Myialges trinotoni (Acariformes: Epidermoptidae), a hyperparasitic mite infesting *Trinoton querquedulae* (Phthiraptera: Menoponidae) on waterfowl

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Abstract—Mites of the family Epidermoptidae (Acariformes) are permanent parasites dwelling on or in the skin of birds. *Myialges* Trouessart species are epidermoptids that have a hyperparasitic relationship with chewing lice (Phthiraptera) or louse flies (Diptera: Hippoboscidae). During 1993–2016 in Manitoba, Canada, 668 ducks (20 species), geese (five species), and swans (two species) were examined for lice. A total of 157 males, 191 females, and 539 nymphs of the menoponid louse *Trinoton querquedulae* (Linnaeus) (Phthiraptera: Menoponidae) were collected, of which 25 adult lice from three hosts (*Mergus merganser* Linnaeus, *Lophodytes cucullatus* (Linnaeus), *Anas platyrhynchos* Linnaeus; Aves: Anatidae) were infested with 38 female *Myialges trinotoni* (Cooreman). Overall prevalence and intensity of *M. trinotoni* was low, and mites showed no statistically significant preference between male and female lice. *Myialges trinotoni* is recorded from Canada (Manitoba) and United States of America (Alaska) for the first time, and two novel avian host species records (*Lophodytes cucullatus* and *Anas platyrhynchos*) are reported. The male of *M. trinotoni* (loose in bird washing) is illustrated and described. The barcode region of cytochrome oxidase subunit I (COI) was amplified from *M. trinoton* and compared with that of *Myialges caulotoon* Speiser, the only congeneric species for which COI is available, and interspecific divergence was high (25%).

Introduction

The family Epidermoptidae (Acariformes: Analgoidea) includes parasitic skin mites associated with birds. Some epidermoptid species of the subfamily Myialginae (*Archemyialges* Mironov, Bochkov, and Fain; *Hemimyialges* Mironov, Bochkov, and Fain; *Myialges* Trouessart), and *Microlichus* Trouessart and Neumann (Epidermoptinae), are unusual in that they have hyperparasitic relationships with parasitic chewing lice (Phthiraptera) and louse flies (Diptera: Hippoboscidae) on birds (Fain 1965).

The taxonomy of the Epidermoptidae and the genus *Myialges* have varied over time. Fain (1965) divided epidermoptids into two subfamilies, Epidermoptinae and Dermationinae, and placed the genus *Myialges* in the former. In addition, Fain (1965) divided *Myialges* into three subgenera, *Myialges*, *Promyialges* Fain, and *Metamicrolichus* Fain. Gaud and Atyeo (1996) elevated *Promyialges* to generic status, and placed *Metamicrolichus* as a subgenus of *Microlichus*; *Metamicrolichus* was later elevated to generic status by Mironov *et al.* (2005). The subfamily Myialginae was resurrected by Mironov *et al.* (2005), and they placed *Myialges* and two new described monotypic genera, *Archemyialges* and *Hemimyialges*, in the myialgine subfamily.

The life cycle of these hyperparasitic mites has been described for only a few species. Nongravid females, males, and immatures are found in burrows in the skin of their hosts (Myialginae) or in feather bulbs (*Microlichus*) feeding on epidermal tissue and body fluids. Ovigerous females attach to the soft integument of a louse or hippoboscid fly using their ambulacra and chelicerae, or by a large anchor-like process on tarsus I (Myialginae), and feed on haemolymph (Evans *et al.* 1963; Fain 1965). Eggs are laid in a cluster

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around the female mite and each egg is attached by a thin thread. Larvae eventually hatch and begin to feed on their avian host (Fain 1965).

The host specificity of Myialginae species varies. Those hyperparasitic on hippoboscids tend to be generalists reported from several bird families, while species on lice show relatively more host specificity for their avian hosts and they are typically only associated with one genus of lice (Fain 1965). However, avian host range of Myialginae species is likely determined by the level of host specificity of the hippoboscid or louse host species. Epidermoptid species can cause considerable response in tissues of their hosts. Some *Microlichus* species have been reported to cause severe lesions in feather bulbs (Fain 1965). Myialgine species burrow into the superficial layers of the skin causing mange-like lesions and inflammation, which may lead to death of the host (Gilardi *et al*. 2001). The attachment of female Myialginae produces strongly sclerotised scars in the integument of their hippoboscid or louse hosts, and heavy infestation on the wings of hippoboscids may impede flight (Bequaert 1953; Fain 1965).

