



Description of *Goffacarus* n. gen., to Reallocate the Species *Euschoengastia latchmani* Brennan and Yunker and *Euschoengastia obscura* Wrenn and Loomis (Trombidiformes: Trombiculidae)

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Abstract

Purpose *Euschoengastia* Ewing is a chigger genus in need of revision as it historically has combined species solely on the presence of expanded prodorsal trichobothria. The objective of the present study is to describe a new genus to reallocate two North American *Euschoengastia* species, to start an organization into this genus.

Methods In this study, we provide drawings, measurements and microscopy images on a Microscope Zeiss for the two redescribed species.

Results After examining the types of the species *Euschoengastia latchmani* Brennan and Yunker and *Euschoengastia obscura* Wrenn and Loomis, we realized that it was necessary to create the new genus to relocate these two species, mainly based on the following characters: (1) the number of prongs on the odontus; and (2) ornamentation of the prodorsal sclerite.

Conclusion *Goffacarus latchmani* n. comb. and *Goffacarus obscura* n. comb. are redescribed here and to reallocate these two species the genus, *Goffacarus* n. gen. is proposed.

Keywords Chiggers · Ectoparasites · Rodents · North America · New genus

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Introduction

The American continent belongs to two zoogeographical areas (Nearctic and Neotropical), and there are more than 100 described genera of chiggers so far [1]. One of the most studied and reported genera for the Nearctic region was *Euschoengastia* Ewing, 1938. Although the genera appear to be stable, by revising literature and types within this genus, *Euschoengastia* seems not to be one such genus.

This genus has historically included species mainly based on the presence of a pair of expanded prodorsal trichobothria [2]. So, after examining the types, different characters were found separating *Euschoengastia latchmani* Brennan and Yunker, 1964 and *Euschoengastia obscura* Wrenn and Loomis, 1974 from *Euschoengastia*. Here, we are redescribing these two species and proposing ***Goffacarus* n. gen.** to reallocate these species. These two species are the only ones in *Euschoengastia* with striations in the prodorsal sclerite [3, 4].

Materials and Methods

After an inspection and examination to the Acari Collection in the U.S. National Entomology Collection, Smithsonian Institution (USNM), the types of *Euschoengastia latchmani* and *Euschoengastia obscura* were found and herein redescribed. This collection is currently located in the Systematic Entomology Laboratory (BARC-USDA-ARS), Beltsville, MD, USA (informally known as Smithsonian National Chigger Collection). The official acronym used to enumerate each slide is USNMMENT, according to Bassini-Silva *et al.* [5].

A literature survey was carried out for all species identified as *Euschoengastia*. The type species within this genus were examined, if available, and only after this exhaustive study, we came with the results of the present study. The types available and examined were listed in the type catalog by Bassini-Silva *et al.* [5].

The drawings were made using a ZEISS Axioskop 2 microscope with DIC and Phase Contrast. Measurements and photographs of the specimens were made using a ZEISS AXIO Imager.D1 with an attached ZEISS AxioCam ICc 5 digital camera. Extended focal range images were processed with AxioVision SE64 Rel. 4.9.1 SP1 software. The figures were prepared with Adobe Photoshop v. 13.0 and Inkscape v.1.0.1.

The terminology of the opisthosomal and prodorsal sclerite setae follow Grandjean [6] with adaptations by Kethley [7]. Also, we are using Grandjean [8, 9] for the specialized setae on the legs and palps.

Systematics

Trombiculidae Ewing, 1944

***Goffacarus* Bassini-Silva, Jacinavicius and Welbourn, n. gen.**

Type species. *Euschoengastia latchmani* Brennan and Yunker, 1964.

Diagnosis. Larva. Palptarsus with seven branched setae and a basal solenidion; odontus trifurcate; cheliceral blade with tricuspid cap; eyes 2/2 without ocular sclerite; prodorsal sclerite subrectangular and striated; with pair of expanded trichobothria (*si*) and five normal setae (*vi*, 2 *ve*, and 2 *se*); *se* setae on prodorsal sclerite; Fe I–III each divided into basifemur and telofemur; coxal fields unisetose; pretarsal empodium without onychotriches; Ge I with two solenidia (σ); Ge II and III each with one solenidion (σ); Ta I and II each with subterminal eupathidium (ζ and ζ''); Ta I with dorsal eupathidium (ζ') and companion seta (*z*); Ti III without solenidion (φ).

Differential diagnosis. The new genus is similar to *Euschoengastia* in having seven branched setae on the palptarsus, a single sigma (σ) on Ge II and III, and the absence of φ on Ti III. However, it can be differentiated from *Euschoengastia*, in having a 3-pronged odontus (vs. multi-pronged odontus) and striations on the prodorsal sclerite (vs. absence of striations). In addition, the new genus is similar to *Neoschoengastia* Ewing, 1929 and *Megaschoengastia* Vercammen-Grandjean, 1960, by having striations on the prodorsal sclerite that changes the posterior margin, but differs in having 1 σ on Ge II (vs. two or more σ on Ge II), absence of φ on Ti III (vs. present) and presence of companion seta (*z*) (vs. absence).

Etymology. The new genus, ‘Goffacarus’, is named in honor of Dr. Lee Goff, for his contributions to the taxonomy of chiggers worldwide, combined with the word ‘mite’ in the new Latin word, ‘acarus’.

