

## ***Zibethacarus beeri* (Astigmata: Glycyphagidae), a new mite species inhabiting vole nests in western Oregon, U.S.A.**

NORMAN J. FASHING AND ANDREW BURTON

Department of Biology, College of William and Mary, Williamsburg, VA 23187-8795, USA. E-mail: njfash@wm.edu

### **Abstract**

*Zibethacarus beeri* **sp. nov.**, is described and illustrated from adults collected from the nest of *Microtus oregoni* (Bachman) (Rodentia) in western Oregon, U.S.A. Males are approximately half the size of females, and samples collected into alcohol using a Berlese funnel contained males still clinging to the dorsum of females, their modified tibiae of legs II clasping the female's modified dorsal setae  $h_2$ . It is probable that such persistent clinging behavior is a result of mate guarding on the part of the male.

**Key words:** Acari, Glycyphagidae, *Zibethacarus*, *Microtus*, *Dermacarus*, mate guarding

### **Introduction**

Rupeš and Whitaker (1968) described *Dermacarus ondatrae* from deutonymphs collected from muskrats, *Ondatra zibethicus* (Linnaeus), in North America. Upon rearing adults from deutonymphs, Rupeš *et al.* (1971) concluded that the species did not actually belong in the genus *Dermacarus* and established a new genus, *Zibethacarus*, to accommodate it. Although Fain and Whitaker (1973) disagreed and provisionally synonymized *Zibethacarus* with *Dermacarus*, Fain and Lukoschus (1974) later concluded that *Zibethacarus* is a valid genus after examining adults of *Glycyphagus* (*Myacarus*) *hypudaei* (Koch) and *Dermacarus sciurinus* (Koch). The present paper describes a second species of *Zibethacarus* collected from the nest of *Microtus oregoni* (Bachman) (Rodentia) in western Oregon, U.S.A.

### **Materials and methods**

Nesting material of *M. oregoni* was collected in Lincoln County, Oregon, and the arthropod inhabitants extracted into 70% ethyl alcohol using a modified Berlese funnel. Mites were cleared in Nesbitt's solution and mounted in Hoyer's medium on microscope slides (Krantz 1978, Evans 1992). Measurements (5 males and 8 females), given in micrometers ( $\mu\text{m}$ ), are summarized as means followed by their range. Nomenclature for idiosomal setae follows Griffiths *et al.* (1990) and for leg setae Grandjean (1939).

### **Results**

**Genus *Zibethacarus*** Rupeš, Yunker and Wilson 1971

*Dermacarus* Rupeš and Whitaker, 1968: 496  
*Zibethacarus* Rupeš, Yunker and Wilson, 1971: 17  
*Dermacarus* Fain and Whitaker, 1973: 155  
*Zibethacarus* Fain and Lukoschus, 1974: 1149

*Type species*

*Dermacarus ondatrae* Rupeš and Whitaker, 1968; by original designation.

*Diagnosis*

Idiosoma with wart-like mammilations; most dorsal setae barbed and elongate, with setae  $e_1$  extremely elongate; dorsal setae not arising from integumental bosses; setae *scx* present; setae *se* lacking. Female with genital opening covered by two lateral valves, not enclosed by circumgenital ring; setae *ve* well developed, barbed;  $h_2$  reduced; short thick, sharply pointed, bare. Male with setae *ve* and  $h_2$  relatively well developed, barbed.

***Zibethacarus beeri* sp. nov.**

*Material examined*

*Holotype*: Male collected two miles west of Mary's Peak, Lincoln County, Oregon, U.S.A., from the nest of *Microtus oregoni* (Bachman) (Rodentia: Muridae), March 21, 1980, by Don Gettinger, Department of Biology, University of Central Arkansas. Holotype deposited in the U.S. National Museum.

*Paratypes*: Four males and eight females with same collection data as holotype. Two males and three females deposited in the U.S. National Museum, Washington, D.C.; one male and two females deposited in the Acarology Collection, Oregon State University, Corvallis, and one male and three females deposited in the Natural History Museum, London.

*Description*

*Male* (Figs. 1–4, 6–9)

Body broadly oval; length 233 (221–242); width at level of seta  $c_3$  168 (158–180). Gnathosoma with chelate chelicerae (Fig. 1), digits robust with interlocking teeth; cheliceral seta short, spine-like; subcapitulum (Fig. 2) broad, somewhat trapezoidal in shape, bearing a pair of pilose palpal supracoxal setae dorso-laterally and a pair of filiform subcapitular setae ventrally. Each palpal tibia bears a filiform dorsal seta and a filiform ventral seta, and each palpal tarsus a filiform dorsal seta and on the apex a seta, solenidion, and eupathidium.