Myialgine specimens are typically collected as females from their insect hosts and are infrequently found on birds. As a result, the other life stages are not known for most species. There are 12 described species of Myialginae and the only species in which the male has been described is *Hemimyialges macdonaldi* (Evans, Fain, and Bafort). Radford (1949) purportedly described the male of *Myialges trinotoni* (Cooreman), but as Fain (1965) suspected Radford's identification was incorrect. The male described by Radford (1949) was actually a female feather mite, *Rectijanua* Gaud (Rectijanuidae) species (identified by H.C. Proctor, University of Alberta, Edmonton, Alberta, Canada). Cooreman (1944) correctly described the female of *Myialges trinotoni* (as *Myialgopsis trinotoni*) from the louse *Trinoton querquedulae* (Linnaeus) (as *Trinoton luridum* Burmeister) on *Mergus merganser* Linnaeus (Aves: Anatidae) in Belgium. Herein, we describe the male of *M. trinotoni*, summarise avian host records and infestation parameters for this species on *Trinoton querquedulae* (Linnaeus), and sequence the barcode region of cytochrome oxidase subunit I (COI) from females of *M. trinotoni*.

Materials and methods

Sampling and identification

Most birds were casualties from the Wildlife Haven (Manitoba Wildlife Rehabilitation Organization, Ile des Chênes, Manitoba, Canada) and the Prairie Wildlife Rehabilitation Centre (Winnipeg, Manitoba, Canada); a small number of birds were obtained from hunters. Date of death and location were recorded for each bird. Birds were individually bagged and stored at −20 °C until processing in the laboratory at the University of Manitoba (Winnipeg, Manitoba, Canada). To collect lice and mites, birds were thawed and placed in a 4–40-L container, depending on the size of the bird, and submerged in warm water containing an appropriate amount of liquid dish detergent. Each bird was agitated vigorously for 3–10 minutes, depending on the size of the bird, then removed from the container and rinsed thoroughly. The washing solution was then passed through a 90-µm sieve. This process was repeated with warm, soapy water, and a third time with just warm water. The filtrate from all three washes was preserved in 70% or 95% ethanol, the latter when specimens were to be used for molecular analysis. All samples were examined for lice using a dissecting microscope; however, only one sample was examined specifically for the presence of male *Myialges*, that being from a common merganser (*Mergus merganser*) found in Winnipeg on 28 August 2014. The location of each mite found attached to a louse was noted, the number of mites and lice were counted, and any mites present were removed and retained. Imaging of lice was done using a Canon (Tokyo, Japan) 7D Mk II DSLR with a 65-mm MP-E lens, and imaging of mites was done using a Leica (Wetzlar, Germany) DM2500 compound microscope and Leica Application Suite v4.8. All mites and lice were collected and preserved in 70% or 95% ethanol for later identification and/or molecular analysis.

Mites were cleared in 85% lactic acid, mounted in polyvinyl alcohol medium (6371A, BioQuip Products, Rancho Dominguez, California, United States of America), and cured on a slide warmer at 40 °C for three to four days. Slide-mounted specimens were examined using a Leica DM2500 compound microscope with differential interference contrast illumination. Host lice were identified using characters suggested by Clay and

Hopkins (1960). Species level identifications of mites were made using keys (Fain 1965) and species descriptions from the primary literature. Voucher specimens (CNC564584 (female) and CNC564585 (male)) are deposited in the Canadian National Collection of Insects, Arachnids, and Nematodes (Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada). Slide-mounted specimens of Epidermoptidae in the Canadian National Collection were also examined for *Myialges*. Scientific permits were issued to T.D.G. for migratory birds by officers of the Canadian Wildlife Service, Environment Canada.

Initial drawings of mites were made with pencil on paper using a camera lucida. These were later merged in Adobe (San Jose, California, United States of America) Photoshop CS3 and redrawn in Adobe Illustrator CS3 using an Intuos 3 Graphics Tablet from WACOM Company (Saitama, Japan). Chaetotaxy was based on Griffiths *et al.* (1990). All measurements are in micrometres (μm) and for paired structures they are presented in the order of right, left.

