A review of the mite subfamily Makialginae (Acari: Psoroptidae) – permanent parasites of strepsirrhine primates

Andre V. Bochkov, Pavel B. Klimov & Georges Wauthy

We present a genus-level taxonomic revision of the mite subfamily Makialgine (Acari: Psoroptidae), which are permanent and highly specialized ectoparasites of strepsirrhine primates distributed in Madagascar and tropical Africa. A key to all named species is provided.

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Introduction

Mites of the subfamily Makialginae (Acari: Psoroptidae) are permanent, highly specialized ectoparasites of primates belonging to the suborder Strepsirrhini. Early derivative makialgines parasitize Galagidae in continental Africa, while the remaining species are known from lemurs in Madagascar (Bochkov & OConnor 2006). To date this mite subfamily includes six genera and eleven species known from all strepsirrhine families, excluding the family Lorisidae (OConnor 1984; Bochkov & OConnor 2006).
Most makialgines were described in the 1960's by Fain (1963a, b, c, 1966). For this reason, homologies of many fine structures with those of other Astigmata, especially setae, which are of principal importance for phylogenetic studies, were not established In this paper, we clarify setal homologies wich were not established by most previous authors (Gaud & Till 1957; Fain 1963a, b, c, 1966, 1972), revise this subfamily at the generic level, and provide a key to all named species.

Material and methods

In the descriptions below, idiosomal chaetotaxy follows Griffiths et al. (1990) with modifications of Norton (1998) for coxal setae. Females of the genera *Cheirogalalges* and *Galagalges* are unknown. Therefore their generic diagnoses are supplied by tritonymphal descriptions because of some characters of tritonymphs are similar to those of adult females. Leg chaetotaxy follows Grandjean (1939). All measurements in descriptions and the key are given in micrometers (μm). Classification and names of hosts follow Groves (2005). Specimen depositories and reference numbers are cited using the following abbreviations:

AMNH	American Museum of Natural History, New York, USA;
BMOC #	B.M. OConnor reference number;
IRSNB	Institut royal des Sciences naturelles de Belgique, Brussels, Belgium;
MNHN	Muséum national d'Histoire naturelle, Paris, France;

Tijdschrift voor Entomologie 153: 217–237, Figs 1–21. [ISSN 0040–7496]. http://www.nev.nl/tve

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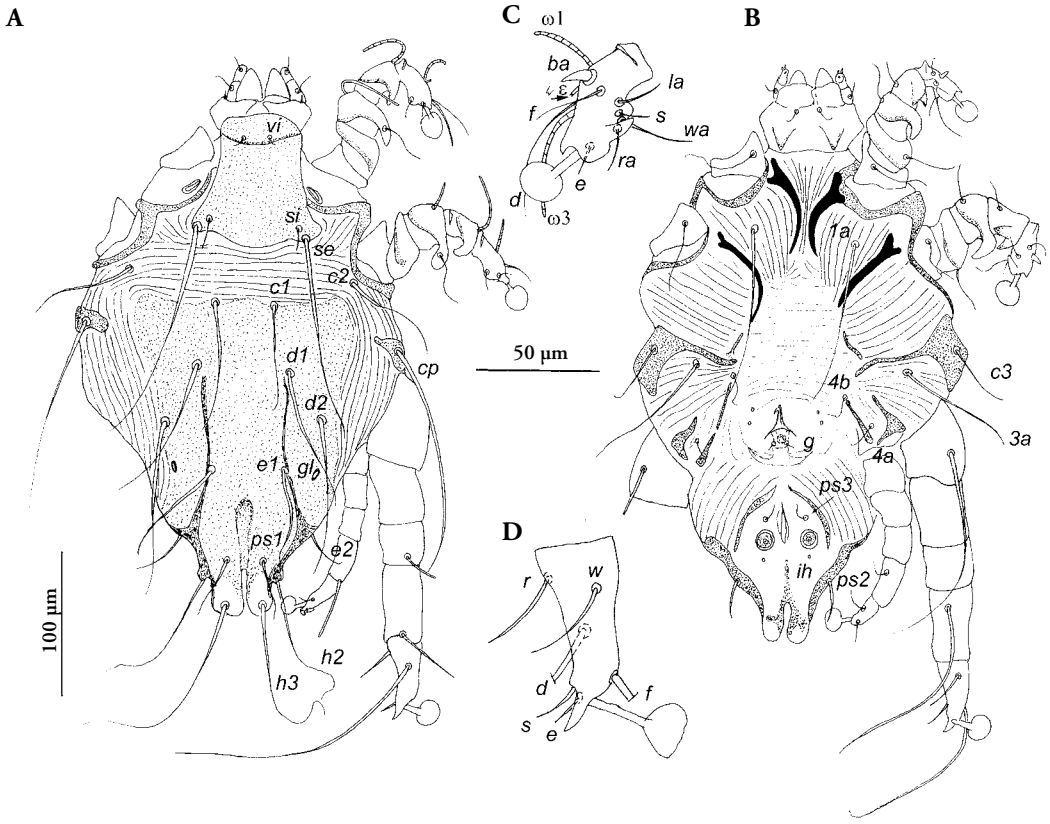

