided into a few widely scattered small plots. For example, *Leptothorax pocahontas* had been collected in August 1977, a few kilometers upriver of the *L. athabasca* site, in Maligne Canyon, in one very small site. One of the authors (A.B.) had found it there again in 1979 (BUSCHINGER 1979) and 1993, J. Heinze had collected it in the very same place in 1988, and also S. Lindgren took specimens from this locality in July 2002 and 2003 (LINDGREN year unknown). In all instances *L. pocahontas* was only found in the type locality and nowhere else in spite of intensive search in similar places along the Athabasca River. *Leptothorax faberi* had been found only once, in 1979, in Jasper NP, and on all later occasions (see data for *L. pocahontas*) we were unable to rediscover this species. One host colony with one queen of *L. faberi* had been found, not far from the *L. athabasca* site. *Temnothorax fragosus* is a clearly separate species. A number of complete colonies had been found near Jasper in 1979, in quite an ordinary habitat at the foot of a moraine, beneath pebbles. No colonies were found in any other place, neither in the year of its detection (1979), nor in subsequent years.

Hence, at least four species of formicoxenine ants have been found as yet exclusively in a comparatively small part of Athabasca River valley near Jasper. Moreover, other species were detected in this same area that had been recorded from only a few but very distant localities. One of these is *Leptothorax wilsoni*, a social parasite living in nests of "*Leptothorax* sp. B" (cf. HEINZE & BUSCHIN-

GER 1987, 1988). *Leptothorax wilsoni* had been described from eastern North America: USA: New Hampshire, Cheshire Co., and from Canada: Québec, Parque National des Grandes Jardins, and New Brunswick, Westmorland Co. (HEINZE 1989a). It has been discovered several times, in July 1993, in Jasper NP, and in USA: Montana, south of Glacier National Park (BUSCHINGER & SCHUMANN 1994). Most recently one specimen had been detected in Alaska (P.S. Ward, in litt.).

What about the reasons for rarity in *Leptothorax athabasca* and the other exceptional species found in the Athabasca River valley? As far as we could recognize, there were numerous places along Athabasca River that were looking quite exactly like the type locality of *L. athabasca*. It is mere speculation to assume that slight differences in exposition, in the flooding regime, and in competition with syntopic *Leptothorax* species may be responsible for the very local occurrence of this species.

Perhaps, at the end of the Ice Age, a comparatively rapid colonization of the area may have occurred, along the valleys that commonly extend in North-South direction. We may speculate that the populations in the comparatively short time have not yet finally settled; that certain species are still increasing, others diminishing due to competition. *Leptothorax athabasca* thus may be secondarily restricted to one or a few sites where they escape competition due to nesting in rock crevices where they can survive flooding. It may be suspected that larger populations of *L. athabasca* can be found farther north in the North American Rocky Mountains.

Anyhow, as is true for most ant genera, much more field research will be necessary to establish the ranges of the North American species of *Leptothorax*.

Acknowledgements

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Zusammenfassung

Gyne (Holotypus), Arbeiterin und Männchen von *Leptothorax athabasca* sp.n. aus dem Tal des Athabasca-Flusses im Jasper National Park, Alberta, Kanada, werden beschrieben. Die charakteristischsten Merkmale von Gyne und Arbeiterin sind ein scharfer dorsaler Kamm auf dem Petiolusknoten, ein gerader Verlauf des dorsalen Mesosoma-Profiles, gerade nach hinten gerichtete, spitze Propodealdornen und eine vergleichsweise flache Oberseite des Mesosoma. *Leptothorax athabasca* wurde nur in einem sehr kleinen Bereich von wenigen hundert Quadratmetern Fläche gefunden, flussaufwärts der Athabasca-Wasserfälle, südlich von Jasper. Es scheint sich um eine seltene, lokale Art zu handeln. Mögliche Gründe für ein derart eingeschränktes Areal werden diskutiert. Die neue Art nistet in Felsspalten, was eine Ausnahme innerhalb der Gattung darstellt, deren Arten in der Regel Totholz bewohnen.