*Dorsum* (Fig. 3). Cuticle moderately sclerotized with wart-like mammilations (Fig. 3a), however irregular plate-like sculpturing occurs in some areas and surrounding some setae as illustrated (e.g., Fig. 3b). Grandjean's organs (*go*) and supracoxal setae (*scx*) present (Fig. 10a). Sejugal furrow absent. Opisthonotal gland openings (*gla*) midway between setae  $d_2$  and  $e_2$ . Cupules located as follows: *ia* between seta  $c_1$  and  $c_2$ , *im* slightly anterior to *gla*, and *ip* between setae  $e_2$  and  $f_2$ . Supracoxal seta (*scx*) 21 (18–23), dendriform with double-barbed branches (Fig. 10a). Setae  $d_1$  87 (76–112) serrate, with serrations uniformly spaced and oriented perpendicular to the setal core. The remainder of the dorsal setae are densely pectinate: *vi* 48 (39–53), *ve* 31 (27–36), *si* 86 (77–92),  $c_1$  13 (12–15),  $c_2$  50 (45–62), *cp* 58 (52–71);  $d_2$  45 (38–53);  $e_1$  267 (248–288);  $e_2$  75 (70–92);  $f_2$  61 (55–73);  $h_1$  85 (73–118) and  $h_2$  64 (53–80).

*Venter* (Fig. 4). Cuticle moderately sclerotized and mammilated. Cupule *ih* on idiosomal margin between setae  $ps_1$  and  $ps_2$ . Anterior coxal apodemes I directed posteromedially, joining at midline.

Anterior and posterior coxal apodemes II joined and directed medially; anterior coxal apodemes III directed posteromedially; anterior apodemes IV directed anteriomedially. Aedeagus strongly sclerotized, located between coxal fields III and IV, and opening through a pair of lateral valves. Anus a longitudinal slit at idiosomal terminus. Venter bearing 11 pairs of setae:  $c_3$  38 (33–47) pectinate, laterad coxae III;  $1a$  20 (17–26) filiform, on coxal fields I;  $3a$  16 (14–18) filiform, on coxal fields II;  $3b$  23 (21–26) filiform, on coxal fields III;  $4a$  22 (17–27) filiform, on coxal fields IV;  $g$  14 (12–17) filiform, laterad genitalia;  $ad_3$  15 (12–18) filiform, slightly anterior anal slit;  $ps_1$  22 (17–32),  $ps_2$  24 (20–33),  $ps_3$  16 (17–21) and  $h_3$  39 (33–48), pectinate, arising at posterior end of idiosoma. Setae  $ad_1$  and  $ad_2$  absent.

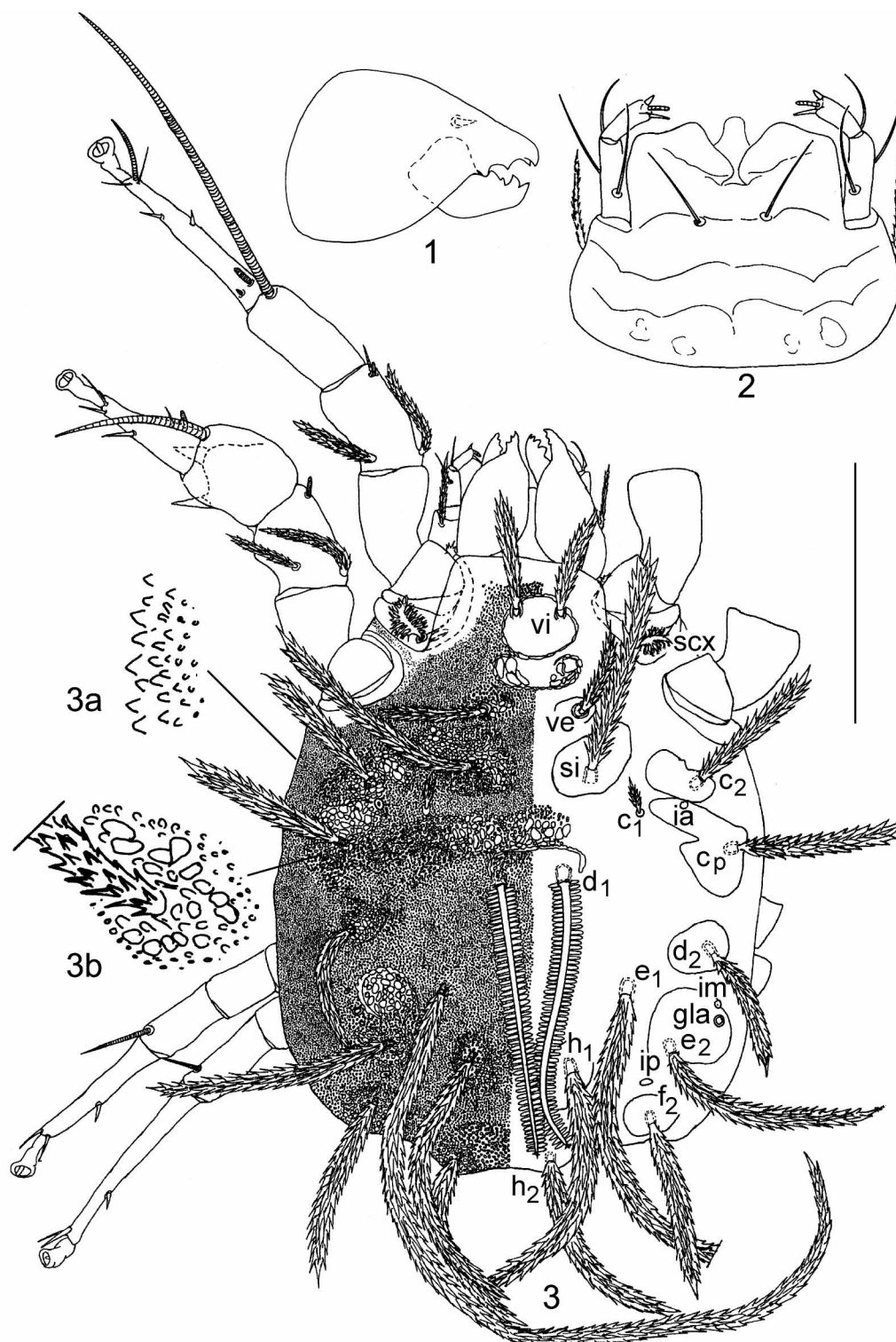
*Legs* (Figs. 6–9). Lengths, measured from base of trochanter to tip of tarsus: I 204, (195–212); II 155 (146–167); III 139 (129–148); IV 165 (149–171). Tarsal lengths: I 71 (67–76); II 42 (38–45); III 56 (55–60); IV 76 (73–79). Trochanteral setation 1-1-1-0; setae  $pR$  I-II and  $sR$  III densely pectinate. Femoral setation 1-1-0-1; setae  $vF$  I-II and  $wF$  IV densely pectinate. Genual setation 2-2-1-0; setae  $cG$  and  $mG$  I-II and  $nG$  III densely pectinate. Tibial setation 2-2-1-1; setae  $hT$ ,  $gT$  I and  $kT$  III-IV densely pectinate; setae  $hT$ ,  $gT$  II stout ventral spines that arise from a protuberance that creates a cleft between the setae and the tibial body. Tarsal setation 10-10-8-8; tarsae I and II with setae  $ba$ ,  $la$ ,  $wa$ ,  $ra$ ,  $d$ ,  $e$  and  $f$  filiform, setae  $s$  and proral setae ( $p$  and  $q$ ) short spines; tarsus III and IV with setae  $d$ ,  $e$  and  $f$  filiform, setae  $r$  slender spines, setae  $w$  and  $s$  stout spines, and proral setae ( $p$  and  $q$ ) short spines. Apical tarsal setae  $u$  and  $v$ , observable in females on legs I–IV, not apparent in males. Genua I solenidia  $\sigma'$  7 (6–7),  $\sigma''$  18 (17–21), genua II solenidia  $\sigma$  7 (6–7) and genua III solenidia  $\sigma$  12 (11–13) originating slightly below segment apex. Tibiae I solenidia  $\phi$  137 (133–138) and tibia II solenidia  $\phi$  58 (54–61) originating on segment apex; tibiae III solenidia  $\phi$  27 (24–31) and tibia IV solenidia  $\phi$  12 (11–14) originating slightly below segment apex. Tarsus I with solenidia  $\omega_1$  11 (9–12) and  $\omega_2$  9 (8–11) originating near segment base, and  $\omega_3$  26 (25–29) apically. Tarsus II with  $\omega$  9 (8–11) originating near segment base. Tarsus I with spinelike famulus  $\epsilon$  originating near segment base. Pretarsi with elongate, slender membranous ambulacra and small, curved claws; condylophores absent.