***Goffacarus latchmani* (Brennan and Yunker, 1964) n. comb.**

Euschoengastia latchmani Brennan and Yunker [3], p. 311; Vercammen-Grandjean [10], p. 97; Wrenn and Loomis [4], p. 241; Wrenn [2], p. 222; Walters *et al.* [11], p. 13 (Tables 1, 2, 3 and 4).

Diagnosis. Palpfemur and palpgenu each with single branched seta; palptibia with three setae, branched dorsal and ventral setae and a nude lateral seta; adoral (*cs*) setae branched; prodorsal sclerite with an expanded obovate trichobothria (*si*), proximal half of the expanded portion with scale-like setules, that gradually increase in size to the middle of the expanded part then disappear on the distal half, 105–114 opisthosomal setae including the C row with 15–16 setae; D row with 12 setae; and 46–50 ventral setae; base famulus (ϵ) on Ta I and II distal and proximal to solenidion (ω), respectively.

Table 1 Standard measurements of the types of *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**

	AW	PW	SB	ASB	PSB	SD	AP	vi	ve	se	si	1a	3a	DMIN	DMAX	VMIN	VMAX
Brennan and Yunker	46	74	30	29	11	40	30	32	63	59	32	–	–	42	58	–	–
Holotype*	45	72	26	29	12	41	24	32	58	56	23	43	27	30	44	34	40
Minimum*	44	70	26	28	10	38	22	31	50	54	22	40	25	28	44	31	38
Maximum*	47	75	28	29	13	42	24	32	60	58	24	44	27	30	45	34	40
Mean*	45	72	27	28	11	40	23	31	55	56	23	42	26	29	44	32	39

AW = distance between the bases of the *ve* setae; PW = distance between the bases of the *se* setae; SB = distance between the trichobothrial (*si*) bases; ASB = distance from trichobothrial (*si*) bases to extreme anterior margin of the prodorsal sclerite; PSB = distance from trichobothrial (*si*) bases to extreme posterior margin of the prodorsal sclerite; SD = ASB + PSB; AP = distance between the bases of *ve* and *se*; *ve* = external vertical setae; *se* = external scapular setae; *vi* = internal vertical setae; *si* = internal scapular setae (trichobothria); *1a* = anterior sternal setae; *3a* = posterior sternal setae; DMIN = minimum length of dorsal opisthosomal setae; DMAX = maximum length of dorsal opisthosomal setae; VMIN = minimum length of ventral idiosomal setae; VMAX = maximum length of ventral idiosomal setae

*Measurements made in this study (*n* = 6)

Table 2 Standard measurements of the types of *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**

	Cx I	Tr I	BFe I	TFe I	Ge I	Ti I	Ta I (L)	Ta I (W)	Cx II	Tr II	BFe II	TFe II	Ge II	Ti II	Ta II (L)	Ta II (W)
Holotype	49	33	23	26	35	37	67	24	51	32	18	21	18	30	38	16
Minimum	48	30	22	26	30	33	65	22	51	30	18	21	17	29	37	14
Maximum	51	38	25	28	35	38	68	24	54	33	20	23	22	34	40	16
Mean (<i>n</i> = 6)	49	34	24	27	33	36	67	23	52	32	19	22	20	32	39	15

Cx I—length of coxal field I; Tr I—length of trochanter leg I; BFe I—length of basifemur leg I; TFe I—length of telofemur leg I; Ge I—length of genu leg I; Ti I—length of tibia leg I; Ta I (L)—length of tarsus leg I; Ta I (W)—width of tarsus leg I; Cx II—length of coxal field II; Tr II—length of trochanter leg II; BFe II—length of basifemur leg II; TFe II—length of telofemur leg II; Ge II—length of genu leg II; Ti II—length of tibia leg II; Ta II (L)—length of tarsus leg II; Ta II (W)—width of tarsus leg II

Table 3 Standard measurements of the types of *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**

	Cx III	Tr III	BFe III	TFe III	Ge III	Ti III	Ta III (L)	Ta III (W)	I	II	III	IP
Holotype	56	36	25	24	24	43	60	10	221	157	212	746
Minimum	52	35	24	22	24	40	59	10	206	152	204	713
Maximum	57	40	28	24	27	44	62	12	232	172	225	791
Mean (<i>n</i> = 6)	54	38	26	23	26	42	61	11	219	162	215	752

Cx III—length of coxal field III; Tr III—length of trochanter leg III; BFe III—length of basifemur leg III; TFe III—length of telofemur leg III; Ge III—length of genu leg III; Ti III—length of tibia leg III; Ta III (L)—length of tarsus leg III; Ta III (W)—width of tarsus leg III; I = length of leg I (trochanter to pretarsus); II = length of leg II (trochanter to pretarsus); III = length of leg III (trochanter to pretarsus); IP—sum of leg lengths (proximal end of coxal field to the base of pretarsus)

Table 4 Standard measurements of the types of *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**

	σ I	κ I	φ' I	φ'' I	κ I	ω I	ε I	ζ' I	z	ζ'' I	σ II	φ' II	φ'' II	ω II	ε II	ζ II	σ III
Brennan and Yunker	23	4	15	18	4	21	3	22	9	12	18	13	12	18	3	12	23
Holotype*	23	4	13	14	3	23	3	16	11	10	20	11	15	16	3	10	17
Minimum*	23	4	13	14	3	21	3	16	10	10	19	11	14	16	3	10	16
Maximum*	25	4	14	16	4	23	3	18	11	12	22	13	15	18	3	10	19
Mean*	24	4	13	15	3	22	3	17	10	11	20	12	14	17	3	10	17