References

ANTWEB.ORG year unknown: Genus: *Leptothorax*. – <<http://www.antweb.org/description.do?subfamily=myrmicinae&name=leptothorax&rank=genus&project=worldants>>, retrieved on 12 July 2008.

- BOLTON, B., ALPERT, G., WARD, P.S. & NASKRECKI, P. 2007: Bolton's catalogue of ants of the world 1758-2005. – Harvard University Press, Cambridge, MA, CD-ROM.
- BROWN, W.L. 1955: The ant *Leptothorax muscorum* (NYLANDER) in North America. – Entomological News 66: 43-50.
- BUSCHINGER, A. 1966: *Leptothorax (Mychothorax) muscorum* NYLANDER und *Leptothorax gredleri* MAYR zwei gute Arten. – Insectes Sociaux 13: 165-172.
- BUSCHINGER, A. 1979: *Doronomyrmex pocahontas* n.sp., a parasitic ant from Alberta, Canada (Hym., Formicidae). – Insectes Sociaux 26: 216-222.
- BUSCHINGER, A. 1983 ("1982"): *Leptothorax faberi* n. sp., an apparently parasitic ant from Jasper National Park, Canada (Hymenoptera: Formicidae). – Psyche 89: 197-209.
- BUSCHINGER, A. & HEINZE, J. 1993: *Doronomyrmex pocahontas*: not a workerless parasite but still an enigmatic taxon (Hymenoptera, Formicidae). – Insectes Sociaux 40: 423-432.
- BUSCHINGER, A. & SCHUMANN, R.D. 1994: New records of *Leptothorax wilsoni* from North America. – Psyche 101: 13-18.
- CREIGHTON, W.S. 1950: The ants of North America. – Bulletin of the Museum of Comparative Zoology at Harvard College 104: 585 pp. + 57 pl.
- GÜSTEN, R., SCHULZ, A. & SANETRA, M. 2006: Redescription of *Tetramorium forte* FOREL, 1904 (Insecta: Hymenoptera: Formicidae), a western Mediterranean ant species. – Zootaxa 1310: 1-35.
- HEINZE, J. 1989a: *Leptothorax wilsoni* n.sp., a new parasitic ant from eastern North America (Hymenoptera; Formicidae). – Psyche 96: 49-61.
- HEINZE, J. 1989b: A biochemical approach toward the systematics of the *Leptothorax "muscorum"* group in North America (Hymenoptera: Formicidae). – Biochemical Systematics and Ecology 17: 595-601.
- HEINZE, J. & BUSCHINGER, A. 1987: Queen polymorphism in a non-parasitic *Leptothorax* species (Hymenoptera, Formicidae). – Insectes Sociaux 34: 28-43.
- HEINZE, J. & BUSCHINGER, A. 1988: Electrophoretic variability of esterases in the tribe, Leptothoracini. – Biochemical Systematics and Ecology 16: 217-221.
- HEINZE, J., SCHULZ, A. & RADCHENKO, A.G. 1993: Redescription of the ant *Leptothorax* (s. str.) *scamni* RUZSKY, 1905. – Psyche 100: 177-183.
- HIGGINS, R. year unknown: <<http://www.tru.ca/schs/biol/facpgs/rhiggins/DOPOC.html>>, retrieved on 23 July 2008.
- LINDGREN, S. year unknown: *Doronomyrmex pocahontas*. – <<http://www.cariboo.bc.ca/schs/biol/FacPgs/rhiggins/DOPOC.html>>, retrieved on 14 July 2008.
- LOISELLE, R., FRANCOEUR, A., FISCHER, K. & BUSCHINGER, A. 1990: Variations and taxonomic significance of the chromosome numbers in the nearctic species of the genus *Leptothorax* (s.s.) (Formicidae: Hymenoptera). – Caryologia 43: 321-334.
- LONGINO, J.T. 2005: *Leptothorax muscorum* complex. – <<http://academic.evergreen.edu/projects/ants/antsofwashington/genera/leptothorax/species/muscorum/muscorum.html>>, retrieved on 12 July 2008.