#### *Female* (Figs. 5, 10–14)

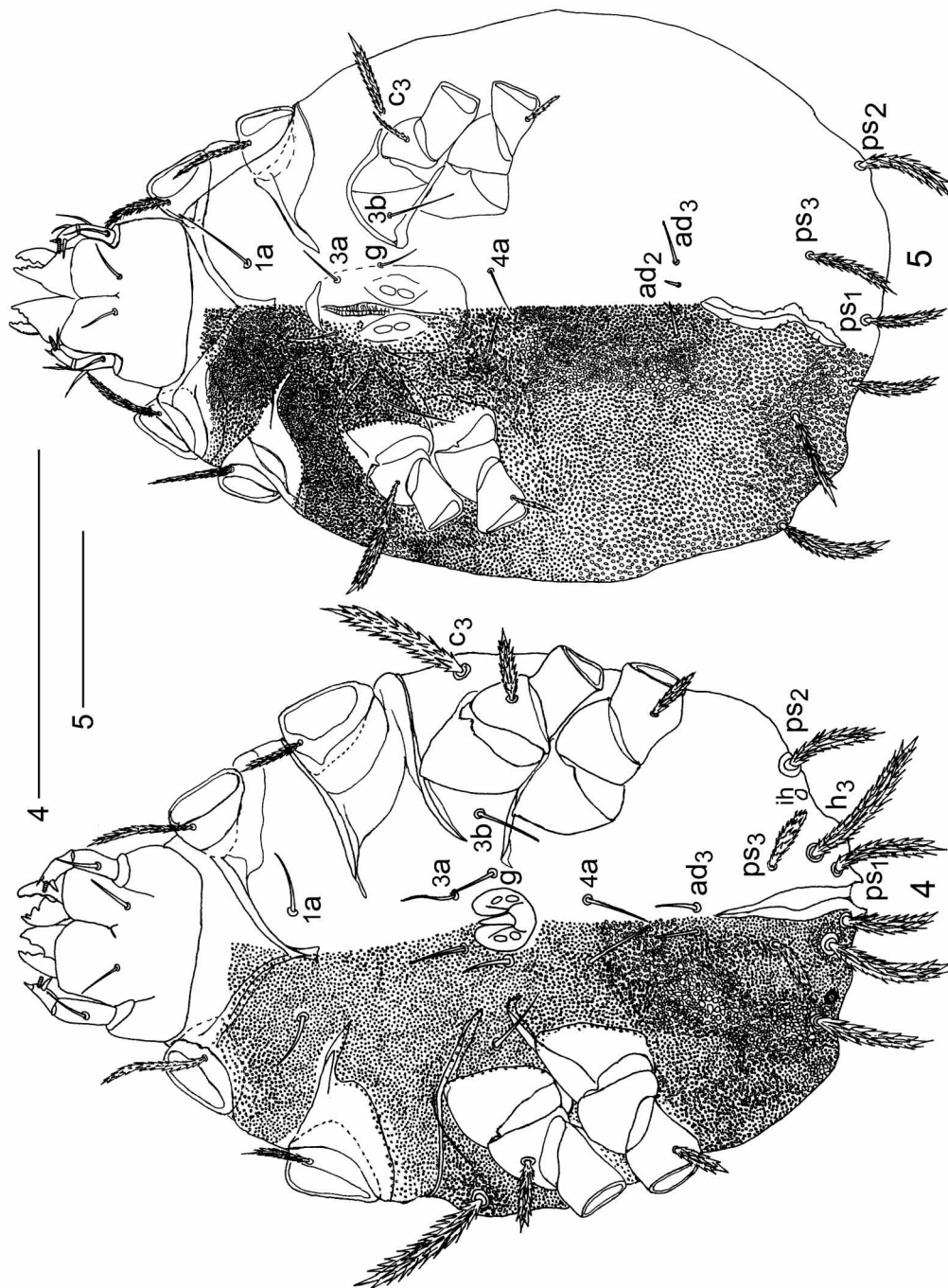
Body broadly oval; length 443 (397–500), width at level of seta  $c_3$  306 (262–364). Chelicerae and subcapitulum similar in appearance to male.

