

The genus *Euryparasitus* in North America (Mesostigmata: Euryparasitidae)

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Abstract

The genus *Euryparasitus* in North America is revised on the basis of the deutonymphal instar. Four species are recognized, two previously described and two new. The four species fall into two easily recognizable groups. The first group, consisting of *E. longicheta* Bondartchuk & Buyakova and *E. occidentalis* n. sp., lacks barbed setae on the idiosoma and serrations on the anterior free margin of the gnathotectum, and shows a well differentiated acrotarsus on legs I. The second, consisting of *E. calcarator* (Banks) and *E. maseri* n. sp., has barbed setae on the idiosoma and serrations on the anterior margin of the gnathotectum, but lacks a well differentiated acrotarsus I. A key to the deutonymphs for the species of *Euryparasitus* and genera of Euryparasitidae in North America is provided. The host association pattern of *Euryparasitus* species appears to fit better with ecological than with host specificity.

Key words: *Euryparasitus*, Nearctic, mammals, Rhodacaroidea, Euryparasitidae

Introduction

The superfamily Rhodacaroidea includes a wide range of largely free-living, soil inhabiting mites. Among the few exceptions is a lineage including the closely related genera *Euryparasitus* and *Cyrtolaelaps*, genera which feature a deutonymph that is associated with small mammals. Non-deutonymphal instars are usually associated with the nests of these mammals. There have been no reports of feeding on the host by the

deutonymph, which suggests a phoretic association. We follow Anthony (1980) in placing *Euryparasitus* and *Cyrtolaelaps* in the family Euryparasitidae.

Euryparasitus and *Cyrtolaelaps* have a distinctly Holarctic distribution (Lee, 1970), but this is not reflected in the number of described species. Only one of ten named species of *Euryparasitus*, *E. calcarator* (Banks), and none of the seven described species of *Cyrtolaelaps*, has been described from North America, even though both genera occur in North America. As a result, nearly all North American records deal with unidentified species (Emberson, 1968; Maser & Whitaker, 1980; Wassel et al., 1978; Whitaker, 1976 (1977); Whitaker & Cudmore, 1987 (1988); Whitaker & French, 1982, 1988a, b; Whitaker et al., 1994 (1995); Whitaker & Lukoschus, 1982; Whitaker & Maser, 1979, 1984; Whitaker et al., 1979; Whitaker et al., 1980). One of us (JOW) has collected a large number of deutonymphs of previously unidentified *Euryparasitus* from North American mammals. This collection includes four different species, one of them indistinguishable from an Eastern Asian species, *E. longicheta* Bondartchuk & Buyakova, a second most probably representing the previously unknown deutonymph of *E. calcarator*, and the remaining two apparently undescribed.

The goal of this study is to describe or redescribe the deutonymphs of all four species and thus provide the basis for species level identification of *Euryparasitus* deutonymphs in North America.

Material & methods

The idiosomal chaetotaxy is based on Lindquist and Evans (1965), but following the interpretation for *Euryparasitus* proposed by Lee (1970). This includes the use of *Jv*, *Zv*, *Sv*, and *Rv* series of setae on the venter, to match the *J*, *Z*, *S*, and *R* series on the dorsum. Terminology for the leg and palp chaetotaxy is based on, respectively, Evans (1963a) and Evans (1963b). Designation of glands and lyrifissures follows Johnston & Moraza (1991) with minor modifications.

A Zeiss Axioskop® compound microscope with a drawing tube was used for initial pencil drawing at magnifications of 400–1000x using phase contrast illumination. These drawings were scanned and imported as templates for final illustrations in Adobe Illustrator® (Adobe Systems Incorporated, San Jose, California). Specimens were measured with an ocular micrometer. Measurements are presented in micrometres (µm) in the format: average (standard deviation), and are summarized in tabular form (Table 1). Idiosomal length is measured excluding the gnathosoma, but including the areas with soft cuticle posterior to the opisthonotal shield; width is measured at the widest point of the body. Host names follow the ITIS on-line database (USDA, 2005).

Depositories of specimens: Canadian National Collection, Ottawa (CNC); Whitaker collection, Indiana State University, Terre Haute, IN (JOW), United States National Museum of Natural History, Washington, D.C. (NMNH), Acarology Laboratory at Ohio

State University, Columbus, OH (OSAL), University of Michigan Museum of Zoology (UMMZ), and Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (ZIN).

TABLE 1. Comparative measurements for deutonymphs of North American *Euryparasitus* spp. (in μm). n=6 for all species.

	<i>E. occidentalis</i>		<i>E. longicheta</i>		<i>E. maseri</i>		<i>E. calcarator</i>	
	Av	SD	Av	SD	Av	SD	Av	SD
idiosoma, length	639	51	655	36	797	57	1183	132
idiosoma, width	421	33	414	15	536	51	773	91
podonotal shield, length	311	24	325	16	430	20	661	102
podonotal shield, width	366	19	355	22	461	37	712	103
opisthonotal shield, length	300	20	301	19	308	18	501	64
opisthonotal shield, width	340	25	356	40	392	37	644	99
sternal shield, length	274	49	289	14	378	26	552	76
sternal shield, width	105	6	111	5	165	12	247	55
anal shield, length	95	4	98	7	109	8	159	17
anal shield, width	107	5	110	5	103	7	215	18
seta <i>j</i> 6	33	6	73	12	40	4	69	16
seta <i>Z</i> 3	105	7	136	10	113	8	215	23
seta <i>Z</i> 5	159	50	142	5	116	6	349	58
seta <i>Sv</i> 5	51	6	94	4				
seta <i>Rv</i> 5					120	7	179	14

Genus level differentiation of *Euryparasitus* and *Cyrtolaelaps*

The tendency to base descriptions and keys solely on adults can create difficulties in identifying immature individuals. This becomes a particular problem in cases such as *Euryparasitus*, where adults and deutonymphs have different habitat usage patterns, and where deutonymphs are often collected without associated adults. Second, many earlier studies dealt with only one species of *Euryparasitus*, *E. emarginatus* (Koch), affecting the generality of differentiating characters proposed. The addition of several species to both *Cyrtolaelaps* and *Euryparasitus*, including the species described below, allows an evaluation of characters that might be used to distinguish not only the adults, but also the deutonymphs of these two genera.

Several studies list specific differences between the genera. Bregetova & Shcherbak (1977) noted the following characteristics for adult *Euryparasitus*: (1) shortened

peritremes (elongate in deutonymphs and *Cyrtolaelaps*), (2) presence of presternal shieldlets (absent in deutonymphs and *Cyrtolaelaps*), (3) absence of a few pairs of elongate, rodlike, and plumose dorsal setae (present in *Cyrtolaelaps*), (4) all *Jv* and *Zv* setae in the female inserted on the ventri-anal shield (one pair of *Jv* and one pair of *Zv* setae inserted in unsclerotized cuticle between genital and ventri-anal shield in *Cyrtolaelaps*), (5) absence of fusion of the anal and dorsal shield in the male (present in *Cyrtolaelaps*). It is unclear whether any of these characteristics is considered derived or not. The latter aspect is clearer in a study by Anthony (1980), focusing on phylogenetic relationships in all Rhodacaroida. She listed (2) and (3) as derived character states of *Cyrtolaelaps* and (1) as derived for *Euryparasitus*, but she did not mention either character (4) or (5). She did add as derived characters for *Euryparasitus*: (6) a modified seta *pv2* on tarsus IV, strongly pilose or with several lateral prongs (not obvious in adults or deutonymphs of *E. calcarator* (Banks) or *E. davydovae* Bondartchuk & Buyakova), (7) a finely pilose seta *al1* on the palp genu, and (8) adanal seta positioned at the level of the posterior margin of the anal valves (level with the middle of the anal valves in adult and deutonymphal *E. davydovae* and *E. goncharovi* Bondartchuk & Buyakova, and in deutonymphs of *E. longicheta*, *E. tori* Davydova, and *E. occidentalis* n. sp.); added derived characters for *Cyrtolaelaps* include: (9) a spine shaped seta *j1* (setiform in deutonymphs) and (10) opisthonotal hypertrichy.