Fig. 1. *Makialges lepilemuri*, male. – A, dorsal view; B, ventral view; C, tarsi I in ventral view; D, tarsi III in ventral view. Scale bars: 100 mm for A-B, 50 µm for C-D.

MRAC Musée royal de l'Afrique Centrale, Tervuren, Belgium;
BMNH Natural History Museum, London, England;
UMMZ Museum of Zoology, University of Michigan, Ann Arbor, USA.

Taxonomy

Family Psoroptidae Canestrini

Subfamily Makialginae Gaud & Mouchet

Makialginae Gaud & Mouchet, 1959: 151 (in Analgidae); Fain 1963a: 154; 1963c: 47 (in Psoroptidae); OConnor 1984: 188 (in Psoroptidae); Bochkov & OConnor 2006: 1 (in Psoroptidae).
Analgidae, Gaud & Till 1957: 128 (part.)
Galalgidae Fain, 1963b: 243 (synonymized by OConnor 1984: 188).
Cheirogalalginae Fain, 1963c: 115 (synonymized by OConnor 1984: 188).
Type genus. *Makialges* Gaud & Till, 1957.

Genera included
Makialges, *Cheirogalalges* Fain, 1963, *Daubentonialges* Fain, 1972, *Galagalges* Fain, 1963, *Gaudalges* Fain, 1963 and *Lemuralges* Fain, 1963.

Hosts and distribution
Primates: Galagidae, Cheirogaleidae, Daubentoniidae, Lepilemuridae, Indriidae, and Lemuridae; tropical Africa and Madagascar.

Diagnosis
Both sexes. Propodonotal shield present, always bearing setae *vi*. Openings of podocephalic canals distinct. Coxal organs absent. Openings of opisthonotal glands (gl) distinctly sclerotized. Coxal apodemes I separated from each other (in male of *Galagalges* fused at posterior ends). Famulus bifurcate. Spur-like setae *ba*I–II and solenidia *omega1*I–II situated in median part of respective tarsi. Solenidion *omega3* situated in apical part of tarsus I. Idiosomal setation: *vi, si, se, c1–c3, cp, d1, d2, e1, e2, f2, h1–h3, ps2, ps3, 1a, 3a, 4a, 4b,*and *g*. Leg setation: *pR*I–II, *sR*III, *vF*I–II,