*Dorsum* (Fig. 10). Cuticle (Figs. 10b, 10c), Grandjean's organs ( $go$ ) and supracoxal setae ( $scx$ ) 36 (32–43) (Fig. 10a) similar to male. Sejugal furrow absent. Opisthonotal gland openings ( $gla$ ) between setae  $d_2$  and  $e_2$ . Cupules located as follows:  $ia$  between setae  $c_2$  and  $cp$ ,  $im$  slightly anterior to  $gla$ ,  $ip$  anterior to seta  $f_2$ , and  $ih$  on rear margin of idiosoma laterad and anterior to seta  $h_3$ . Setae  $d_1$  163 (150–173) serrate, with serrations oriented toward setal apex. Setae  $h_2$  37 (35–41) broad spines, laterally flattened and pointed. The remainder of the dorsal setae are densely pectinate:  $vi$  84 (76–94),  $ve$  60 (48–67),  $si$  123 (94–138),  $c_1$  21 (18–23),  $c_2$  92 (76–121),  $cp$  85 (74–95),  $d_2$  78 (73–83);  $e_1$  383 (358–409);  $e_2$  159 (145–176),  $f_2$  144 (130–162),  $h_1$  117 (105–135), and  $h_3$  90 (79–97). Bursa copulatrix ( $bc$ ) at end of short protuberance located dorsal to anus.