Of these ten potential characters, only two, (3) presence or absence of elongate, rodlike, plumose setae, and (7) presence of finely pilose seta *al1* on the palp genu, allow distinction between deutonymphs of *Cyrtolaelaps* and *Euryparasitus*. Given that character (7) is not easily recognizable, especially in *E. occidentalis* and *E. longicheta* (condition in *E. tori*, *E. goncharovi*, and *E. davydovae* unknown), that leaves only character (3). Fortunately, this is a clear and unambiguous character. *Euryparasitus* deutonymphs may have a few elongate setae, but none show exceptional elongation of median podonotal setae (often found in *Cyrtolaelaps* deutonymphs), and none have rodlike, plumose setae. Setae in *Euryparasitus* retain a setiform shape, even when elongate.

Key to the deutonymphs for the species of *Euryparasitus* and the genera of Euryparasitidae in North America

1. Some elongate dorsal idiosomal setae (e.g. setae *z5*, *r4*, *Z3*, and/or *Z5*) rodlike and distinctly plumose *Cyrtolaelaps* Berlese
- All dorsal idiosomal setae, setiform, tapering to a point..... *Euryparasitus* Oudemans 2
2. Barbed setae on idiosoma absent; serrations on the free, anterior margin of the gnathotectum absent (Fig. 1A); well differentiated acrotarsus on legs I present 3
- Barbed setae on idiosoma present (e.g. setae *r4*, *Z5*, occasionally *s2*, *r2*, *Z3*) (Figs. 5, 6); serrations on the free, anterior margin of the gnathotectum present (Figs 1C, 1E); well differentiated acrotarsus on legs I absent 4

3. Median dorsal setae *J1-J4* (and most other dorsal setae also) long, surpassing insertion base of the next seta in the series. *Euryparasitus longicheta* Bondartchuk & Buyakova
- Median dorsal setae *J1-J4* (and most other dorsal setae also) shorter, not surpassing insertion of the next seta in the series *Euryparasitus occidentalis* n. sp.
4. Species very large, idiosomal length averaging nearly 1200 μ m. Chelicerae with 6 teeth on fixed, 3 on movable digit (Fig. 1F) *Euryparasitus calcarator* (Banks)
- Species smaller, idiosomal length averaging about 800 μ m. Chelicerae with 4 teeth on fixed, 3 on movable digit (Fig. 1E) *Euryparasitus maseri* n. sp.

Descriptions

Euryparasitus occidentalis Hagele, Kaufman, Whitaker & Klompen n. sp.

(Figs. 1A, 1B, 2A, 3)

Diagnosis. Deutonymph relatively small. Idiosomal setae smooth, setae *r4*, *Z3*, and *Z5* distinctly longer than remaining dorsal setae. Chelicerae with 5 teeth on fixed digit, 3 teeth on movable digit. Gnathotectum with smooth anterior free margin. Tarsus I with a distinct acrotarsus.

Description. Idiosomal length 639 (51) and width 421 (33) (N=6).

Gnathosoma. Chelicerae well developed, fixed digit with 5 teeth, movable digit with 3 distinct teeth (Fig. 1B). Dorsal seta stout and smooth, dorsal lyrifissure present, poorly developed, lateral lyrifissure *i α* not observed (only two specimens had the chelicerae in a lateral position, and in both the relevant part of the chelicerae was unclear); pilus dentilis small and thin. Gnathotectum with smooth anterior margin extending to a prominent, median prong with a semi blunt point (Fig. 1A). Hypostomal setae smooth; setae *hyp1* and *hyp3* much longer than *hyp2*. Subcapitular setae (*cs*) with a few small barbs. Corniculi smooth, hornlike; inserted slightly dorsal. Deutosternum with 7–9 files of teeth; teeth vary in sharpness, relative size, and number per row (from 4–11), and are irregularly distributed within rows. Palps with five distinct segments, tibia and tarsus not fused. Setation standard for free living Dermanyssina (Evans, 1963b), with 2 setae on the trochanter, 5 on the femur, 6 on the genu, and 14 on the tibia; sensilla on tarsus not counted. Palp pretarsus with three tines, one of which very small.

Idiosoma. Dorsum almost completely covered by two shields of subequal size; shields covered with a reticulate pattern (Fig. 3A). Off shield cuticle weakly striate (see Fig. 5). All dorsal setae smooth, setiform. Setae *r4*, *Z3*, and *Z5* relatively long, median and marginal opisthosomal setae shorter; setae *j1* and *z1* short; setae *Z3* about three times the length of setae *j6*; setae *Z5* distinctly longer than *Z3*. One pair of lateral propodosomal setae, designated *px*, associated with the peritrematal shield. Dorsal setal complement nearly complete for *jJ*, *zZ*, and *sS* series (only *s1* lacking). Most *R* and *Rv* setae (designations tentative) inserted in soft cuticle. Complement of dorsal lyrifissures and

glands similar to that listed for Zerconidae (Johnston & Moraza, 1991), but lacking lyrifissures *idz4*, *ids2*, and, possibly *idR3*, and opisthosomal glands *gdJ2*, *gdJ3*, *gdJ4*, and *gdZ1*. The pairs of lyrifissures and glands designated in Zerconidae as *ids4* and *gds5* (Johnston & Moraza, 1991) are most probably homologous to the pair designated as *ids5* and *gds6* in Parasitidae (Al-Atawi *et al.*, 2002). Glands *gds6* relatively large.

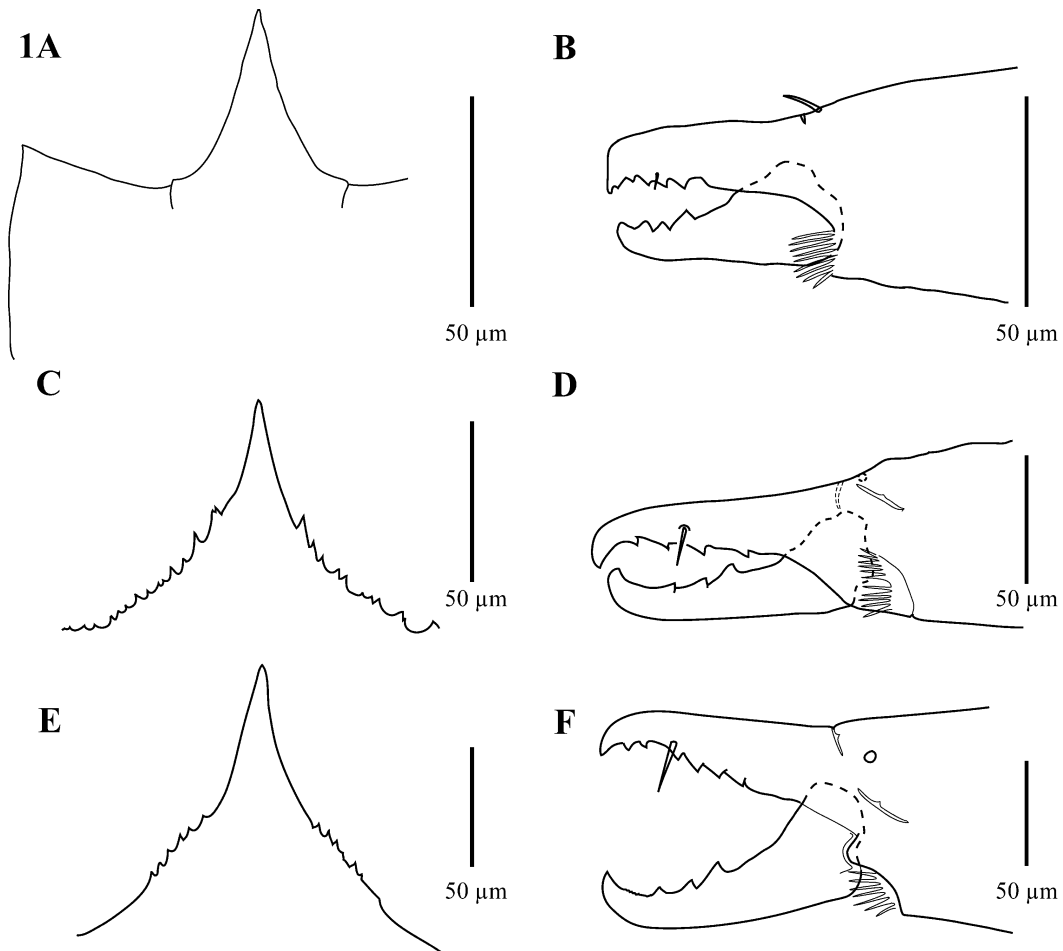


FIGURE 1. *Euryparasitus* deutonymphs, gnathotectum (A, C, E) and chelicerae (B, D, F). A, B: *occidentalis* n. sp.; C, D: *E. maseri* n. sp.; E, F: *E. calcarator* (Banks).