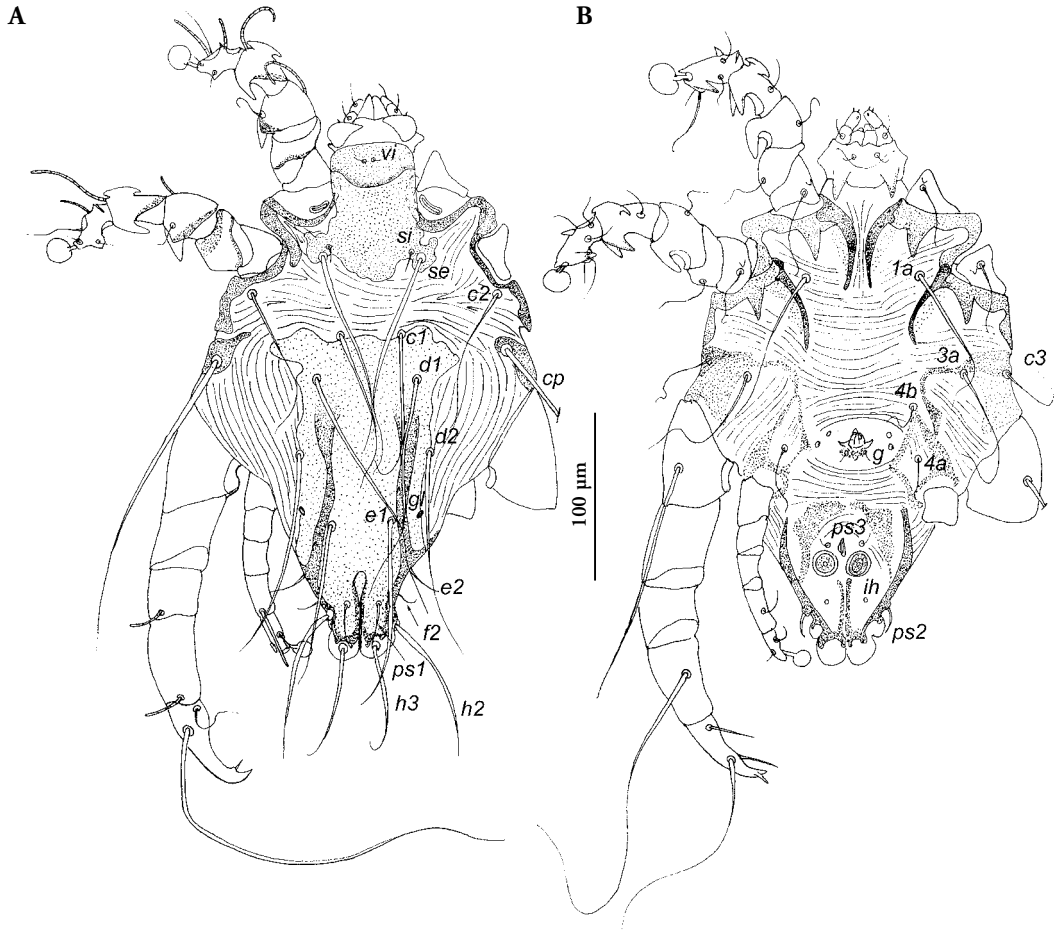

Fig. 2. *Makialges sternodon*, male. – A, dorsal view; B, ventral view.

*cG*I–II, *mG*I–II, *gT*I–II, *kT*III, *ba*I–II, *la*I–II, *s*I–III, *e*I–IV, *f* I–IV, and *d*I–IV, *omega1*I–II, *omega3*I, *phi*I–IV, and *sigma*I–III (in *Galagalges d2, e2*, *e*III, and *f* III absent). Projections of genua I–II present. Projection of tibiae I–II present.

Male. Hysteronotal shield entire (in *Galagalges* transversally subdivided). Aedeagus minute, situated at level of coxal fields III–IV. Adanal shields present. Opisthosomal lobes present, absent in *Galagalges*, and weakly developed in *Cheirogalalges*. Paranal suckers distinct (absent in *Galagalges*). Legs III strongly widened, except subequal in width to legs IV in *Galagalges*. Tarsi III distinctly developed (in *Galagalges* strongly shortened), acute apically. Pretarsi III present or absent. Setae *d*IV and *e*IV modified into suckers.