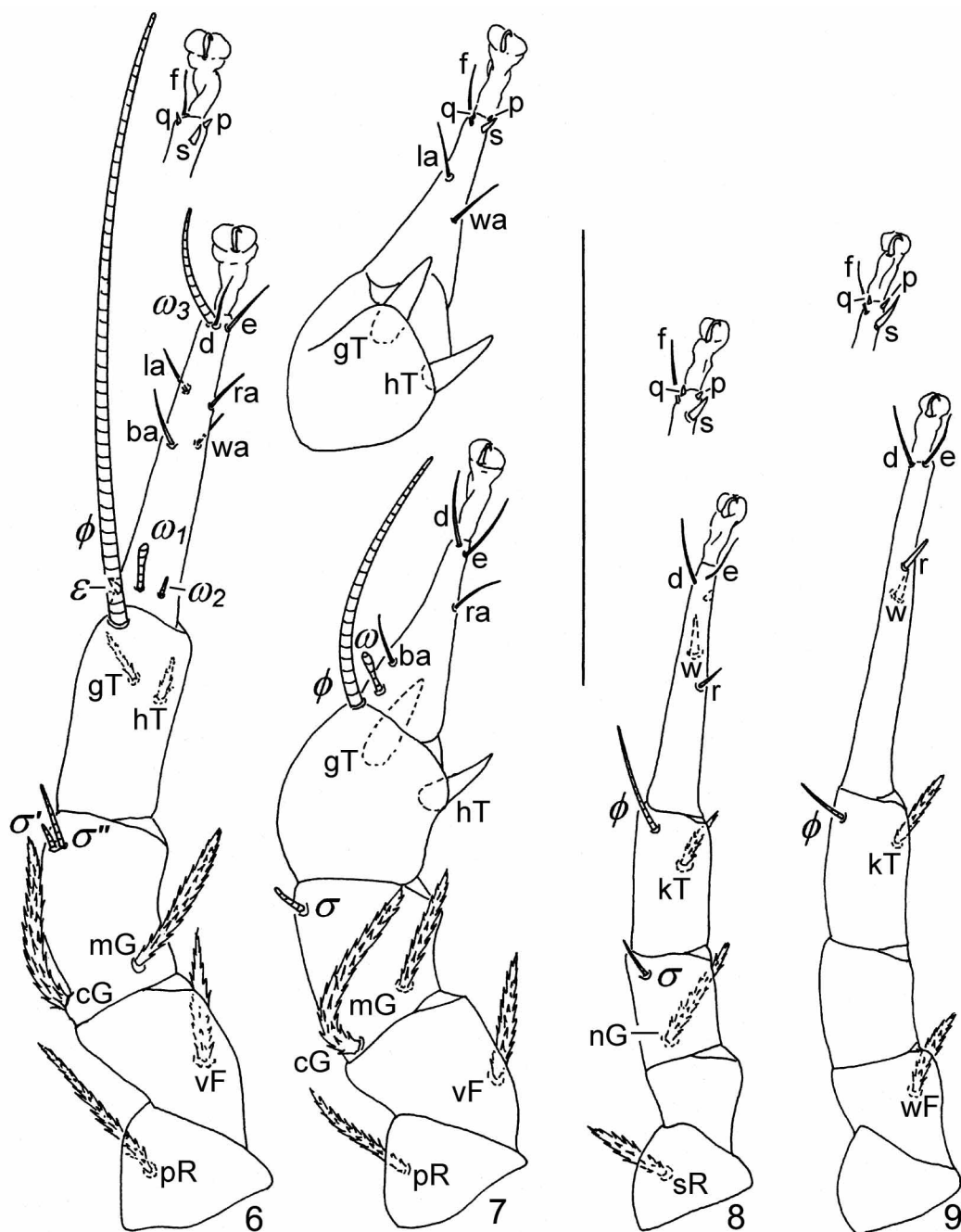
*Venter* (Fig. 5). Cuticle similar to male. Venter bearing 11 pairs of setae:  $c_3$  51 (47–55) densely pectinate, laterad coxae III;  $1a$  54 (50–59) filiform, on coxal field I;  $3a$  28 (24–30) filiform, on anterior end of genital valve;  $3b$  36 (30–41) filiform, on coxal field III;  $4a$  31 (26–35) filiform, on coxal fields IV;  $g$  25 (21–27) filiform, on genital valve laterad genital papillae;  $ad_2$  10 (8–12) and  $ad_3$  25 (20–27) filiform, located slightly anterior anal slit;  $ps_1$  59 (52–71),  $ps_2$  64 (52–76) and  $ps_3$  58 (53–65) pectinate, on posterior margin of idiosoma. Oviparous located centrally between coxae II–IV, bearing two genital valves. Epigynial apodeme small, located anterior to oviparous. Anus a longitudinal slit at posterior end of idiosoma.



**FIGURES 1–3.** *Zibethacarus beeri*, **sp. nov.** (male). 1, chelicera, lateral view; 2, gnathosoma, ventral view; 3, idiosomal dorsum; 3a, enlarged view of idiosomal mammilations; 3b, enlarged view of idiosomal sculpturing. Scale bar: 200  $\mu$ m (Figs. 1, 2), 100  $\mu$ m (Fig. 3).



FIGURES 4-5. *Zibethacarus beeri*, sp. nov. idiosomal venter. 4, male; 5, female. Scale bar = 100 μm, 4 = male, 5 = female.



**FIGURES 6–9.** *Zibethacarus beeri*, **sp. nov.** (male). 6, leg I dorsal view, ventral view tarsal terminus; 7, leg II dorsal view, ventral view tibia and tarsus; 8, leg III dorsal view, ventral view tarsal terminus; 9, leg IV dorsal view, ventral view tarsal terminus. Scale bar = 100  $\mu$ m.

Legs (Figs. 11–14). Legs I and III–IV similar in appearance to male; unlike male, legs II not modified and therefore similar in appearance to other legs. Lengths, from base of trochanter to tip of tarsus: I 284 (272–298), II 217 (204–233), III 213 (201–222), IV 255 (236–267). Tarsal lengths: I 96 (89–105), II 72 (68–75), III 84 (82–89), IV 116 (106–123). Similar in chaetotaxy to males with

the following exceptions: setae *gT* and *hT* of tibiae II densely pectinate rather than stout spines, and tarsal apical setae *u* and *v* present thereby making tarsal formula 12-12-10-10. Solenidotaxy similar to males, but with the following measurements: genua I solenidia  $\sigma'$  9 (8–12),  $\sigma''$  38 (34–41), genua II solenidia  $\sigma$  10 (9–12), genua III solenidia  $\sigma$  27 (24–30), tibiae I solenidia  $\phi$  182 (169–189), tibia II solenidia  $\phi$  99 (92–105), tibiae III solenidia  $\phi$  60 (58–63), tibia IV solenidia  $\phi$  26 (22–30), tarsus I solenidia  $\omega_1$  15 (14–17),  $\omega_2$  13 (11–14),  $\omega_3$  52 (47–55) and tarsus II solenidia  $\omega$  13 (11–14).