I = σ I, σ II, σ III = length of the solenidia on Ge I-III; κ I = length of microseta on Ge and Ti I; φ' I, φ'' I = length of the solenidia on Ti I; κ I = length of microseta on Ti I; ω I = length of solenidion on Ta I; ε I = length of famulus on Ta I; ζ' I = length of dorsal eupathidium on Ta I; z = length of companion seta on Ta I; ζ'' I = length of subterminal eupathidium on Ta I; φ' II, φ'' II = length of the solenidia on Ti II; ω II = length of solenidion on Ta II; ε II = length of famulus on Ta II; ζ II = length of subterminal eupathidium on Ta II

*Measurements made in this study, *n* = 6

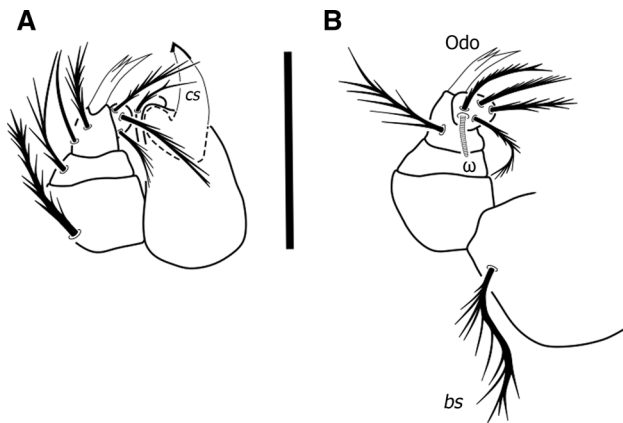


Fig. 1 *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**; **A**—dorsal view of gnathosoma; **B**—ventral view of palp. Symbols: ω = solenidion on palptarsus; Odo = odontus; *cs* = adoral setae; *bs* = subcapitular setae. Scales: **A** and **B** 50 μ m

Redescription. Larvae (holotype and with the range for six paratypes in parentheses). *Gnathosoma*—fPp = B/B/BNB/7B ω ; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase with a few punctuations, subcapitular (*bs*) and adoral (*cs*) setae branched (Figs. 1A, B). *Idiosoma*—eyes 2/2, subequal, without ocular plate; prodorsal sclerite subrectangular with striations on posterior half; anterior and lateral prodorsal sclerite slightly sinuous, posterior margin broadly convex (Figs. 2 and 9A, C), with pair of expanded obovate trichobothria (*si*), with rounded scale-like setules that increase in size toward the middle of the expanded portion then disappear on the distal half, and five branched normal setae [pair of *ve* (= AL) seta, single *vi* (= AM) seta and pair of *se* (= PL) seta]; *ve* \geq *se* > *vi* > *si*. Opisthosoma (Fig. 3A, B) with 110 (105–114) setae; dorsal opisthosoma with 63 (59–64) setae, C row with 16 (15–16) irregularly placed setae, D row with six pairs of setae, E, F and H rows

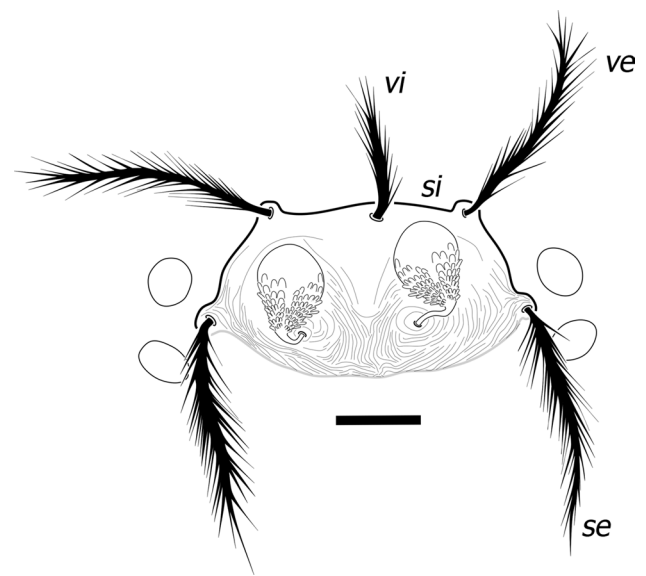
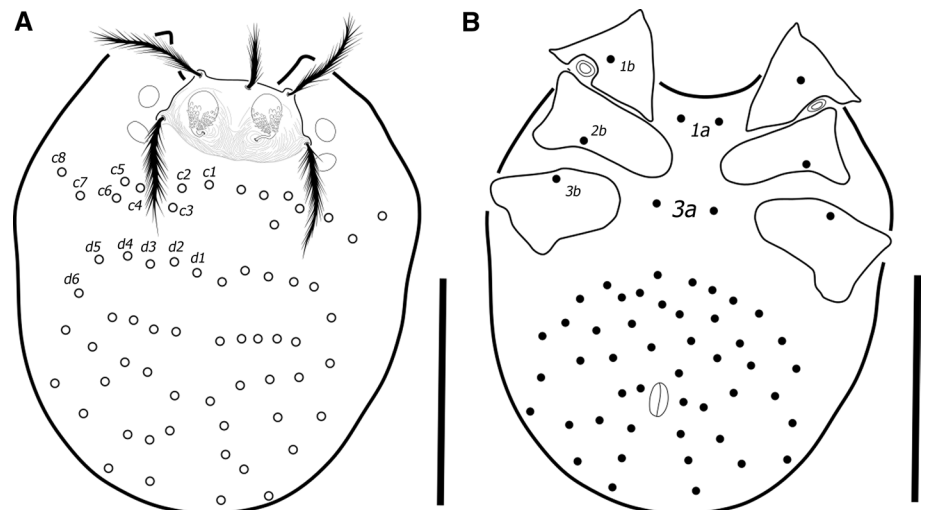