Female. Hysteronotal shield absent (present in *Makialges*). Epigynum distinctly developed, situated between coxal fields II or III (in *Lemuralges* between I). Bursa-copulatrix open ventro-terminally. Basal cap and walls of inseminatory canal indistinct. Femora III–IV strongly shortened, shorter than respective genua (in *Galagalges* moderately developed). Ventral spur of tibiae III and IV present (in *Galagalges* absent).

Remarks

The genus *Makialges* was created by Gaud & Till (1957) in the family Analgidae for three newly described species, *M. lepilemuri* (type species), *M. sternodons*, and *M. propitheci*. Later on, Gaud & Mouchet (1959) established for this genus a separate subfamily, Makialginae (Analgidae). Fain (1963a) moved this subfamily to Psoroptidae and established *Gaudalges* for *Makialges propitheci* (type species) and described *G. caparti*. In subsequent works, Fain (1963c, 1966, 1972) emended the diagnosis of this subfamily, redescribed all known genera and species,

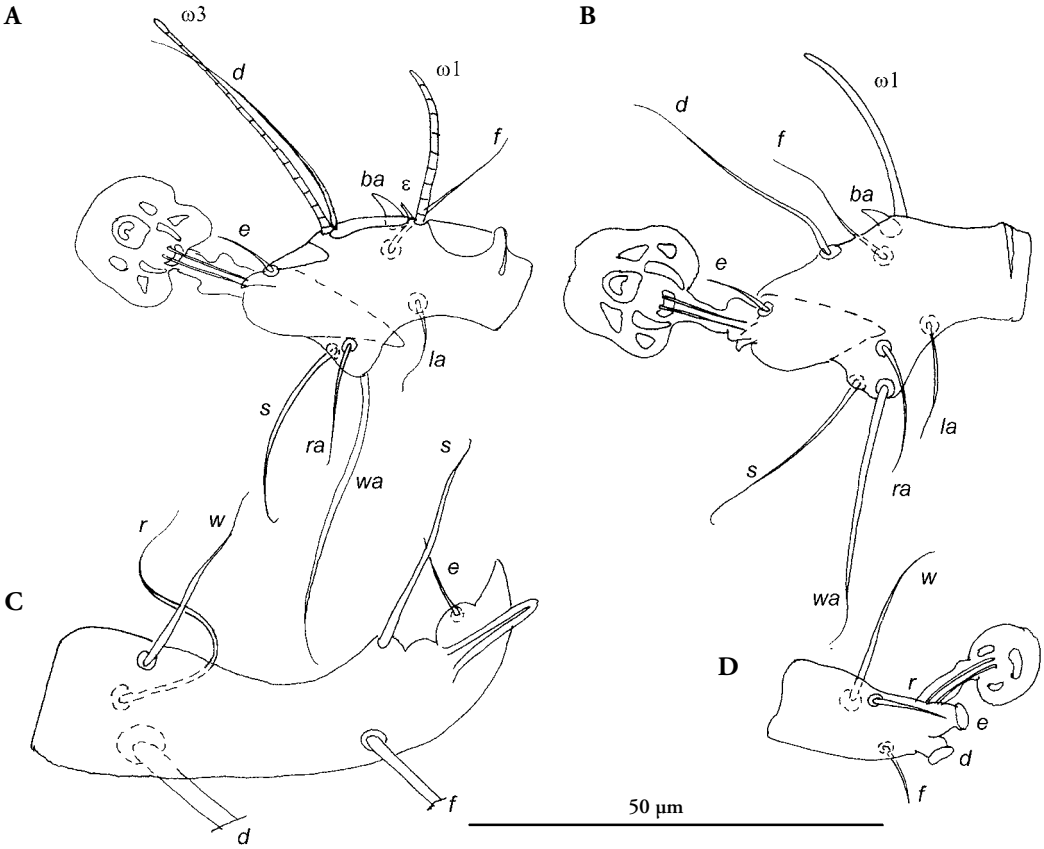

Fig. 3. *Makialges sternodons*, male, tarsi I–IV in ventral view, respectively (A-D).

including two new monotypic genera, *Lemuralges* and *Daubentonialges* and two species, *Gaudalges haymani* Fain and *Makialges lobatus* Fain.