Molecular techniques

Genomic DNA was extracted from whole specimens for 24 hours using a DNeasy Tissue kit (Qiagen, Santa Clara, California, United States of America). Following extraction, mites were removed from the extraction buffer, vouchers were slide mounted, and genomic DNA was purified following the DNeasy Tissue kit protocol. Polymerase chain reaction amplifications were performed in a total volume of 25 μL, with 14.7 μL ddH_2O, 2.5 μL 10× ExTaq buffer, 0.65 μl 25 mM $MgCl_2$, 1.0 μL of each 10 μM primer, 2.0 μL 10 mM dNTPs, 0.15 μL ExTaq DNA polymerase, and 3 μL genomic DNA template. Primer pairs LCO1490 + HCO2198 (Folmer *et al.* 1994) were used to amplify a 679 base-pair fragment of the 5'-end of COI. Polymerase chain reaction amplification was performed on an Eppendorf ep Gradient S Mastercycler (Eppendorf, Hamburg, Germany), using the following protocol: initial denaturation cycle at 94 °C for three minutes, followed by 45 cycles of 94 °C for 45 seconds, primer annealing at 45 °C for 45 seconds, 72 °C for one minute, and a final extension at 72 °C for five minutes. Amplified products and negative controls were visualised on 1% agarose electrophoresis gels, and purified using pre-cast E-Gel CloneWell 0.8% SYBR Safe agarose gels (Invitrogen, Carlsbad, California, United States of America). Sequencing reactions followed the protocol of Knee *et al.* (2012), and sequencing was performed at the Agriculture and Agri-Food Canada, Eastern Cereal and Oilseed Research Centre Core Sequencing Facility (Ottawa, Ontario, Canada). Sequence chromatograms were edited and contiguous sequences were assembled using Sequencher v5.4.6 (Gene Codes Corporation, Ann Arbor, Michigan, United States of America). Cytochrome oxidase subunit I sequences were aligned manually in Mesquite v3.10 (Maddison and Maddison 2016) according to the translated amino acid sequence. Sequence for female *Myialges trinotoni* has been submitted to GenBank (KX060553).

Results

From 1993 to 2016, 27 species of waterfowl (Aves: Anatidae) have been examined for lice in the Galloway laboratory (post-downy stages only), including 20 species of ducks ($n = 323$), five species of geese ($n = 328$), and two species of swans ($n = 17$) (Table 1). Six genera and at least 17 species of chewing lice were collected from these hosts (see in part, Galloway *et al.* 2014; Grossi *et al.* 2014). Of the 323 ducks examined, 104 (32% prevalence) were infested with at least one *T. querquedulae*. Of the 345 geese and swans examined, 15 (4%) were infested by at least one *Trinoton anserinum* (Fabricius). *Myialges trinotoni* infested only *Trinoton querquedulae*. *Trinoton* Nitzsch species were collected from all but six species of Anatidae (ring-necked duck, bufflehead, long-tailed duck, white-winged scoter, red-breasted merganser, and ruddy duck), all six of which were examined in small numbers. *Trinoton anserinum* were collected in relatively small numbers from trumpeter swans, and the five species of geese examined (Table 1). *Trinoton anserinum* were collected in large numbers on tundra swans (Table 1). *Myialges* specimens were not found on any of the *Trinoton* from geese.

In total, 157 males, 191 females, and 539 nymphs of *T. querquedulae* were collected (Table 1). A total of 38 female *M. trinotoni* were collected, and these only infested adult *T. querquedulae* (15 adult lice with one mite each,

Table 1. Diversity and abundance of ducks (Aves: Anatidae: Anatinae) and geese/swans (Aves: Anatidae: Anserinae) (post-downy stages only) examined for lice (*Trinoton querquedulae* infesting ducks; *Trinoton anserinum* infesting geese/swans) in Manitoba from 1993 to 2016.