Venter (Fig. 3B). Tritosternum with well developed laciniae. Large sternal shield with faint reticulation, including insertions of setae *st1–st4*. Setae *st5* inserted in soft cuticle, flanking posterior end of sternal shield. Relative size of sternal setae decreases gradually from *st1* to *st5*. Endopodal shields distinct, exopodal shields weakly developed, not fused to peritrematal shields. Stigmata at level of middle of coxal acetabula IV; peritremes extending anteriorly until the middle of coxal acetabula I. Peritrematal shields not very extensive. Metapodal shields small, without setae, glands or lyrifissures. Anal shield nearly round; para-anal setae inserted at the level of center of the anal valves; unpaired

postanal seta slightly longer than para-anal setae. Cribrum transverse, linear, poorly developed. Opisthogastral setae relatively short, only Sv5 slightly longer. All ventral setae smooth and setiform. All 3 sternal lyrifissures well developed, peritrematal shield with lyrifissures *ip1* and *ip2*, and gland *gp*. Opisthogastral glands *gv2* close to coxae IV, multiple; glands *gv3* at margin of anal shield; sternal glands *gv1* not observed. Opisthogastral lyrifissures as in Zerconidae (Johnston & Moraza, 1991), but lyrifissure pair *ivo3* may be absent (the identity of the lyrifissure between setae *Rv3* and *Rv4* is unclear; it may be homologous to *ivo3* or *idR3*).

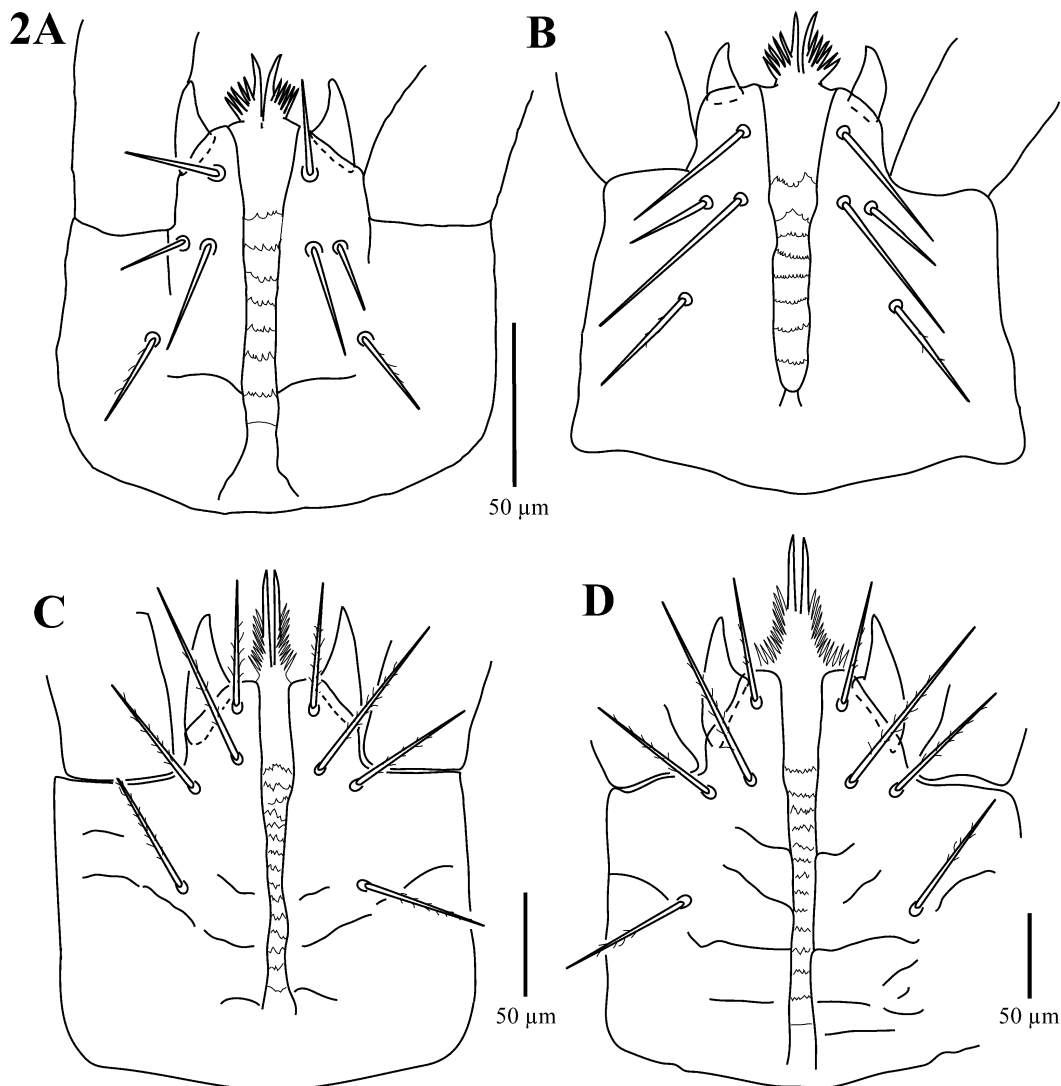


FIGURE 2. *Euryparasitus* deutonymphs, subcapitulum. A: *E. occidentalis* n. sp.; B: *E. longicheta* Bondartchuk & Buyakova; C: *E. maseri* n. sp.; D: *E. calcarator* (Banks).