An attempt to reconstruct the phylogeny of the subfamily Makialginae was undertaken by OConnor (1984) using not parsimonious Hennig-Remane method. In his analysis, data for some taxa were derived from early inaccurate descriptions, which affected the pattern of cladistic relationships within the subfamily (for detailed comments see Bochkov & OConnor 2006).

Based on his phylogenetic analysis, OConnor (1984) included in this subfamily the two monobasic genera *Cheirogalalges* and *Galagalges*. The former genus had previously belonged to the monobasic psoroptid subfamily Cheirogalalginae, and the latter genus was a single member of the family Galalgidae (Fain 1963b, c). Despite some problems with OConnor's (1984) analysis, this inclusion was absolutely reasonable. All representatives of the subfamily possess a unique synapomorphy in Psoroptidae, spur-like setae *ba*I–II, being unique synapomorphy in Psoroptidae and the projections on genua and tibia I, II (present in Listropsoralginae, another psoroptid subfamily). These features support consideration of this subfamily as a natural group.

Finally, Bochkov & OConnor (2006) redefined the genus *Gaudalges*, redescribed three species known in this genus, and described a new species, *G. brevisetosus*.

Genus *Makialges* Gaud & Till

Makialges Gaud & Till, 1957: 138; Fain 1963c: 55, 1966: 94; OConnor 1984: 188; Bochkov & OConnor 2006: 6. Type species. *Makialges lepilemuri* Gaud & Till, 1957, by original designation.

Species included

Makialges lepilemuri, M. sternodons Gaud & Till, 1957 and *M. lobatus* Fain, 1966.

Hosts and distribution

Lepilemuridae; Madagascar.