Bird subfamily	Bird species	Common name	Number of birds examined	Number of *Trinoton* collected
Anatinae	*Aix sponsa* (Linnaeus)	Wood duck	45	7M; 14F; 18N
	Anas acuta Linnaeus	Northern pintail	3	2N
	A. americana Gmelin	American wigeon	1	1F
	A. carolinensis Gmelin	Green-winged teal	17	8M; 19F; 26N
	A. clypeata Linnaeus	Northern shoveler	5	1M; 12F; 2N
	A. discors (Linnaeus)	Blue-winged teal	19	11M; 14F; 24N
	A. platyrhynchos Linnaeus	Mallard	156	74M; 70F; 353N
	A. strepera Linnaeus	Gadwall	2	2M; 6F; 27N
	Aythya affinis Eyton	Lesser scaup	6	1M; 1N
	A. americana (Eyton)	Redhead	8	4M; 3F; 7N
	A. collaris (Donovan)	Ring-necked duck	2	0
	A. valisineria (Wilson)	Canvasback	14	1M
	Bucephala albeola (Linnaeus)	Bufflehead	5	0
	B. clangula (Linnaeus)	Common goldeneye	8	4M; 3F; 3N
	Clangula hyemalis (Linnaeus)	Long-tailed duck	2	0
	Lophodytes cucullatus (Linnaeus)	Hooded merganser	11	27M; 39F; 53N
	Melanitta deglandi (Bonaparte)	White-winged scoter	1	0
	Mergus merganser Linnaeus	Common merganser	11	17M; 10F; 23N
	M. serrator Linnaeus	Red-breasted merganser	2	0
	Oxyura jamaicensis (Gmelin)	Ruddy duck	5	0
Anserinae	*Branta bernicla* (Linnaeus)	Brant	2	1F; 5N
	B. canadensis (Linnaeus)	Canada goose	283	4M; 1F; 3N
	B. hutchinsii (Richardson)	Cackling goose	19	2M; 2F; 2N
	Chen caerulescens (Linnaeus)	Snow goose	21	7M; 3F; 23N
	C. rossii (Cassin)	Ross's goose	3	2M; 1F; 1N
	Cygnus buccinator Richardson	Trumpeter swan	1	2F; 3N
	C. columbianus (Ord)	Tundra swan	16	4M; 13F; 46N
Anatinae total			323	157M; 191F; 539N
Anserinae total			345	19M; 23F; 83N

F, female; M, male; N, nymph.

seven with two each, and three lice with three mites each), and on only three birds: one mallard (Winnipeg, 18 November 2012; one of two female *T. querquedulae* infested with mites), one hooded merganser (Riverton, 13 October 2011; one female *T. querquedulae* infested), and one common merganser (Winnipeg, 28 August 2014; 10 of 10 female and 13 of 17 male *T. querquedulae* infested with mites). One *M. trinotoni* was attached to a teneral male *T. querquedulae*. One male mite of *M. trinotoni* was collected from the whole body washing of a common merganser that also had female mites, collected in Winnipeg, Manitoba. Female mites were attached to the intersegmental membranes along the lateral margins of their hosts (Fig. 1; Table 2), using anchor-like process on modified tarsus I (Fig. 2). There was no significant difference (bootstrap two-sample *t*-test, 2000 replicates, $P = 0.844$) in mean intensity of infestation for males (mean intensity = 1.54) versus female lice (mean intensity = 1.60). Infestation parameters were calculated using Quantitative Parasitology 3.0 (Rózsa *et al.* 2000).

The barcode region of COI was successfully amplified from a female of *M. trinotoni* and deposited on GenBank (KX060553). Cytochrome oxidase subunit I has been amplified for only one other *Myialges* species, identified as *M. caulotoon* Speiser (GenBank numbers DQ503439–DQ503447) (Whiteman *et al.* 2006), and these

Fig. 1. Two female *Myialges trinotoni* with egg masses, attached to intersegmental membranes between abdominal segments I–II and III–IV of a female *Trinoton querquedulae*.

Table 2. Distribution of female *Myialges trinotoni* attached to intersegmental membranes along the lateral margins of the thorax or abdomen (Ab.) of adult *Trinoton querquedulae* ($n = 23$) collected from one common merganser, one hooded merganser, and one mallard.

Point of attachment	Number of mites
Pro-mesothorax	3
Meso-metathorax	10
Metathorax and Ab. I	3
Ab. I–II	6
Ab. II–III	7
Ab. III–IV	3
Ab. IV–V	2
Ab. V–VI	2

two species show considerable genetic divergence (25% uncorrected *p*-distance).

Myialges trinotoni (Cooreman, 1944)

Material examined

Nine female mites (CNC564584) on *Trinoton querquedulae* from *Mergus merganser*, and one male mite (CNC564585) from *M. merganser* collected in Winnipeg, Manitoba, Canada; 28.viii.2014; T.D. Galloway, E.N. McNally, and W. Knee. One female mite on *T. querquedulae* from *Anas platyrhynchos* collected in Winnipeg, Manitoba, Canada; 18.xi.2012; T.D. Galloway and L.E. Peixoto. One female mite (CNC585101) on *T. querquedulae* from *A. platyrhynchos* collected 9 miles north of Juneau, Alaska, United States of America; 15.x.1949; R.B. Williams. One female mite on *T. querquedulae* from *Lophodytes cucullatus* collected in Riverton, Manitoba, Canada; 13.x.2011; T.D. Galloway and P. Snarr.