U.S.A: Colorado, Grand Co., Jones Pass, 1 mi S of, 39°46'25"N, 105°53'19"W, 3475 m, ex *Microtus longicaudus* (DMA2021), coll. Armstrong, D. M., OSAL013795; Oregon, Benton Co., Mary's Peak, 4 mi from jct. sr344 & forest rd 1244, 44°30'16"N, 123°33'00"W, ex *Sorex bendirii* (Soricidae) (GSJ1035), 14 Jul 1972, coll. Jones, G. S., OSAL013763; Mary's Peak, 32 km SW Philomath, ex *Sorex pacificus* (GSJ1047), 14 Jul 1972, coll. Jones, G. S., OSAL013764; Mary's Peak, station 1, 32 km SW Philomath, ex *Arborimus albipes* (Muridae) (GSJ1645), 28 Jun 1973, coll. Jones, G. S., OSAL013767; Benton Co., 44°30'N, 123°25'W, ex *Sorex pacificus* (CM1034), 24 Mar 1968, coll. Maser, C. O., OSAL013772–73; ex *Sorex trowbridgii* (CM1042), 21 Mar 1968, coll. Maser, C. O., OSAL013771; Clackamas Co., Estacada Quadrangle, 4517'23"N, 122°19'57"W, ex *Mustela erminea* (Mustelidae), 31 Jul 1969, coll. Maser, C. O., OSAL013787–90; Coos Co., Bandon, SE of, 43°07'09"N, 124°24'26"W, ex *Sorex pacificus* (CM2962), 27 Dec 1971, coll. Maser, C. O., OSAL013780; Bandon, 4 mi NNE of, ex *Peromyscus maniculatus* (Muridae) (CM2511), 25 Feb 1971, coll. Maser, C. O., OSAL013776; Bandon, E of, ex *Peromyscus maniculatus* (CM3267), 16 Jul 1972, coll. Maser, C. O., OSAL013804; Coos Co., 43°29'N, 124°00'W, ex *Sorex trowbridgii* (CM2495), 21 Jan 1971, coll. Maser, C. O., OSAL013759; ex *Arborimus albipes* (RML59592), 3 Jun 1970, coll. Maser, C. O., OSAL013756; Curry Co., Brookings, 16 km E of, ex *Scapanus orarius* (Talpidae) (CM3144), 21 Apr 1970, coll. Maser, C. O., OSAL013803; Curry Co., 42°30'N, 124°13'W, CM2462, ex *Neurotrichus gibbsii* (CM2462), 4 Dec 1970, coll. Maser, C. O., OSAL013785–86; Douglas Co., Reedsport, SW of, 43°42'09"N, 124°05'44"W, 3 m, ex *Arborimus albipes* (RML62993), 22 Mar 1972, coll. Maser, C. O., OSAL013760; Douglas Co., 43°20'N, 123°10'W, ex *Sorex pacificus* (CM2091), 5 Feb 1970, coll. Maser, C. O., OSAL013775; Lane Co., H. J. Andrews Exp. Forest, 43°55'N, 122°50'W, ex *Neurotrichus gibbsii* (CM6115A), 14 Aug 1972, coll. Maser, C. O., OSAL013793–94; ex *Sorex pacificus*, (CM3387), 12 Aug 1972, coll. Maser, C. O., OSAL013784; ex *Peromyscus maniculatus*, 5 Apr 1972, coll. RAN, OSAL013791; Lincoln Co., Cascade Head Exp. Forest, 45°02'03"N, 123°55'20"W, ex *Sorex bendirii* (CM3305), 13 Aug 1972, coll. Maser, C. O., OSAL013781; ex *Sorex bendirii* (CM3310), 15 Aug 1972, coll. Maser, C. O., OSAL013782; ex *Sorex pacificus* (CM2600), 27 Apr 1971, coll. Maser, C. O., OSAL013778; ex *Arborimus albipes* (RML59829), 4 Aug 1972, coll. Maser, C. O., OSAL013757; ex *Arborimus albipes* (RML59835), 7 Aug 1972, coll. Maser, C. O., OSAL013758; ex *Arborimus albipes* (RML63008), 12 Aug 1972, coll. Maser, C. O., OSAL013761; ex *Arborimus albipes* (RML63010), 19 Aug 1972, coll. Maser, C. O., OSAL013762; ex *Microtus oregoni* (CM2573), 14 Apr 1971, coll. Maser, C. O., OSAL013777; ex *Zapus trinotatus* (Dipodidae) (CM2743), 8 Aug 1971, coll. Maser, C. O., OSAL013779; Lincoln Co., 44°40'N, 123°50'W, ex *Sorex bendirii* (CM3329), 18 Aug 1972, coll. Maser, C. O., OSAL013783; ex *Sorex pacificus*, 16 Aug 1972, coll. Maser, C. O., OSAL013792; Linn Co., 44°30'N, 122°35'E, ex *Peromyscus maniculatus* (CM1949), 2 Nov 1969, coll. Maser, C. O., OSAL013774; Washington, Clallam Co., Olympic Nat. Pk.,

forest rd. 304, 48°16'00"N, 124°40'30"W, ex *Peromyscus* sp. (GSJ1090), 18 Jul 1972, coll. Jones, G. S., OSAL013765; Snohomish Co., Gold Bar, 48°03'N, 121°43'W, ex *Neurotrichus gibbsii* (JOW6953), 24 Jun 1971, coll. Whitaker, J. O., Jr., OSAL013770.

Deposition of types. Holotype deutonymph, OSAL013769, in OSAL. Paratypes in collection of OSAL, CNC, JOW, NMNH, UMMZ, and ZIN.

Etymology. The species name refers to the western North American distribution of this species.

Remarks. *Euryparasitus tori*, *E. longicheta*, *E. goncharovi*, and *E. occidentalis* differ from all other described *Euryparasitus* deutonymphs by the complete absence of barbed setae on the idiosoma, the presence of a gnathotectum with a completely smooth margin, the presence of an acrotarsus on legs I, and the presence of 5 teeth on the movable digit, and 3 teeth on the fixed digit of the chelicerae. However, *E. longicheta* has much longer setae than all others (Bondartchuk & Buyakova, 1978), and *E. goncharovi* has a more or less pentagonal shaped anal shield with dorsal setae that are all subequal in length (Bondartchuk & Buyakova, 1976). *Euryparasitus occidentalis* and *E. tori* share elongate setae Z5 and an almost round anal shield (especially distinct in *E. tori*). However, setae Z3 in *E. tori* are similar in length to setae Z2 and S3 (Davydova, 1970), while they are distinctly longer in *E. occidentalis*. Setae Z5 in *E. occidentalis* are almost half as long as the opisthosomal shield, in *E. tori* those setae are at most 1/3 the length of that shield.

The presence of an acrotarsus on legs I is an unusual character for Dermanyssina, and is more commonly associated with deutonymphs of Parasitidae. Continued assignment of the above group of species to *Euryparasitus*, rather than some genus of Parasitidae is based in part on the morphology of the cribrum (a thin row lining most of the posterior margin of the anal shield in all *Euryparasitus*, a triangular field in parasitid deutonymphs), and the multiplication of ventral glands gv2 (single in Parasitidae). There is also evidence from the adults. While only the deutonymphs of *E. occidentalis*, *E. longicheta*, and *E. tori* are known, *E. goncharovi* is known from both nymphal instars and the adults. Its female has the sternal and metasternal shields fused, with seta *st4* on the sternal shield, and a subrectangular genital shield, characteristics of, respectively, Rhodacaroidea, and Euryparasitidae sensu Anthony (1980). The male shows a free spermatodactyl (fused in Parasitidae) with the massive elongate shape typical for *Euryparasitus* and *Cyrtolaelaps*. Based on this evidence we continue to assign these species to *Euryparasitus*. This assignment implies that the occurrence of an acrotarsus on legs I of the deutonymph is homoplasious, with separate origin or retention in Parasitidae and some *Euryparasitus*.

Lee (1970) noted a ventral setal complement in adult *E. emarginatus* of 3 *Jv*, 3 *Zv*, 3 *Sv*, and 3 *Rv* setae. *E. occidentalis* deutonymphs carry one less *Rv* seta.

***Euryparasitus longicheta* Bondartchuk & Buyakova (Figs. 2B, 4)**

Euryparasitus longicheta Bondartchuk & Buyakova, 1978, *Zool. Zh.* 57: 1578

Diagnosis. This species differs from all other known *Euryparasitus* deutonymphs by the relatively long dorsal setae, nearly all of which surpass the insertion point of the next seta in the series. In most other characteristics it is quite close to *E. tori* and *E. occidentalis*. The following notes are intended to supplement the original description, and to provide comparative data for *E. occidentalis*.

Description. Idiosomal length 655 (36) and width 414 (15) (N= 6).

Gnathosoma. Cheliceral dentition, gnathotectal shape, and palp segmentation and setation as in *E. occidentalis*. Hypostomal setae relatively longer, lengths of setae *hyp2* far surpassing the insertion of setae *cs* (Fig. 2B).