Fig. 2 *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**; prodorsal sclerite. Symbols: *ve* = external vertical setae; *se* = external scapular setae; *vi* = internal vertical setae; *si* = internal scapular setae (trichobothria). Scales: 20 μ m

merged, with 35 (32–36) setae; ventral opisthosomal with 47 (46–50) setae of which 26 are anterior to anus and 21 (20–24) are posterior. Two pairs of sternal setae (*1a*, *3a*) between coxal fields I and III. *Legs*—femur of legs I–III each divided into basifemur and telofemur, each leg terminated with paired claws, and claw like empodium without onychotriches, coxal fields with a few punctuations; *Leg I*—coxal field seta *1b* branched (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2σ and κ ; tibia 7B, 2ϕ and κ ; tarsus 22B with ω , ϵ , dorsal eupathidium (ζ') with companion seta (z) and subterminal eupathidium (ζ''), base of famulus (ϵ) distal to solenidion (ω) (Fig. 4A). *Leg II*—coxal field seta *2b* (1B); trochanter 1B; basifemur 2B; telofemur 4B; genu

Fig. 3 *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**; **A**—dorsal view of idiosoma; **B**—ventral view of idiosoma. Solid circles = ventral setae; open circles = dorsal setae; Symbols: *c*₁–*c*₈ = C row setae; *d*₁–*d*₆ = D row setae; *1a* = anterior sternal setae; *3a* = posterior sternal setae; *1b* = coxal field I seta; *2b* = coxal field II seta; *3b* = coxal field III seta. Scales: **A** and **B** 100 μ m



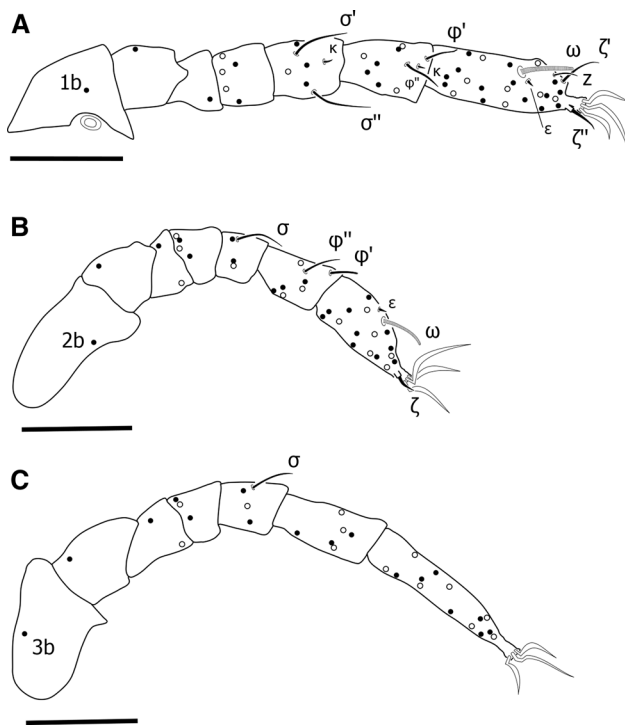


Fig. 4 *Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**; **A**—Leg I; **B**—Leg II; **C**—Leg III; Solid circles=ventral leg setae; open circles=dorsal leg setae; Symbols: ζ'=dorsal eupathidium on Ta I; ζ'' and ζ=subterminal eupathidium on Ta I and II; ω=solenidion on Ta I and II; σ, σ', σ''=solenidia on Ge I-III; κ=microsetae on Ge and Ti I; φ', φ''=solenidia on Ti I-II; ε=famulus on Ta I and II; 1b=coxal field I seta; 2b=coxal field II seta; 3b=coxal field III seta. Scales: **A–C** 50 μm

3B, σ; tibia 6B, 2 φ; tarsus 16B with ω, ε and subterminal eupathidium (ζ), base of ε proximal to ω (Fig. 4B). *Leg III*—coxal field seta 3b (1B); trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ, tibia 6B; tarsus 14B (Fig. 4C).

Type material. HOLOTYPE: larva (USNMENT01757381); Sonora County, California State, USA; 13 Feb. 1963; ex *Equus caballus* L. (Perissodactyla: Equidae); original number: RML 38601. PARATYPES: six larvae (USNMENT01757382, USNMENT01757383, USNMENT0175784, USNMENT01757385, USNMENT01757386, USNMENT01757387), same data as holotype.

Type depository. USNM (holotype and six paratypes) and FMNH (two paratypes).

***Goffacarus obscura* (Wrenn and Loomis, 1974) n. comb.**

Euschoengastia radfordi: Loomis and Bunnell [12], p. 183; Loomis and Somerby [13], p. 223 (in part); *Euschoengastia obscura* Wrenn and Loomis [4], p. 244; Wrenn [2], p. 222; Walters et al. [11], p. 16 (Tables 5, 6, 7 and 8).