Diagnosis

Defining characters for female mites of this species are: propodosomal shield large; epimera I fused forming relatively long sternum divided posteriorly into two short branches; punctation absent between epimera I; epigynum thick and straight; legs I thick; T-shaped, anchor-like process on tarsus I bearing a tooth proximally (Fig. 2); tibia II retrorse process absent; ventral seta present on trochanter IV; bell-shaped pulvilli (Fain 1965).

Defining characters for male mites of this species are: small, paired posterolateral hysterosomal shields present; genital setae *g* short and rounded; epimera I fused forming sternum divided posteriorly into two short branches; punctation absent between epimera I; extensive punctation on coxa III and IV; epimera IV poorly developed or absent; ventral seta present on trochanter IV; bilobate pulvilli. The following is the first description of the male of a *Myialges* species as defined by Mironov *et al.* (2005).

Description

Male (Figs. 3, 4). ***Dorsum***. idiosoma 313 µm long and 295 µm wide (level of *cp* seta), total length 368 µm. Cuticle striated, all dorsal seta simple. All dorsal shields finely punctate. Propodosomal shield 103 µm long at median and 156 µm wide (level of *se* seta). Setae *se* (right 54, left 65 µm long) and *si* (7, 6 µm) on lightly sclerotised, posterolateral margin of propodosomal shield. Paired lateral shields posterior of leg II wrapped around on dorsum and venter (57, 60 µm wide). Two small posterolateral hysterosomal shields present, right shield 62 µm long and 60 µm wide, left shield 59 µm long and 60 µm wide, seta *e2* (30, 31 µm) on hysterosomal shields. Setae *c2* (22, 21 µm),

Fig. 2. Female *Myialges trinotoni* dorsum showing modified tarsus I with anchor-like process.

d2 (18, 19 µm), *f2* (31, 30 µm), *h1* (53, 54 µm), *h2* (246, 261 µm), and *h3* (113, 120 µm) in soft integument. Anus terminal.

Venter. Similar to known males of all other Myialginae species, male *M. trinotoni* lack adanal suckers and posterior lobes. Cuticle striate, all ventral setae simple. Epimera I fused forming sternum 22 µm long and 26 µm wide; sternum divided posteriorly forming two short branches. Epimera I and II with narrow punctate areas wider than those of female specimens. No punctation between epimera I. Extensive punctation on coxa III and IV. Epimera III narrow and divided (y shaped). Epimera IV poorly developed or absent. Two pairs of setae *c3* (18, 22 µm) and *cp* (100, 95 µm) on coxa III, seta *cp* prominent and on lateral margin. Genital region with paired, lateral shields with fine punctation and seta *4a* (7 µm) on the shield; seta *g* short (3, 2 µm), rounded and on small paired shieldlets. Setae *la* (17, 15 µm), *3a* (9, 10 µm), *3b* (18, 16 µm), *ps2* (23, 26 µm), *ps3* (13, 11 µm) in soft integument.

Gnathosoma. Gnathosoma 55 µm long and 67 µm wide. One pair of setae on subcapitulum and one pair of setae on dorsal palps. Chelicerae 69, 68 µm long. Palpal segmentation obscure.

Legs. Legs I and II similar to each other and without anchor-like tarsal process seen in female specimens, legs III and IV similar to each other and slimmer than legs I and II. Tibia II without a ventral retrorse process. Leg IV 116 µm long, trochanter IV 37 µm long. All leg setae simple, leg setation (solenidia) of coxa 0–0–2–0, trochanter 1–1–1–1, femur 1–1–0–0, genu 2(2)–2(1)–0–0, tibia 1(1)–1(1)–1(1)–1(1), tarsus 8(2)–8(1)–6–5. Tarsus I with solenidia ω1 (11, 9 µm) and ω3 (21, 18 µm), tarsus II with one solenidion (16, 14 µm). Tibia I and II with one long solenidion 22 µm (right) and 25 µm (left) in length. Tibia III with a long solenidion (24 µm), and tibia IV with a long solenidion (22, 21 µm). Genu I with a pair of solenidia in duplex, σ1 (5 µm) and σ2 (3 µm). Genu II with thick conical solenidion (7, 6 µm). Bilobate pulvilli.