#### Remarks

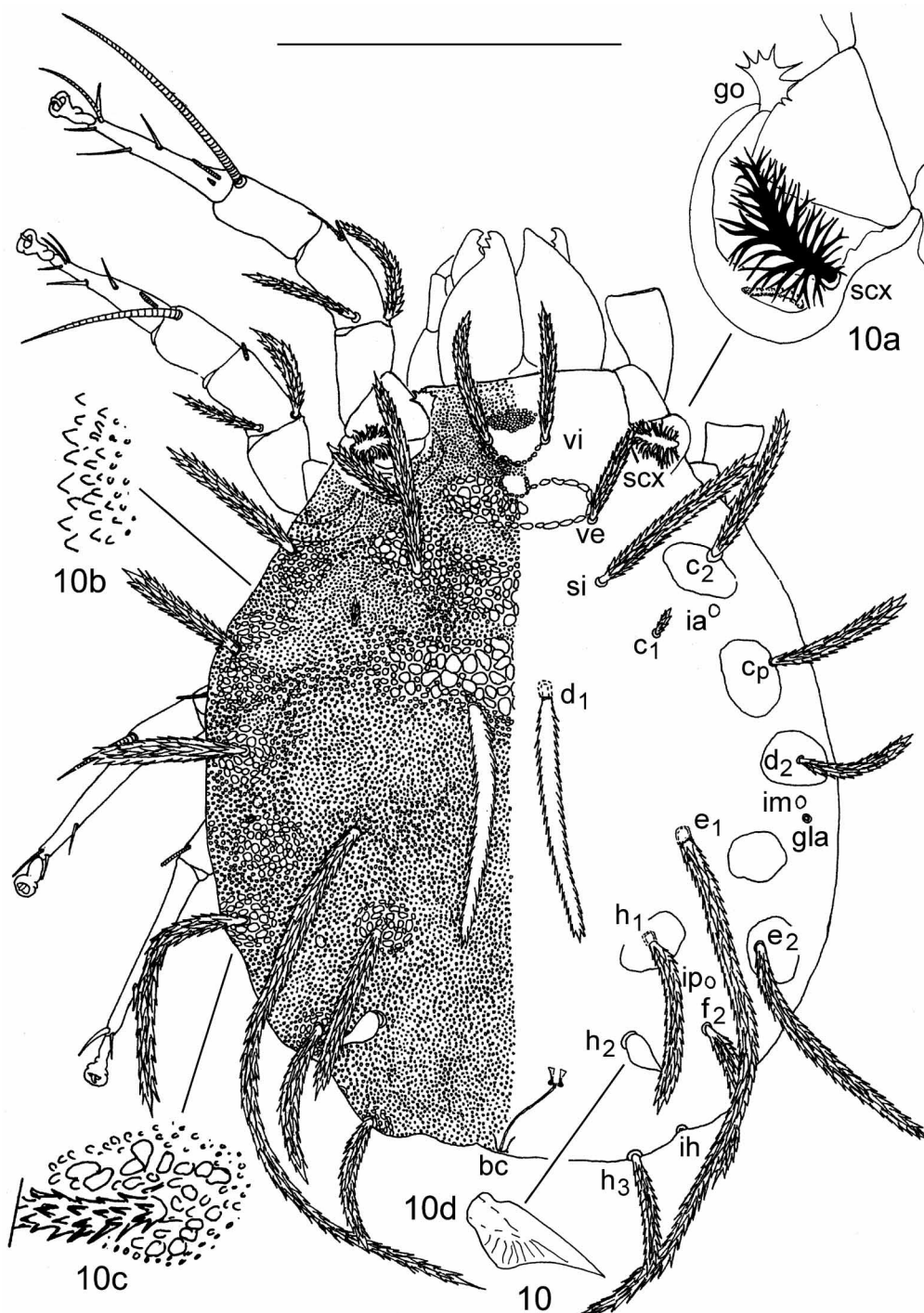
Rupeš *et al.* (1971) report that specimens of all stages of *Z. ondatrae* were deposited in the collections of the NIH Rocky Mountain Laboratory, Hamilton, Montana, and in the U.S. National Museum, Washington, D.C., however the U.S. National Museum has no record of this transaction and attempts to locate the Rocky Mountain Laboratory specimens proved futile. Morphological characteristics of *Z. ondatrae* are therefore based on the illustrations and descriptions present in the literature.

Rupeš *et al.* (1971) distinguished the genus *Zibethacarus* from other genera in the family Glycyphagidae by the following combination of characteristics (setal designations in parenthesis are equivalents from Griffiths *et al.* (1990) as used in this paper): Adult body soft, pebbled (= mammilated); most dorsal setae elongated, barbed, not arising from integumental bosses; supracoxal, *Ve* (= *ve*) and *Sai* (= *h<sub>2</sub>*) setae present. Female with genital opening covered by 2 lateral valves, not enclosed by circumgenital ring; setae *Ve* (= *ve*) well developed, barbed; *Sai* (= *h<sub>2</sub>*) reduced; short thick, sharply pointed, bare. Male setae *Ve* (= *ve*) and *Sai* (= *h<sub>2</sub>*) relatively well developed, barbed; seta *hT* of tibiae I and II serrate, fanlike.