Table 5 Standard measurements of the types of *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**

	AW	PW	SB	ASB	PSB	SD	AP	vi	ve	se	si	Ia	3a	DMIN	DMAX	VMIN	VMAX
Wrenn and Loomis	44–54	68–79	14–26	23–28	12–18	35–46	22–25	23–28	48–54	38–46	28–32	41	23	34	41	34	–
Holotype*	51	73	22	25	14	39	22	23	33	38	18	21	25	29	36	21	24
Paratype*	49	72	22	24	14	38	23	24	34	38	17	24	27	28	38	20	26

AW = distance between the bases of the ve setae; PW = distance between the bases of the se setae; SB = distance between the trichobothria (si) bases; ASB = distance from trichobothria (si) bases to extreme anterior margin of the prodorsal sclerite; PSB = distance from trichobothria (si) bases to extreme posterior margin of the prodorsal sclerite; SD = ASB + PSB; AP = distance between the bases of ve and se; ve = external vertical setae; se = external vertical setae; vi = internal vertical setae; si = internal scapular setae (trichobothria); Ia = anterior sternal setae; 3a = posterior sternal setae; DMIN = minimum length of dorsal opisthosomal setae; DMAX = maximum length of dorsal opisthosomal setae; VMIN = minimum length of ventral idiosomal setae; VMAX = maximum length of ventral idiosomal setae

*Measurements made in this study

Table 6 Standard measurements of the types of *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**

	Cx I	Tr I	BFe I	TFe I	Ge I	Ti I	Ta I (L)	Ta I (W)	Cx II	Tr II	BFe II	TFe II	Ge II	Ti II	Ta II (L)	Ta II (W)
Holotype	49	30	28	27	33	36	60	27	52	28	19	17	23	29	43	25
Paratype	48	29	28	26	30	34	59	25	50	29	20	16	21	32	44	23

Cx I—length of coxal field I; Tr I—length of trochanter leg I; BFe I—length of basifemur leg I; TFe I—length of telofemur leg I; Ge I—length of genu leg I; Ti I—length of tibia leg I; Ta I (L)—length of tarsus leg I; Ta I (W)—width of tarsus leg I; Cx II—length of coxal field II; Tr II—length of trochanter leg II; BFe II—length of basifemur leg II; TFe II—length of telofemur leg II; Ge II—length of genu leg II; Ti II—length of tibia leg II; Ta II (L)—length of tarsus leg II; Ta II (W)—width of tarsus leg II

Table 7 Standard measurements of the types of *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**

	Cx III	Tr III	BFe III	TFe III	Ge III	Ti III	Ta III (L)	Ta III (W)	I	II	III	IP
Wrenn and Loomis	–	–	–	–	–	–	–	–	258	227	275	760
Holotype*	54	33	30	25	28	36	68	18	214	159	220	748
Paratype*	52	30	29	25	27	35	70	20	206	162	216	734

Cx III—length of coxal field III; Tr III—length of trochanter leg III; BFe III—length of basifemur leg III; TFe III—length of telofemur leg III; Ge III—length of genu leg III; Ti III—length of tibia leg III; Ta III (L)—length of tarsus leg III; Ta III (W)—width of tarsus leg III; I=length of leg I (trochanter to pretarsus); II=length of leg II (trochanter to pretarsus); III=length of leg III (trochanter to pretarsus); IP—sum of leg lengths (proximal end of the coxal field to the base of pretarsus)

*Measurements made in this study

Table 8 Standard measurements of the types of *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**

	σ I	κ I	φ' I	φ'' I	κ I	ω I	ϵ I	ζ' I	z	ζ'' I	σ II	φ' II	φ'' II	ω II	ϵ II	ζ II	σ III
Wrenn and Loomis	14	4	12	13	5	22	3	18	8	9	10	8	9	20	3	9	10
Holotype*	16	3	10	11	4	24	3	18	9	10	9	10	11	21	2	14	10
Paratype*	16	3	10	11	4	24	3	17	9	9	9	9	10	20	2	13	10

I= σ I, σ II, σ III=length of the solenidia on Ge I-III; κ I=length of microseta on Ge and Ti I; φ' I, φ'' I=length of the solenidia on Ti I; κ I=length of microseta on Ti I; ω I=length of solenidion on Ta I; ϵ I=length of famulus on Ta I; ζ' I=length of dorsal eupathidium on Ta I; z=length of companion seta on Ta I; ζ'' I=length of subterminal eupathidium on Ta I; φ' II, φ'' II=length of the solenidia on Ti II; ω II=length of solenidion on Ta II; ϵ II=length of famulus on Ta II; ζ II=length of subterminal eupathidium on Ta II

*Measurements made in this study

Diagnosis. Palpfemur and palpgenu each with single branched seta; palptibia with three setae, branched dorsal and ventral setae and a nude lateral seta; adoral (*cs*) setae branched; prodorsal sclerite with a capitate expanded trichobothria (*si*), the expanded portion with scale-like setules, that gradually increase in size distally; 130 or 132 opisthosomal setae including the C row with 20 setae; D row with 14 setae; and 62 or 64 ventral setae; base famulus (ϵ) on Ta I and II distal and proximal to solenidion (ω), respectively.