Remarks. Of the few described males of Epidermoptidae, *Myialges trinotoni* males are most similar to *Metamicrolichus nudus* Fain (Epidermoptinae), described from *Bombycilla garrulus* (Linnaeus) (Aves: Bombycillidae) from Belgium. Both species have small posterolateral hysterosomal shields; however, the margins of the hysterosomal shields are more irregular in *M. nudus*. Setae *si* and *se* are on the propodosomal shield in *M. trinotoni* and off the shield in *M. nudus*. Coxa III and IV are almost entirely covered with punctures in *M. trinotoni*, while in *M. nudus* the coxa are partially covered with punctures. Epimera IV are poorly developed or absent in *M. trinotoni*, epimera IV are well developed in *M. nudus*.

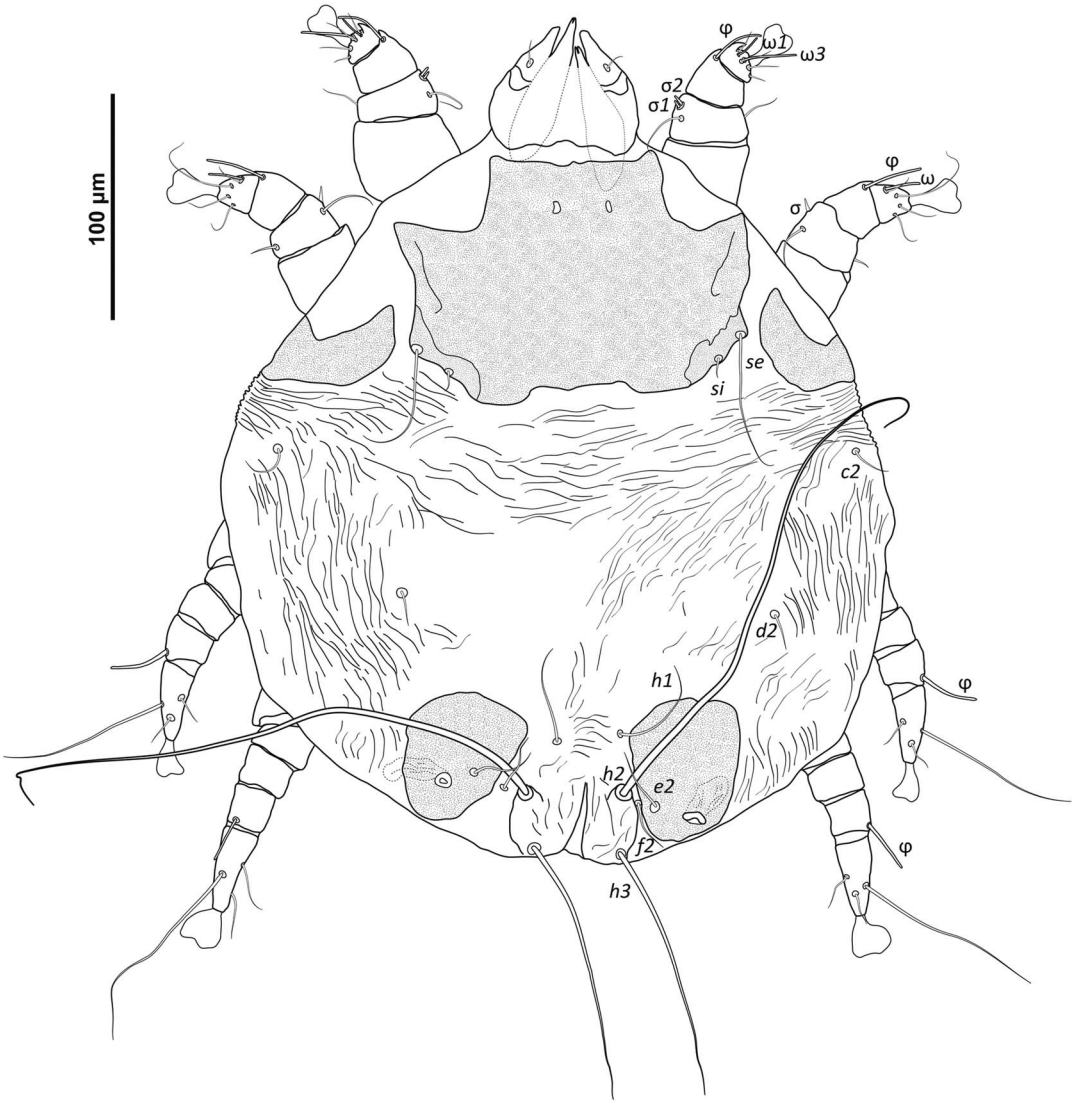

Fig. 3. *Myialges trinotoni* male dorsum.