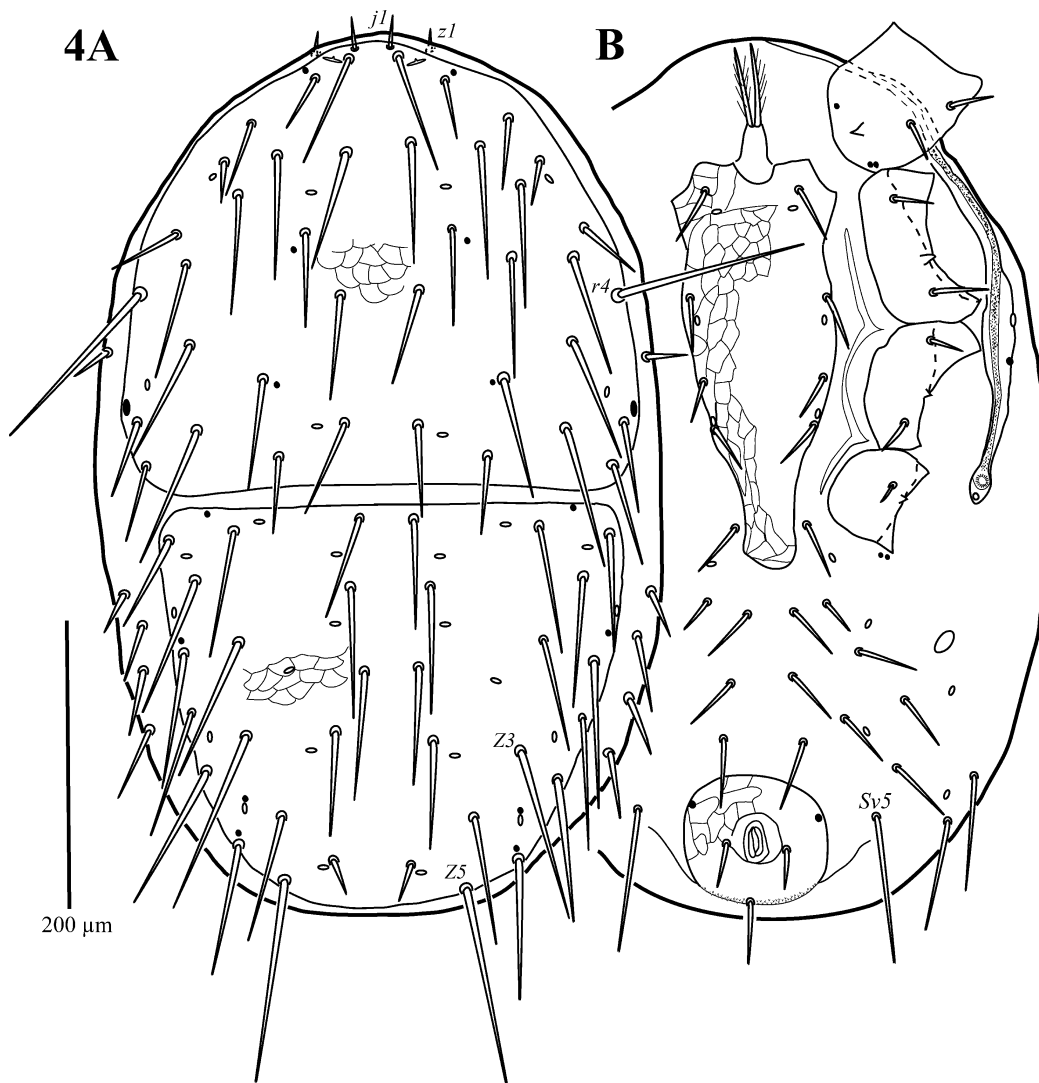


FIGURE 4. *Euryparasitus longicheta* Bondartchuk & Buyakova, deutonymph. A: dorsal view; B: ventral view.

Idiosoma. Dorsal shields subequal in size, covering most of dorsum (Fig. 3A). Podonotal shield length 325 (16), width 355 (16), opisthonotal shield length 301 (19), width 356 (40). All setae smooth; most setae long, although setae *j*1, *z*1, and some marginal setae are short; setae *r*4, *Z*3, and *Z*5 longer than most other setae, but less obviously so than in *E. occidentalis*. Distribution of setae, lyrifissures, and glands as in *E. occidentalis*.

Venter. Sternal shield large. Peritremes extending beyond the anterior edge of coxal acetabula I. Peritrematal, metapodal, and anal shields as in *E. occidentalis*. Setae slightly longer than in *E. occidentalis*, but much less so than on the dorsum. Lyrifissures *ivp*, situated posterior to the anus not observed. This may be an artifact of inadequate material.

Legs. Leg morphology and setation pattern as in *E. occidentalis*.

Material examined (all deutonymphs). U.S.A.: Oregon, Union Co., Starkey Exp. Forest, 45°14'N, 118°33'W, ex *Sorex vagrans* (CM7004), 19 Oct 1976, coll. Maser, C. O., OSAL013796–800; ex *Clethrionomys gapperi* (Muridae) (CM6994) 26 Oct 1976, coll. Maser, C. O., OSAL013801.

Deposition of specimens. Specimens deposited in JOW and OSAL.

Remarks. *Euryparasitus longicheta* was described from Western Siberia associated with *Eutamias sibericus* (Sciuridae) and *Cricetulus barabensis* (Muridae) (Bondartchuk & Buyakova, 1978).

***Euryparasitus maseri* Whitaker & Klompen n. sp. (Figs. 1C–D, 2C, 5)**

Diagnosis. Deutonymph of medium size. Some idiosomal and all hypostomal setae barbed. Setae *S*3 absent from opisthosomal shield. Chelicerae with 4 teeth on the fixed, 3 teeth on the movable digit. Gnathotectum with a serrate anterior, free, margin. Acrotarsus on legs I absent.

Description. Idiosomal length 797 (57), width 536 (51) (N= 6).

Gnathosoma. Chelicerae with 4 large teeth on the fixed digit, and 3 on the movable digit (Fig. 1D). Lyrifissures *id* and *iα* present, well developed; dorsal seta vestigial or absent; pilus dentilis much larger than in *E. occidentalis*. Gnathotectum developed into a single median point; with serrate anterior margin (Fig. 1C). All hypostomal setae barbed, tip of setae *hyp*2 surpassing the insertion points of setae *cs*; setae *hyp*2 subequal in length to setae *hyp*1 (Fig. 2D). Deutosternum with 14–16 rows of irregular shaped and arranged teeth. Palps as in *E. occidentalis*, but third tine of palpal pretarsus distinct.

Idiosoma. Podonotal shield distinctly larger than opisthonotal shield (Fig. 5A). Most setae inserted on dorsal shields smooth, but setae *s*2, *r*2, *r*4, *Z*5, and all marginal opisthosomal setae barbed. Setal complement on shields largely as in *E. occidentalis*, but opisthonotal seta *S*3 absent. The occasional presence of an undesignated seta off the shield, near the usual position of seta *S*3, suggests that *S*3 might still be present, but inserted off the shield (see Fig. 5A). Number of marginal setae in soft cuticle increased by presence of

five additional setae, tentatively designated as setae *R3*, *R4*, *R5*, *Rv2*, and *Rv5*. Shield setae *j2*, *r4*, *Z3* and *Z5* distinctly longer than remaining dorsal setae; setae *Z3* and *Z5* subequal in length, almost twice as long as the other opisthonotal setae; setae *j1* and *z1* similar in length to other podonotal shield setae; marginal opisthosomal setae generally shorter. Gland pattern and lyrifissure complement as in *E. occidentalis*.