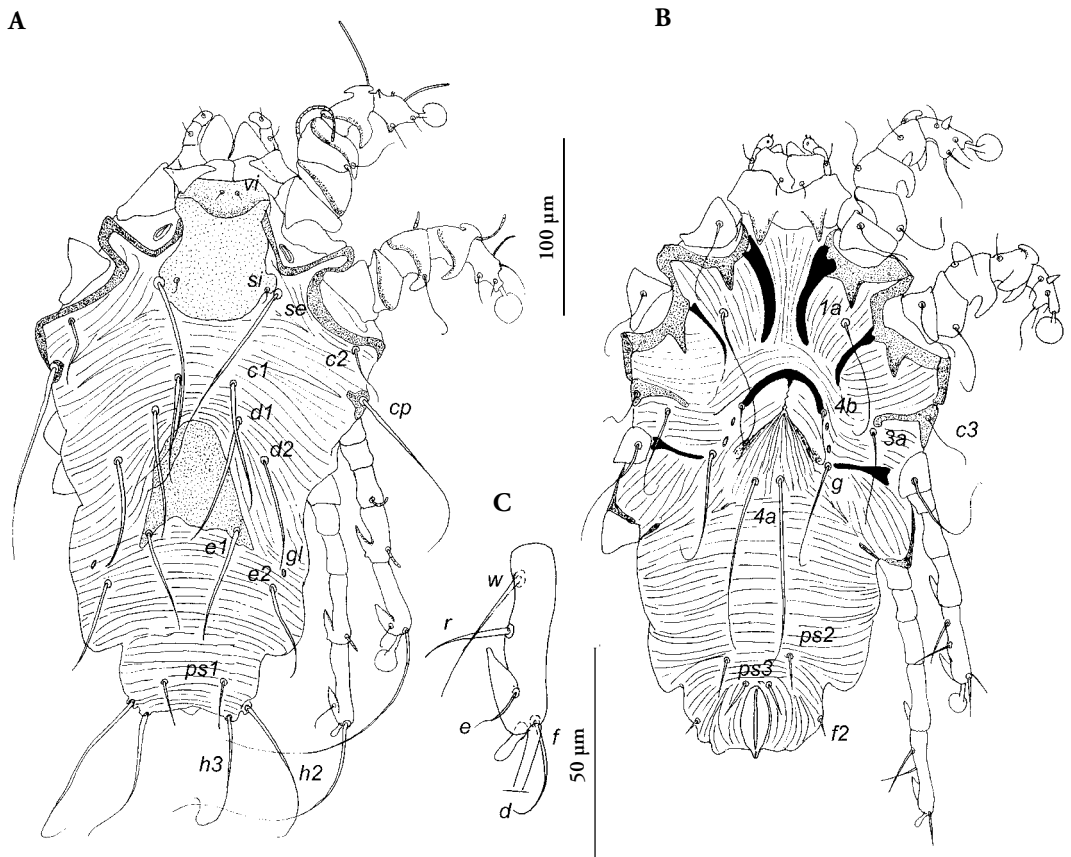

Fig. 4. *Makialges sternodons*, female. – A, dorsal view; B, ventral view; C, tarsi IV in dorsal view. Scale bars: 100 mm for A-B –, 50 µm for C.

Diagnosis

Both sexes. Ventral apophyses of subcapitulum present. Spurs of coxal fields I–II absent or present. Projections of femora I–II absent. Dorsal harpoon-like projection of tibiae I and II present or absent. Ventral spur of tarsi I and II present or absent. Ventral spur of tarsi III and IV present.

Male. Hysteronotal shield without ornamentation. Ventral expansion of hysteronotal shield present. Latero-dorsal apodemes of hysteronotal shield present. Supranal apodeme weakly developed. Coxal fields III open or fused. Postgenital shield weakly developed. Adanal shields paired. Adanal membrane weakly developed or absent. Opisthosomal lobes moderately developed, convergent but not fused. Legs IV strongly shortened. Pretarsi III present or represented only by pretarsal stalk. Dorso-apical projection of tibiae III absent. Tarsal apices III acute. Setae *s*III filiform.

Female. Epigynum moderately developed, arch-like, situated between coxal fields II. Lateral sclerites of vulva poorly developed. Dorso-median setae of idiosoma relatively long and thickened. Setae *1a* whip-like. Setae *ps2* located anterior of seta *ps3* bases. Setae *4a* whip-like. Hysteronotal shield present. Pretarsi III not longer than respective tarsi. Pretarsi IV developed or represented only by pretarsal stalk.

Makialges lepilemuri Gaud & Till

Fig. 1

Makialges lepilemuri Gaud & Till, 1957: 139, figs 2B, Pl. I – 3, II – 5; Fain 1963c: 55, 1966: 94, figs 1–4, 7; Bochkov & OConnor 2006: 5 [Syntypes in MNHN and IRSNB].

Hosts. *Lepilemur mustelinus* Geoffroy, 1851 (type host) (Gaud & Till 1957), *Lepilemur ruficaudatus* Grandidier, 1867 (Fain 1963c, 1966).

Type material examined. 2♀, 2♂, and 1 tritonymph syntypes (IRSNB) from *Lepilemur mustelinus*,