Radford (1949) described what he thought was the male of *M. trinotoni*, but this was actually a female feather mite, *Rectijanua* Gaud (Acariformes: Rectijanuidae) species (identified by H.C. Proctor). Considering that the male of *M. trinotoni* has been incorrectly described in the past, the question should be raised whether the male specimen described in this publication is the male of *M. trinotoni*. This specimen shares character states with the males of all other species of Myialginae and was identified as a *Myialges* species using keys in Fain (1965). This specimen was found in the material washed from a common merganser that had only *M. trinotoni* females parasitic on the associated host louse, *T. querquedulae*. Myialginae species hyperparasitic on lice show greater host specificity than those on hippoboscid flies (Fain 1965); *M. trinotoni* has only been recorded from one genus of lice, *Trinoton* (Table 3). Taking this evidence into consideration, it is reasonable to assume this male specimen to be *M. trinotoni*.

Discussion

In this study, we report *M. trinotoni* from Canada (Manitoba) and United States of America (Alaska) for the first time. Although this mite was

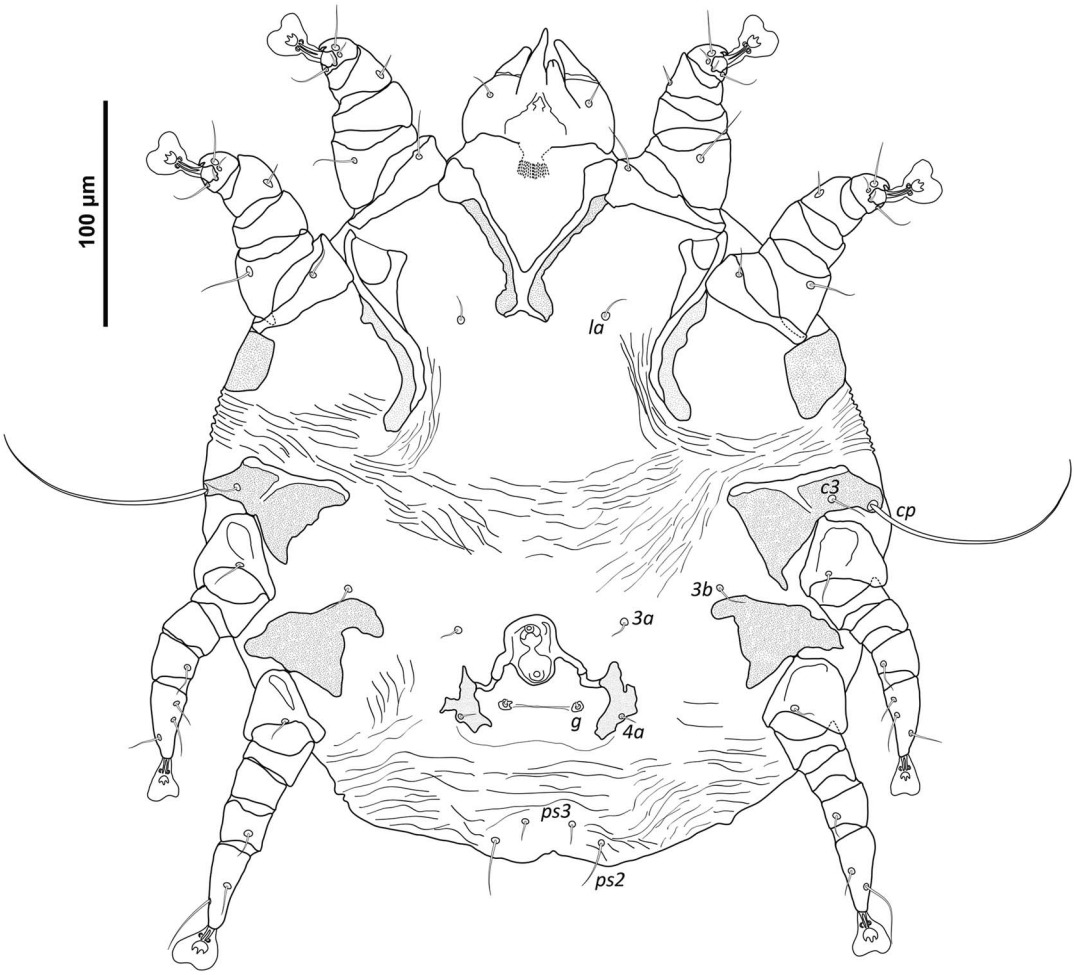

Fig. 4. *Myialges trinotoni* male venter.