Redescription. Larvae (holotype and one paratype). *Gnathosoma*—fPp = B/B/BNB/7B ω ; odontus trifurcate; cheliceral blade with tricuspoid cap; gnathobase with a few punctuations, subcapitular (*bs*) and adoral (*cs*) setae branched (Fig. 5A, B). *Idiosoma*—eyes 2/2, anterior lens larger, without ocular plate; prodorsal sclerite subrectangular with a few punctuations in the middle and striations on the posterior half; anterior and lateral, margins slightly

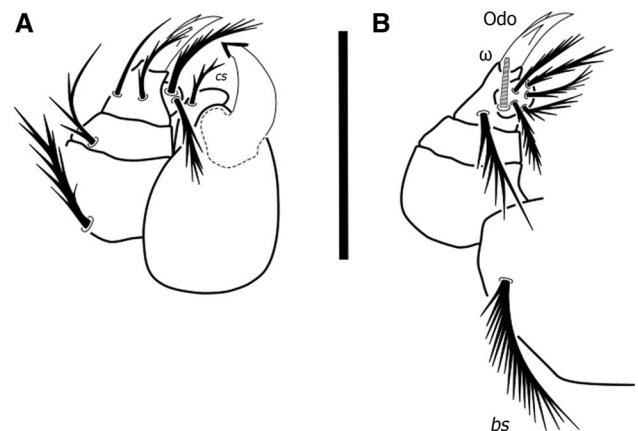


Fig. 5 *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**; **A**—dorsal view of gnathosoma; **B**—ventral view of palp. Symbols: ω =solenidion on palptarsus; Odo=odontus; *cs*=adoral setae; *bs*=subcapitular setae. Scales: **A** and **B** 50 μ m

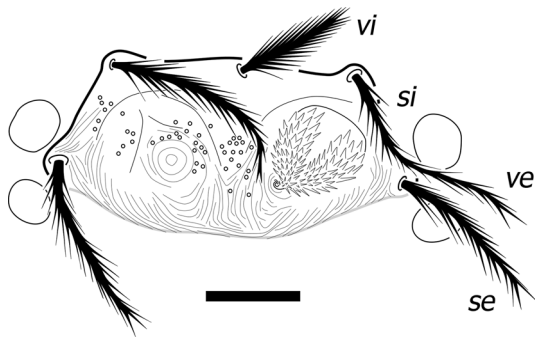


Fig. 6 *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**; prodorsal sclerite. Symbols: *ve* = external vertical setae; *se* = external scapular setae; *vi* = internal vertical setae; *si* = internal scapular setae (trichobothria). Scales: 20 μ m

sinuous, posterior margin broadly convex (Figs. 6 and 9B and D), with pair of capitate trichobothria (*si*), with pointed scale-like setules that gradually increase in size distally, and 5 branched normal setae [pair of *ve* (= AL) seta, single *vi* (= AM) seta and pair of *se* (= PL) seta]; *se* > *ve* > *vi* > *si*. Opisthosoma (Fig. 7A, B) with 130 (132 in paratype) setae; dorsal opisthosomal with 68 setae, C row with 20 irregularly placed setae, D row with seven pairs of irregularly placed setae, E, F and H rows merged, with 34 setae pairs of setae and 62 (64 in paratype) ventral opisthosomal setae with 34 setae anterior to anus and 28 (30 in paratype) setae posterior. Two pairs of sternal setae (*1a*, *3a*) between coxal fields I and III. *Legs*—femur of legs I–III each divided into basifemur and telofemur, each leg terminated with paired claws, and claw like empodium without onychotriches, coxal fields with a few punctuations; *Leg I*—coxal field seta *1b* branched (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 σ and κ ; tibia 7B, 2 ϕ and κ ; tarsus 22B with ω , ϵ , dorsal eupathidium (ζ') with companion seta (*z*) and subterminal

eupathidium (ζ''), base of famulus (ϵ) distal to solenidion (ω) (Fig. 8A). *Leg II*—coxal field seta *2b* (1B); trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, 2 ϕ ; tarsus 16B with ω , ϵ and subterminal eupathidium (ζ), base of ϵ proximal to ω (Fig. 8B). *Leg III*—coxal field seta *3b* (1B); trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ ; tibia 6B; tarsus 15B (Fig. 8C).

Type material. HOLOTYPE: larva (USNM01758568); Joshua Tree National Park Riverside County, California State, USA; 17 Mar. 1963; ex *Dipodomys merriami* Mearns (Rodentia: Heteromyidae); H. S. Logsdon coll.; original number: HSL 630317. PARATYPE: 1 larva (USNM01758569); same data as holotype.

Type depository. USNM (holotype and paratype).

Discussion

Euschoengastia latchmani was described from horses, dogs, the black-tailed jackrabbit, *Lepus californicus* Gray, 1837 (Lagomorpha: Leporidae), and the golden-crowned sparrow, *Zonotrichia atricapilla* (Gmelin, 1789) (cited as *Zonotrichia coronata*) in California, USA [3]; while *E. obscura* was described from cricetid and heteromyid rodents in California, the USA, and Baja California Norte, Mexico [4]. The heteromyid host records include: Baja California Norte host was the agile kangaroo rat, *Dipodomys agilis* Gambel, 1848, and the California hosts include the San Diego pocket mouse, *Chaetodipus fallax* (Merriam, 1889) (cited as *Perognathus fallax*); the long-tailed pocket mouse, *Chaetodipus formosus* (Merriam, 1889) (cited as *Perognathus formosus*); the Merriam's kangaroo rat, *Dipodomys merriami* Mearns, 1890; the Stephens' kangaroo rat, *Dipodomys stephensi* (Merriam, 1907); the little pocket