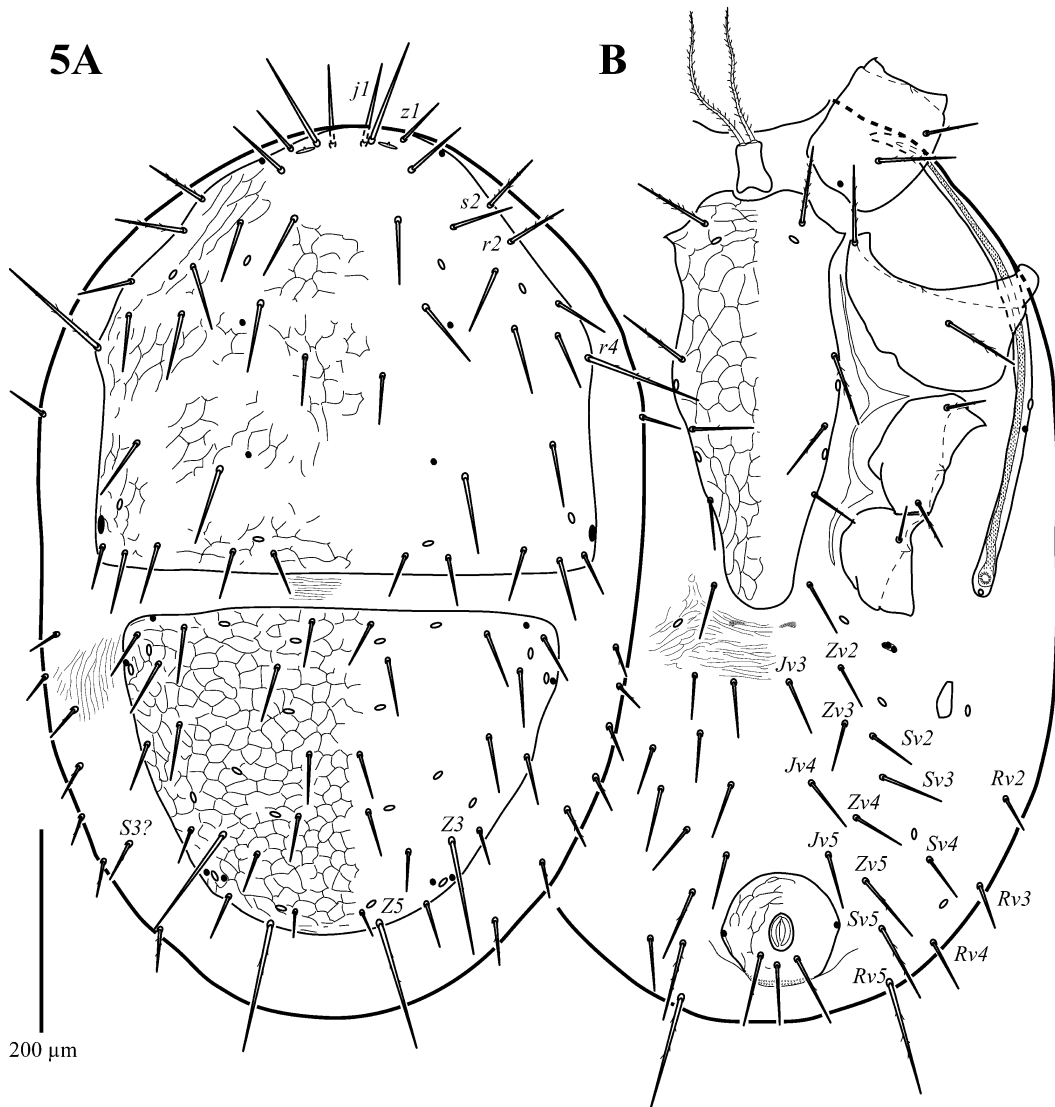


FIGURE 5. *Euryparasitus maseri* n. sp., deutonymph. A: dorsal view; B: ventral view.

Venter (Fig. 5B). Sternal shield large. Setae *st4* inserted off shield in soft cuticle in one specimen, on sternal shield in all other specimens examined. Peritremes extending anteriorly to the middle of coxal acetabula I. Peritrematal, metapodal, and anal shields as in *E. occidentalis*, although anal shield not quite as rounded. Sternal setae *st1* and *st2*, and opisthogastral seta *Rv5* strongly barbed, remaining sternal and opisthogastral setae with

weak barbs or smooth. Opisthogastral setal complement richer than in *E. occidentalis* by the addition of setae *Zv*4 and *Sv*2. Para-anal setae positioned slightly posterior to the anus. Lyrifissure and gland pattern generally as in *E. occidentalis*; cluster of *gv*2 glands posterior to each coxa IV more prominent; lyrifissure *ivp*, situated posterior to the anus in *E. occidentalis*, not observed (may be an artifact).

Legs. Leg setation pattern similar to that in *E. occidentalis*. Acrotarsus I absent or poorly developed. Legs II more conspicuously thickened than in *E. occidentalis*. Tarsal setae *av*2, *pv*2, and *mv*, and tibial setae *pv*1 of legs II strongly thickened, spinelike, with distinct barbs. Tibial seta *av*1 barbed, but less thick and spinelike. Lateral and dorsal setae may be barbed, but remain setiform.

Material examined (all deutonymphs). U.S.A.: Oregon, Malheur Co., Whitehorse Ranch, 10 km SE of, 43°15'N 117°40'W, ex *Onychomys leucogaster* (CM7223), 19 Aug 1976, coll. Maser, C. O., OSAL013968 (Holotype). Paratypes: Same collection data, OSAL013956–67; Malheur Co., 10 km SSE Vale, 43°15'N, 117°40'W, ex *Dipodomys ordii* (Dipodidae) (CM6478), coll. Maser, C. O., OSAL013969; ex *Spermophilus townsendii* (Sciuridae) (CM6471), 20 Mar 1975, coll. Maser, C. O., OSAL013971; ex *Spermophilus townsendii* (CM6496), 21 Mar 1975, coll. Maser, C. O., OSAL013970; Malheur Co., 43°15'N, 117°40'W, ex *Lemmings curtatus* (Muridae) (CM7233), 27 Aug 1976, coll. Maser, C. O., OSAL013972; ex *Lemmings curtatus* (CM7239), 29 Aug 1976, coll. Maser, C. O., OSAL013973.

CANADA: Alberta, Bow Island, 49°52'N, 111°22'W, ex *Onychomys* sp. (Muridae) (GSJ1307), 11 Aug 1972, coll. Jones, G. S., OSAL013974–75.

Deposition of types. Holotype deutonymph, OSAL013968, in OSAL. Paratypes in OSAL, JOW, ZIN.

Etymology. This species is named in honor of Chris Maser, who collected many of the mites in this study.

Remarks. Relative to the ventral setal complement of adult *E. emarginatus* (Lee, 1970) this deutonymph features one additional *Zv* and one *Sv* seta. The additional *Rv* setae are considered less significant as some of these lateral setae may appear dorsal or ventral on slide mounted specimens. They may be homologous with any of the large number of marginal setae figured for *E. emarginatus* in dorsolateral position.

***Euryparasitus calcarator* (Banks) (Figs. 1EF, 2D, 6)**

Gamasus calcarator Banks, 1910, *Proc. Entomol. Soc. Wash.* 12: 4

Parasitus calcarator Banks, 1915, *U.S. Dept. Agric. Rep.* 108: 83

Euryparasitus calcarator Lee, 1970, *Rec. S. Aust. Mus.* 16: 154; Hennessey & Farrier, 1988, *North Carolina Agric. Res. Serv., Tech. Bull.* 285:16.

Diagnosis. Very large species. Some idiosomal and all hypostomal setae barbed. Chelicerae with 6 teeth on the fixed, 3 teeth on the movable digit. Gnathotectum with

serrate anterior, free, margin. Acrotarsus on legs I absent.

Description. Idiosomal length 1183 (132), width 773 (91) (N= 6).