collected in North America before this study, specific localities were not provided (Thompson 1939; Fain 1965). *Myialges trinotoni* has been collected from lice in five countries and on seven species of birds, two of which are novel host species reported in this study (Table 3). Comprehensive collections of *Trinoton* lice will likely reveal additional avian or louse host species records for this mite. Considering the broad geographic and avian host range of *M. trinotoni*, it is possible that future molecular investigations will reveal that this mite is actually a complex of cryptic species.

Myialges trinotoni appears to be quite rare in Manitoba. We found female mites attached to *T. querquedulae* on only three of 323 host ducks collected over a span of 23 years. The prevalence of *M. trinotoni* on lice from the three host ducks that had mites was high, 85% of adult *T. querquedulae* on the common merganser were infested, although only small numbers of adult *Trinoton* were present on the mallard (two lice) and the hooded merganser (one louse). Despite the high prevalence in the adult *Trinoton* on these three birds, the low overall prevalence on all *T. querquedulae* in this study invites speculation about the persistence of *M. trinotoni* in these populations. It is possible that dispersal on *Trinoton* is effective, and *Myialges* populations can maintain their survival. Each of the ovigerous *Myialges* may have many eggs suspended around them (Fig. 1), so total reproductive output may be sufficient to guarantee survival of a small population. On the other hand, these waterfowl species

Table 3. Louse and bird host records for *Myialges trinotoni* (modified from Fain 1965).

Louse host	Bird host	Locality	References
Trinoton aculeatum Piaget	*Dendrocygna bicolor* (Vieillot)	Uganda	Thompson (1936), Radford (1949), Fain (1965)
	Sarkidiornis melanotos (Pennant)	Uganda	Thompson (1936), Radford (1949), Fain (1965)
T. anserinum (Fabricius)	*Plectropterus gambensis* (Linnaeus)	Uganda	Thompson (1936), Fain (1965)
T. querquedulae (Linnaeus)	*Anas platyrhynchos* Linnaeus	Winnipeg, Manitoba, Canada	Present study
	A. platyrhynchos	Alaska, United States of America	Present study, CNC
	A. querquedula Linnaeus	Sri Lanka	Thompson (1939), Fain (1965)
	Lophodytes cucullatus (Linnaeus)	Riverton, Manitoba, Canada	Present study
	Mergus merganser Linnaeus	North America	Thompson (1939), Fain (1965)
	M. merganser	Winnipeg, Manitoba, Canada	Present study
T. querquedulae (as *T. luridum* Burmeister)	*M. merganser*	Belgium	Cooreman (1944)

CNC, Canadian National Collection of Insects, Arachnids, and Nematodes.

are all migratory, and it is possible the birds we found carrying *Myialges* were part of a more southern element of the host species, some part of North America where this mite is more prevalent. However, there are few records of *M. trinotoni* in North America (Thompson 1939; Fain 1965), and given the large size of *Trinoton*, and the conspicuous nature of ovigerous *Myialges*, it is surprising it has not been reported more frequently if prevalence was higher elsewhere. *Myialges trinotoni* does infest other species of *Trinoton* (Table 3), though we did not find any *T. anserinum* from geese or swans infested in our study. This species of chewing louse was rarely collected, and given the low prevalence of *Myialges* associated with *T. querquedulae* on ducks, our sample sizes may have been too small to detect its occurrence.

The common merganser in our study was infested by 17 males, 10 females, and 23 nymphs of *T. querquedulae*, yet only adult lice (23 of 27) were infested with *M. trinotoni*. Female mites do not appear to differentiate between male and female lice, but we do not know whether mites are able to distinguish between adults and nymphs. If a female mite attached to a nymph, it could possibly be shed with the cuticle at the next moult. If this is the case, it is not surprising we found no infested nymphs, though it is still possible female mites are able to recognise adult lice and attach only to them. The factors that influence louse host selection by *Myialges* females are unknown, as are many ecological features in the life history of these fascinating mites.

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