With the exception of the shape of seta *hT* on tibiae I and II in males, *Z. beeri* exhibits the generic characteristics outlined by Rupeš *et al.* (1971). In *Z. beeri* setae *hT* on tibia I is pectinate and on tibia II it is a stout spine rather than serrate and fanlike. This character has therefore been dropped from the generic diagnosis.

**TABLE 1.** Dorsal setal lengths expressed as a percentage of idiosomal length. Setal signatures in parentheses are those used by Rupeš *et al.* (1971)

Seta	Male		Female	
	<i>Z. beeri</i>	<i>Z. ondatrae</i>	<i>Z. beeri</i>	<i>Z. ondatrae</i>
<i>vi</i> (Vi)	21	31	19	30
<i>ve</i> (Ve)	13	18	14	23
<i>si</i> (Sci)	37	38	27	51
<i>c<sub>1</sub></i> (D <sub>1</sub> )	6	21	5	23
<i>c<sub>2</sub></i> (Sce)	22	40	21	56
<i>c<sub>3</sub></i> (Ha)	16	24	12	26
<i>cp</i> (Hp)	25	49	19	51
<i>d<sub>1</sub></i> (D <sub>2</sub> )	37	14	37	19
<i>d<sub>2</sub></i> (L <sub>1</sub> )	19	16	18	19
<i>e<sub>1</sub></i> (D <sub>3</sub> )	115	84	86	88
<i>e<sub>2</sub></i> (L <sub>2</sub> )	32	51	36	51
<i>f<sub>2</sub></i> (L <sub>2</sub> )	26	49	32	35
<i>h<sub>1</sub></i> (D <sub>4</sub> )	36	64	26	19

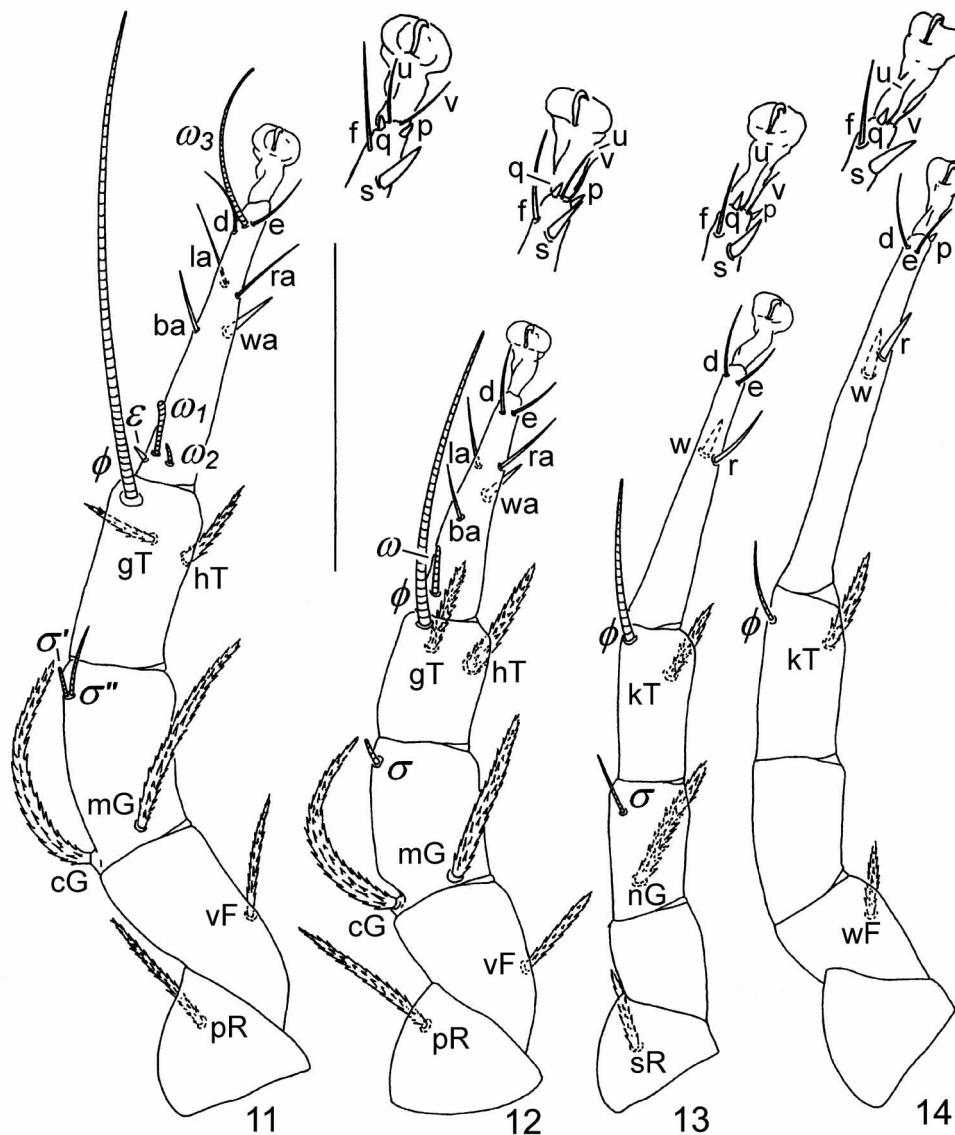


**FIGURES 10.** *Zibethacarus beeri*, **sp. nov.** (female). 10, idiosomal dorsum; 10a, enlarged view of Grandjean's organs (go) and supracoxal setae (scx); 10b, enlarged view of idiosomal mammillation; 10c, enlarged view of idiosomal sculpturing; 10d, enlarged view of seta  $h_2$ . Scale bar: 200  $\mu$ m.