Fig. 7 *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**; **A**—dorsal view of idiosoma; **B**—ventral view of idiosoma. Solid circles = ventral setae; open circles = dorsal setae; Symbols: *c*₁–*c*₁₀ = C row setae; *d*₁–*d*₇ = D row setae; *1a* = anterior sternal setae; *3a* = posterior sternal setae; *1b* = coxal field I seta; *2b* = coxal field II seta; *3b* = coxal field III seta. Scales: **A** and **B** 100 μ m

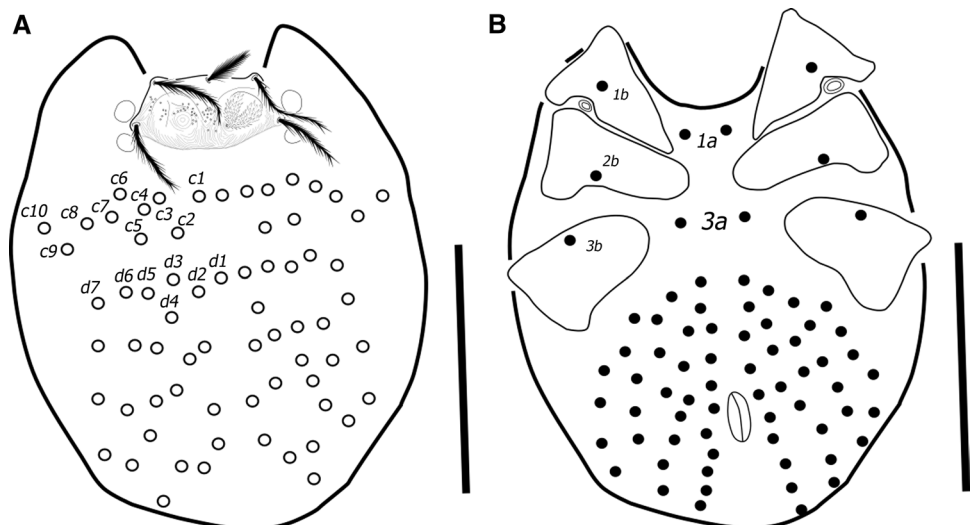
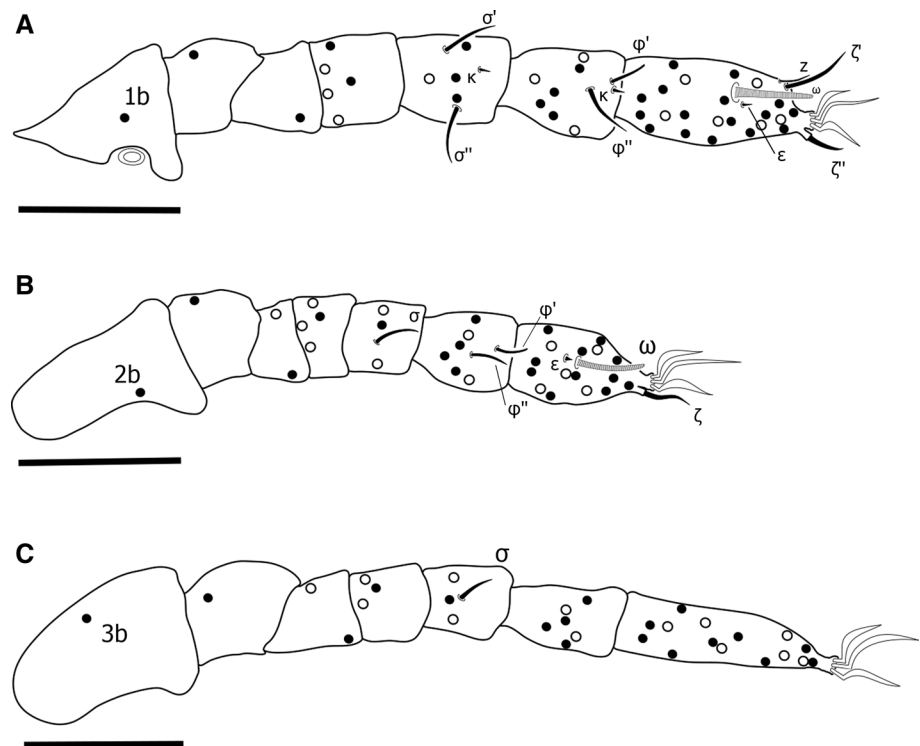


Fig. 8 *Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**; **A**—Leg I; **B**—Leg II; **C**—Leg III; Solid circles = ventral leg setae; open circles = dorsal leg setae; Symbols: ζ' = dorsal eupathidium on Ta I; ζ'' and ζ = subterminal eupathidium on Ta I; ω = solenidion on Ta I and II; σ , σ' , σ'' = solenidia on Ge I–III; κ = microsetae on Ge and Ti I; ϕ' , ϕ'' = solenidia on Ti I–II; ε = famulus on Ta I and II; *1b* = coxal field I seta; *2b* = coxal field II seta; *3b* = coxal field III seta. Scales: **A–C** 50 μ m



mouse, *Perognathus longimembris* (Coues, 1875); and cricketid host records includes: the dusky-footed woodrat, *Neotoma fuscipes* Baird, 1858; the desert woodrat, *Neotoma lepida* Thomas, 1893; the cactus mouse, *Peromyscus eremicus* (Baird, 1858); and the pinyon mouse, *Peromyscus truei* (Shufeldt, 1885) [4].

After examining all *Euschoengastia* types and conducting an exhaustive bibliographic review, we concluded *G. latchmani* **n. comb.** and *G. obscura* **n. comb.** represented a new genus, represented by having unique combination of characters (e.g. 3-pronged odontus and striations on the prodorsal sclerite) that may these two species different from the rest of *Euschoengastia*.