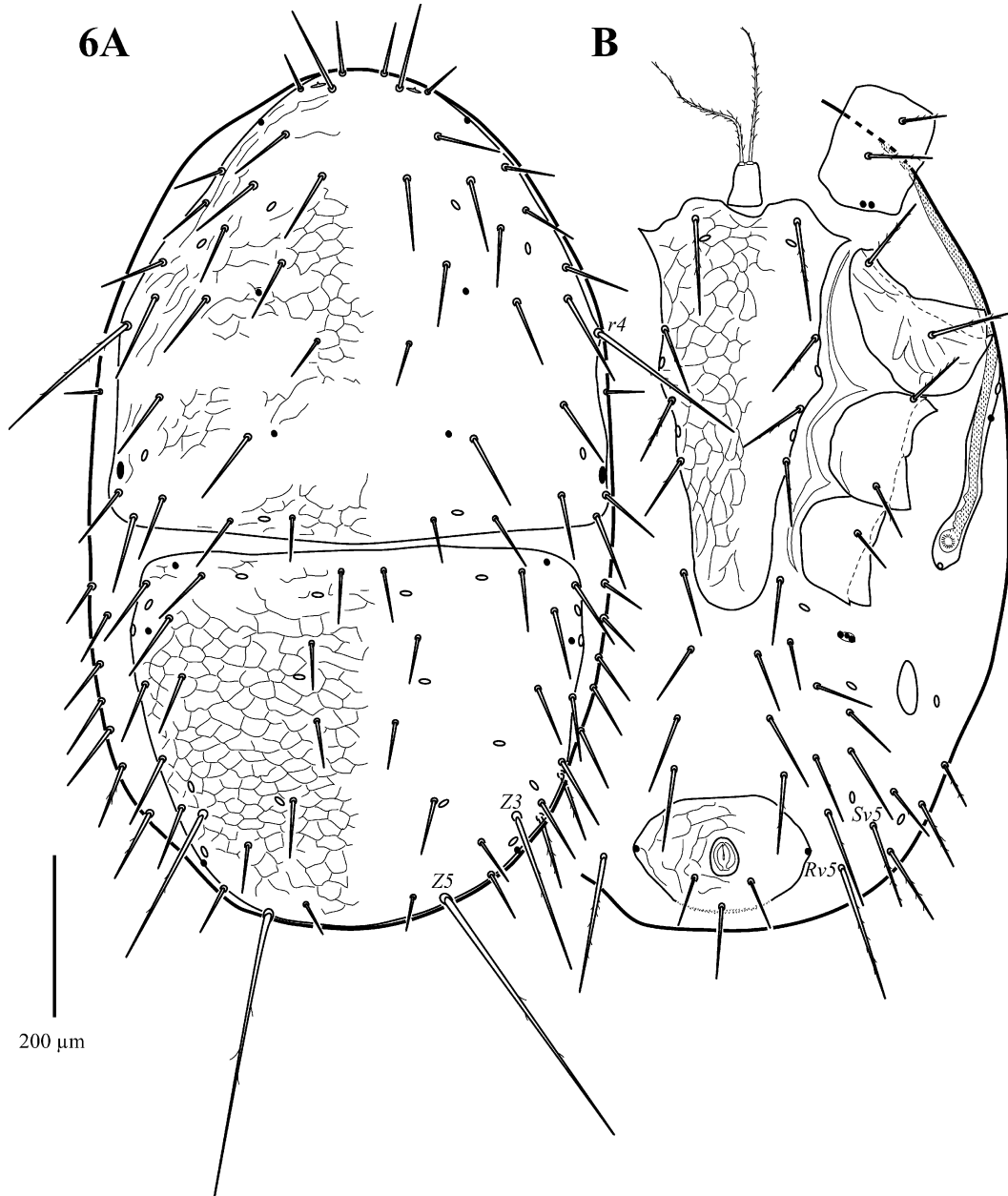


FIGURE 6. *Euryparasitus calcarator* (Banks), deutonymph. A: dorsal view; B: ventral view.

Gnathosoma. Chelicerae with 6 teeth on the fixed digit, 2 of which are small, and 3 large teeth on the movable digit (Fig. 1F). Lyrifissures *id* and *iα* present, well developed; dorsal seta vestigial or absent; pilus dentilis as in *E. maseri*. Gnathotectum developed into a single median point and with serrate anterior margin (Fig. 1E); serrations less robust than

in *E. maseri*. Subcapitulum (Fig. 2D), including relative size and shape of the hypostomal setae, quite similar to that of *E. maseri*. Deutosternum with 13–15 rows of irregular teeth. Palps as in *E. maseri*.

Idiosoma. Podonotal shield slightly larger than opisthonotal shield (Fig. 6A). Most setae inserted on dorsal shields smooth, but setae *r*₄, and most marginal opisthosomal setae barbed. Setal complement on shields as in *E. occidentalis*. Number of marginal setae in soft cuticle as in *E. maseri*. Shield setae *r*₄, *Z*₃, and *Z*₅ distinctly longer than remaining dorsal setae; setae *j*₂ only slightly longer than setae *z*₂ and *z*₃; setae *j*₁ and *z*₁ similar in length to most other podonotal setae; setae *Z*₅ distinctly longer than setae *Z*₃; both at least twice as long as all other opisthonotal setae; marginal setae not shorter than opisthonotal ones. Gland pattern and lyrifissure complement as in *E. occidentalis*.

Venter (Fig. 6B). Sternal shield large. Stigmatal position, peritremes and peritrematal shields as in *E. occidentalis*; metapodal shields relatively large; anal shield distinctly wider than long (see Table 1). All sternal and most marginal opisthogastral setae barbed, remaining opisthogastral setae with weak barbs or smooth; opisthogastral setal complement identical to that in *E. maseri*; para-anal setae positioned slightly posterior to the anus. Lyrifissure and gland pattern as in *E. maseri*.

Legs. Leg setation pattern similar to that in *E. occidentalis*. Leg morphology more similar to that in *E. maseri*: acrotarsus I absent and ventral setae of tarsus and tibia II thickened and barbed, although less obviously so.

Material examined (unless indicated otherwise all specimens are deutonymphs). CANADA: British Columbia, Hope, 11.5 mi SW of, 49°23'N, 121°26'W, ex *Zapus trinotatus* (GSJ1704), 6 Jul 1973, coll. Jones, G. S., OSAL014022; Cottonwood River & BC94 Jct, 59°06'03"N, 129°46'46"W, ex *Zapus princeps* (GSJ1207), 30 Jul 1972, coll. Jones, G. S., OSAL013984; Fraser River valley, 25 km W jct. BC1 & BC3 on BC1, 53°29'N, 122°43'W, ex *Microtus* sp. (GSJ1166), 23 Jul 1972, coll. Jones, G. S., OSAL014023; New Brunswick, Mt. Carleton Park, 47°23'00"N, 066°53'00"W, ex *Condylura cristata* (Talpidae) (TF102), 16 Jun–20 Jul 1980, coll. French, T. W., OSAL013992; ex *Blarina brevicauda* (Soricidae) (TF644), coll. French, T. W., OSAL013993; ex *Blarina brevicauda* (TF675), coll. French, T. W., OSAL013994; ex *Sorex cinereus* (TF764), coll. French, T. W., OSAL013999; ex *Sorex fumeus* (TF118), coll. French, T. W., OSAL013989–90; ex *Sorex fumeus* (TF479), coll. French, T. W., OSAL013996; ex *Sorex gaspensis* (TF372), coll. French, T. W., OSAL013991; ex *Microtus chrotorrhinus* (TF601), coll. French, T. W., OSAL014000–01; ex *Microtus pennsylvanicus* (TF107), coll. French, T. W., OSAL014002; ex *Napaeozapus insignis* (Dipodidae) (TF765), coll. French, T. W., OSAL013997–98; up the Tabusintac River, ex *Blarina brevicauda* (TF761), 15 Jun–29 Jul 1980, coll. French, T. W., OSAL013995.

U.S.A.: Colorado, Routt Co., 40°31'N, 106°59'W, ex *Tamiasciurus hudsonicus* (Sciuridae) (CM2360), 7 Sep 1970, coll. Maser, C. O., OSAL014006; ex *Tamias quadrivittatus* (Sciuridae) (CM1736), 30 Jul 1969, coll. Maser, C. O., OSAL014008;