*Zibethacarus beeri* can be distinguished from *Z. ondatrae* by the following: shape of setae on tibiae I and II of male as indicated above; shorter idiosomal lengths (males—*Z. beeri* 233, *Z.*



*ondatrae* 450; females—*Z. beeri* 433, *Z. ondatrae* 570); males much smaller than females (*Z. beeri* 53% of female idiosomal length, *Z. ondatrae* 79%), dorsal setae  $d_1$  of both males and females serrate rather than pectinate, both males and females with many dorsal setae shorter relative to idiosomal length, especially setae  $c_1$  (Table 1).



**FIGURES 11–14.** *Zibethacarus beeri*, **sp. nov.** (female). 11, leg I dorsal view, ventral view tarsal terminus; 12, leg II dorsal view, ventral view tarsal terminus; 13, leg III dorsal view, ventral view tarsal terminus; 14, leg IV dorsal view, ventral view tarsal terminus. Scale bar = 100  $\mu$ m.

Male legs II are highly modified, with tibiae enlarged and robust. Ventral setae  $gT$  and  $hT$  are enlarged, stout spines that arise from a protuberance that creates a cleft between them and the tibial body. Female dorsal setae  $h_2$  are stout spines and flattened laterally. Males are approximately half the size of females and cling to them by wedging the ventral setae of tibiae II over setae  $h_2$  of the female. Males were found clinging to females even after extraction into alcohol. It is quite probable that such tenacious clinging behavior is a result of mate guarding on the part of the male.

Deutonymphs were not recovered from the nesting material in this study, and unfortunately the pelt of the vole inhabitant was not examined for deutonymphs. Deutonymphal characters that separate *Z. beeri* from *Z. ondatrae* therefore remain to be determined. In a study of mites parasitic on Oregon voles, Whitaker and Maser (1984) report finding a single deutonymph of *Z. ondatrae* in the hair of one of 76 *M. oregoni* examined, and restate this finding in a second paper (Whitaker and Maser 1985). The only other reported host for *Z. ondatrae* is the muskrat, *O. zibethicus*. The nest localities and composition differ greatly between muskrats and voles, and it seems unlikely that *Z. ondatrae* would utilize such disparate hosts. It is more likely that the deutonymph found by Whitaker and Maser (1984) on the fur of *M. oregoni* was that of *Z. beeri*, however more research is needed to substantiate this conjecture.

#### Etymology

The species is named in honor of Dr. Robert E. Beer for teaching me (NJF) the beauty and wonders of mites, and for instilling in me a love for these small creatures. He had a lifelong dedication to the field of acarology and mentored numerous acarology students during his career as Professor of Entomology at the University of Kansas. Although deceased, his legacy will live on forever.

#### Acknowledgements

We are indebted to Dr. Don Gettinger, University of Central Arkansas, for collecting the nests from which the specimens were extracted, and to Dr. Gerald Krantz, Oregon State University, for providing research space for NJF. This research was supported in part by a Research Leave Grant awarded to NJF by the College of William and Mary, VA.

#### References

- Evans, G. O. (1992) Principles of Acarology. CAB International, Oxford. 563 pp.
- Fain, A. & Lukoschus, F. (1974) Observations sur le développement postembryonnaire des acarins de la famille Glycyphagidae à hypopes pilicoles ou endofolliculaires (Acarina: Astigmata). *Bulletin de l'Académie royale de Belgique*, 60, 1137–1159.
- Fain, A. & Whitaker, J. O. Jr. (1973) Phoretic hypopi of North American mammals (Acarina: Sarcoptiformes, Glycyphagidae). *Acarologia*, 15, 144–170.
- Grandjean, F. (1939) La chaetotaxie des pattes chez les Acaridae. *Bulletin de la Société Zoologique de France*, 64, 50–60.
- Griffiths, D. A., Atyeo, W. T., Norton, R. A., & Lynch, C. A. (1990) The idiosomal chaetotaxy of astigmatid mites. *Journal of Zoology (London)*, 220, 1–32.
- Krantz, G. W. (1978) A Manual of Acarology, Second Edition. Oregon State University Book Stores, Oregon. 509 pp.
- Rupeš, V. & Whitaker, J. O. Jr. (1968) Mites of the subfamily Labidophorinae (Acaridae, Acarina) in North America. *Acarologia*, 10, 493–499.
- Rupeš, V., Yunker, C. E. & Wilson, N. (1971) *Zibethacarus*, n. gen., and three new species of *Dermacarus* (Acari: Labidophoridae). *Journal of Medical Entomology*, 8, 17–22.
- Whitaker, J. O. Jr. & Maser, C. (1984) Parasitic mites of voles of the genera *Microtus* and *Clethrionomys* from Oregon. *Northwest Science*, 58, 142–150.
- Whitaker, J. O. Jr. & Maser, C. (1985) Mites (excluding chiggers) of mammals of Oregon. *Great Basin Naturalist*, 45, 67–76.

Accepted by O. Seeman: 8 Jun. 2007