Both species share generic characteristics, but they can be separated by the following characters: *G. latchmani* **n. comb.** has obovate *si* setae, with rounded scale-like setules, C row with 15–16 dorsal opisthosomal setae, and D row with 12 setae. In comparison, *G. obscura* has capitate *se* setae, with pointed scale-like setules, C row with 20 dorsal opisthosomal setae, D row with 14 setae.

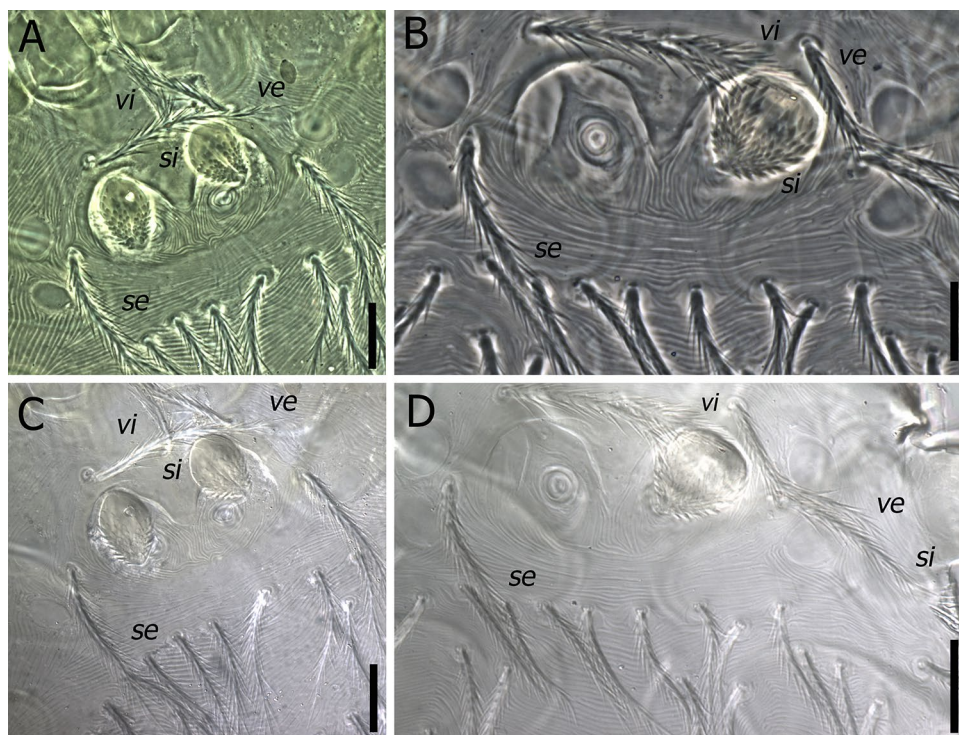
Some differences between the original descriptions include discrepancies in the numbers of dorsal and ventral opisthosomal setae in both species. *Goffacarus latchmani* **n. comb.** was described with 101 opisthosomal setae, we observed 110 setae in the holotype, with a range of 105–114 in the paratypes. *Goffacarus obscura* **n. comb.**

was described with 137 opisthosomal setae, we observed 130 (holotype) and 132 (paratype) setae.

Some discrepancies and omissions in the measurements were observed in Brennan and Yunker's [3] description of *G. latchmani* **n. comb.** They did not provide measurements of the legs, sternal or ventral opisthosomal setae and did not provide the complete schematic drawing of the legs, gnathosoma or the dorsal and ventral opisthosomal setal arrangement. The original description [4] of *G. obscura* **n. comb.** was more detailed, but the complete schematic drawings of the legs and the arrangement of the dorsal and ventral opisthosomal setae were omitted. While metric data were provided for *G. obscura* **n. comb.**, we noticed differences in the *ve*, *si*, *1a* setal lengths, as well as the dorsal and ventral opisthosomal setae. These differences are shown in Tables 5 and 8. In the present study, the missing measurements and drawings were provided for both species along with their microscopic images.

Despite being presented in the wide diagnosis provided by Wrenn [2] with the following consideration: “cuticular striae usually not encroaching over posterior portion of scutum”, the ornamentation of the prodorsal sclerites when changes and/or make it difficult to observe the line of the posterior margin (Fig. 9) become a stable and useful structure in differentiating genera, in the same way that it is used to separate genera as *Neoschoengastia* Ewing, 1929 and *Megaschoengastia* Vercammen-Grandjean, 1960. In this

Fig. 9 Phase Contrast and DIC images of the prodorsal sclerite of *Goffacarus* Bassini-Silva, Jacinavicius and Welbourn, **n. gen.** **A** and **C**—*Goffacarus latchmani* (Brennan and Yunker, 1964) **n. comb.**; **B** and **D**—*Goffacarus obscura* (Wrenn and Loomis, 1974) **n. comb.**; Symbols: *ve* = external vertical setae; *se* = external scapular setae; *vi* = internal vertical setae; *si* = internal scapular setae (trichobothria). Scales: **A–D** 20 μ m



case, the marked striations change the margins, changing the shape of the prodorsal sclerite, consequently these striations help to separate *Goffacarus* **n. gen.** from *Euschoengastia*. It is important to highlight that the present study is part of a systematic review of *Euschoengastia* made by us that has always been necessary over the years.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All applicable institutional, national and international guidelines for the care and use of animals were followed.

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