Colorado, ex *Clethrionomys gapperi* (DMA1972), coll. Armstrong, D. M., OSAL014020; Illinois, Clark Co., Marshall, 10 km NE of, 39°23'29"N, 087°41'37"W, ex *Microtus pinetorum* (DDP76), 20 Nov 1967, coll. Pascal, D. D., Jr., OSAL014018; ex *Microtus pinetorum* (DDP500), 5 Dec 1968, coll. Pascal, D. D., Jr., OSAL014019; Indiana, Jasper Co., 41°02'29"N, 087°09'05"W, ex *Sorex cinereus* (REM6323), 20 Mar 1970, coll. Whitaker, J. O., Jr., OSAL014017; Pulaski Co., 41°03'05"N, 086°36'11"W, ex *Tamias striatus* (JOW9225), 30 Mar 1975, coll. Whitaker, J. O., Jr., OSAL013982; Vigo Co., Terre Haute, 39°28'00"N, 087°24'50"W, 153 m, ex *Scalopus aquaticus* (Talpidae) (JOW7587), 17 Oct 1971, coll. Whitaker, J. O., Jr., OSAL014015; New York, Delaware Co., Dry Brook Ridge, Catskills, 42°06'08"N, 074°35'51"W, ex *Microtus chrotorrhinus* (TF1197), 23 Sep 1981, coll. French, T. W., OSAL014025; ex *Microtus chrotorrhinus* (TF1564), 8 Oct 1981, coll. French, T. W., OSAL014024; Otsego Co., Milford, 42°35'26"N, 074°56'44"W, ex *Tamias striatus* (JOW5926), 24 Jun 1970, coll. Whitaker, J. O., Jr., OSAL013983; Schuyler Co., Arnot Forest, 42°25'N, 076°28'W, ex *Blarina brevicauda*, 14 Sep 1974, coll. Northam, M., UMMZ; Tompkins Co., jct. Warren Rd & Rte 13, 42°27'N, 076°28'W, ex *Microtus pennsylvanicus*, 6 Mar 1975, coll. OConnor, B. M., UMMZ; jct. Rte 13 & Rte 366, ex *Blarina brevicauda*, 24 Feb 1976, coll. OConnor, B. M., UMMZ (Female); North Carolina, Clay Co., Fire Creek, Bristol cabin, 35°04'05"N, 083°52'06"W, ex *Ochrotomys nuttalli* (Muridae) (JOW8266), 22 Apr 1973, coll. Whitaker, J. O., Jr., OSAL014016; Oregon, Benton Co., 4429'N, 123°25'W, ex *Sorex bendirii* (CM1046), 25 Mar 1968, coll. Maser, C. O., OSAL014012; Clackamas Co., Estacada Quadrangle, 45°17'23"N, 122°19'57"W, ex *Mustela erminea*, 31 Jul 1969, coll. Maser, C. O., OSAL013980; Coos Co., Bandon, SE of, 43°07'09"N, 124°24'26"W, ex *Sorex pacificus* (CM2962), 27 Dec 1971, coll. Maser, C. O., OSAL014009; Coos Co., 43°29'N, 124°00'W, ex *Sorex vagrans* (CM1795), 26 Aug 1969, coll. Maser, C. O., OSAL014013; Harney Co., 43°10'N, 119°00'W, ex *Lemmiscus curtatus* (CM6981), 3 Aug 1975, coll. Maser, C. O., OSAL013979; Lane Co., H.J. Andrews Exp. Forest, 43°55'N, 122°50'W, ex *Sorex trowbridgii* (CM3359), 31 Aug 1972, coll. Maser, C. O., OSAL013977; ex *Tamias townsendii* (CM5606), 28 Sep 1972, coll. Maser, C. O., OSAL014007; Lane Co., 43°55'N, 122°50'W, ex *Sorex bendirii* (CM6100), 15 Aug 1972, coll. Maser, C. O., OSAL014011; ex *Sorex trowbridgii* (CM1104), 8 May 1968, coll. Maser, C. O., OSAL013976; Lincoln Co., Cascade Head Exp. Forest, 45°02'03"N, 123°55'20"W, ex *Microtus oregoni* (CM2570), 13 Apr 1971, coll. Maser, C. O., OSAL014004; ex *Microtus longicaudus* (CM2801), 24 Aug 1971, coll. Maser, C. O., OSAL014005; ex *Arborimus albipes* (RML63010), 19 Aug 1972, coll. Maser, C. O., OSAL014010; Linn Co., 44°29'N, 122°35'E, ex *Sorex trowbridgii* (CM4134), 26 Sep 1972, coll. Maser, C. O., OSAL013978; Washington, Clallam Co., Olympic Nat. Pk, E border Nat. For. nr rd349, 48°12'N, 124°23'W, ex *Sorex trowbridgii* (GSJ 1102), 19 Jul 1972, coll. Jones, G. S., OSAL013988; Clallam Co., Olympic Nat. Pk., 48°16'00"N, 124°40'30"W, ex *Phenacomys intermedius* (Muridae) (MLJ594349), 15 Sep 1976, coll., OSAL013985; Pierce Co., Tacoma, 16 km

SE of, between McChord & Spanaway, 47°06'15"N, 122°26'00"W, ex *Peromyscus maniculatus* (PGF979), 18 Apr 1972, coll. Fish, P. G., OSAL014021; Snohomish Co., Gold Bar, 48°03'N, 121°43'W, ex *Sorex bendirii* (JOW6945), 24 Jun 1971, coll. Whitaker, J. O., Jr., OSAL013987; ex *Neurotrichus gibbsii* (JOW 6953), coll. Whitaker, J. O., Jr., OSAL013986; Wyoming, Carbon Co., Medicine Bow Natl. For., 41°15'N, 106°15'W, ex *Zapus* sp. (GSJ 2136), 12 Aug 1973, coll. Jones, G. S., OSAL013981.

No locality information, ex *Scalopus aquaticus* (71777), 17 Nov 1971, coll. Forsyth, D. J., OSAL014026; ex *Scalopus aquaticus* (71772), 14 Nov 1971, coll. Forsyth, D. J., OSAL014027; ex *Scalopus aquaticus* (DJF82), coll. Forsyth, D. J., OSAL014028; ex *Scalopus aquaticus* (DJF83), coll. Forsyth, D. J., OSAL014029.

Deposition of specimens. Specimens deposited in collection of OSAL, CNC, JOW, NMNH, UMMZ, and ZIN.

Remarks. *Euryparasitus calcarator* was described and redescribed for the adults only (Banks, 1910; Hennessey & Farrier, 1988). The species is quite similar to *E. emarginatus*, but differs by the presence of 3, rather than 4, teeth on the movable digit. The association of this name with the series of deutonymphs described below is tentative. It is based on similarity in the structure of the chelicerae, and the fact that so far only one type of deutonymph of a very large *Euryparasitus* has been collected in eastern North America, despite extensive collecting.

Within North America, this deutonymph is most similar to that of *E. maseri* n. sp. The two species share a serrate anterior margin of the gnathotectum, presence of a large complement of opisthosomal setae, position of the para-anal setae posterior to the anus, absence of an acrotarsus on tarsus I, and the morphology of the ventral setae of tarsus and tibia II. The two species differ in absolute size, presence/absence of setae S3, the relatively larger size of legs II and the smaller size of the opisthonotal shield in *E. maseri*, and the dentition of the fixed digit of the chelicerae.

This species also shows some clear intraspecific variation. Specimens from western North America (Oregon, Washington) are larger than those from eastern North America (New Brunswick, New York, Indiana), e.g. podonotal shield length 747 (63) vs. 576 (12). However, these size differences did not correlate with qualitative characters, and may be allometric changes representing an East–West cline. The available collections were insufficient to exclude that possibility, and we therefore elect to retain all specimens in a single species.

Discussion

The *Euryparasitus* fauna we found in Western North America is remarkably similar to that of northern Asia. *Euryparasitus tori* and *E. occidentalis* are very closely related, and *E. longicheta* occurs in both areas. The pattern is less clear for *E. calcarator*. Its closest relative appears to be *E. emarginatus*, which occurs from Europe to Eastern Siberia. Given

the northern distribution of the genus, and the low level of morphological diversification, it is tempting to invoke transfer across the Bering Strait to explain the distribution of the western (and perhaps all) North American species, but such a hypothesis may be premature given the still relatively poor knowledge of the genus.

The host association pattern in *Euryparasitus* does not suggest host specificity. Deutonymphs of *E. occidentalis* are recorded from mammalian hosts in three orders and five families, Insectivora (Soricidae, Talpidae), Rodentia (Muridae, Dipodidae), and Carnivora (Mustelidae), while *E. calcarator* was recorded from the same host groups plus Sciuridae. Even *E. maseri*, with only seven collection records, was recorded from three different families of rodents. In contrast, the distribution records appear consistent with habitat specificity. Notably, there is no geographical overlap between the ranges of the “small” species, *E. occidentalis* (moist regions of western Oregon, Washington, British Columbia), *E. longicheta* (Eastern Oregon), and *E. maseri* (drier regions of Eastern Oregon and Alberta), suggesting at least the possibility that these species are specific for climatic regions. Added records from especially central and eastern Oregon would be required to further test this hypothesis. Requirements for the large *E. calcarator* appear less strict. The species has a much wider geographical range than the other species, and does overlap with that of the smaller species. In fact, a single host specimen may carry representatives of a small species and of *E. calcarator*. This is demonstrated most clearly for a few host specimens in western Oregon, that carried both *E. calcarator* and *E. occidentalis*. Interestingly, this general distribution patterns mirrors that of *E. emarginatus* and the smaller *Euryparasitus* species in Eurasia.

Acknowledgements

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