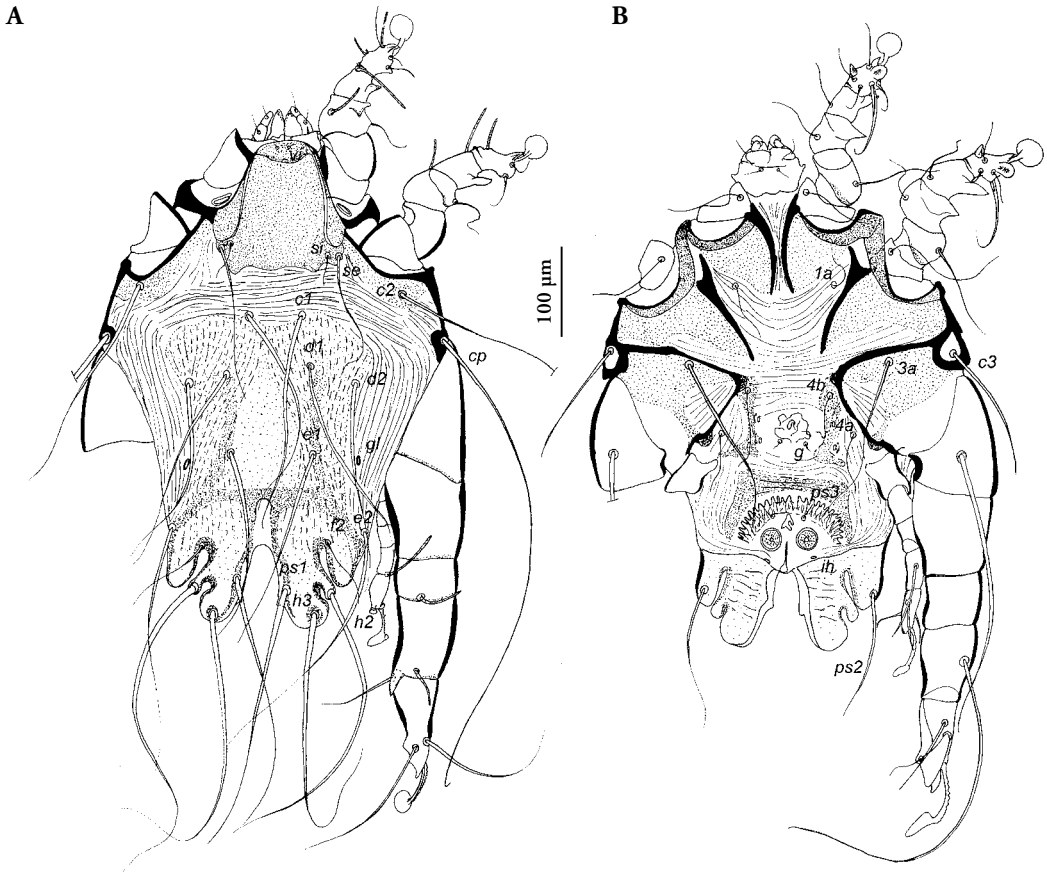

Fig. 5. *Lemuralges intermedius*, male. – A, dorsal view; B, ventral view.

Madagascar, Ambatolampy (? many localities with this name) (unknown coll.).
Additional material. 2♀ and 2♂ (UMMZ), from same host and locality as syntypes (unknown coll.); 1♀ and 2♂ (IRSNB) from *Lepilemur ruficaudatus* (BMNH 94.1.22.2.3), Madagascar, Fort Dauphin, 25°02'S, 47°00'E (unknown coll.).

Makialges sternodons Gaud & Till

Figs 2–4

Makialges sternodons Gaud & Till, 1957: 140, figs 2C, Pl. I – 4, II – 6; Fain 1963c: 56, 1966: 99, fig. 5; Bochkov & OConnor 2006: 5 [Syntypes in MNHN and IRSNB].

Hosts. *Lepilemur* sp. (Gaud & Till 1957).
Type material examined. 1♀, 1♂, and 1 tritonymph syntypes (IRSNB) from *Lepilemur* sp., Madagascar, Toliara, 23°21'S, 43°40'E (unknown coll.).

Makialges lobatus Fain

Makialges lobatus Fain, 1966: 99, fig. 6; Bochkov & OConnor 2006: 5 [Holotype in IRSNB]

Hosts. *Lepilemur ruficaudatus.*
Type material examined. Tritonymph holotype from *Lepilemur ruficaudatus* (BMNH 94.1.22.2.3), Madagascar, Fort Dauphin, 25°02'S, 47°00'E (unknown coll.).
Remark. This species was described from a single tritonymphal specimen from an ethanol preserved host specimen. *M. lepilemuri* was collected from the same host individual and differs from the last species only by the shape of the propodonotal shield in the tritonymph. Additional material, especially adults, should be obtained to validate the species status of *M. lobatus*.

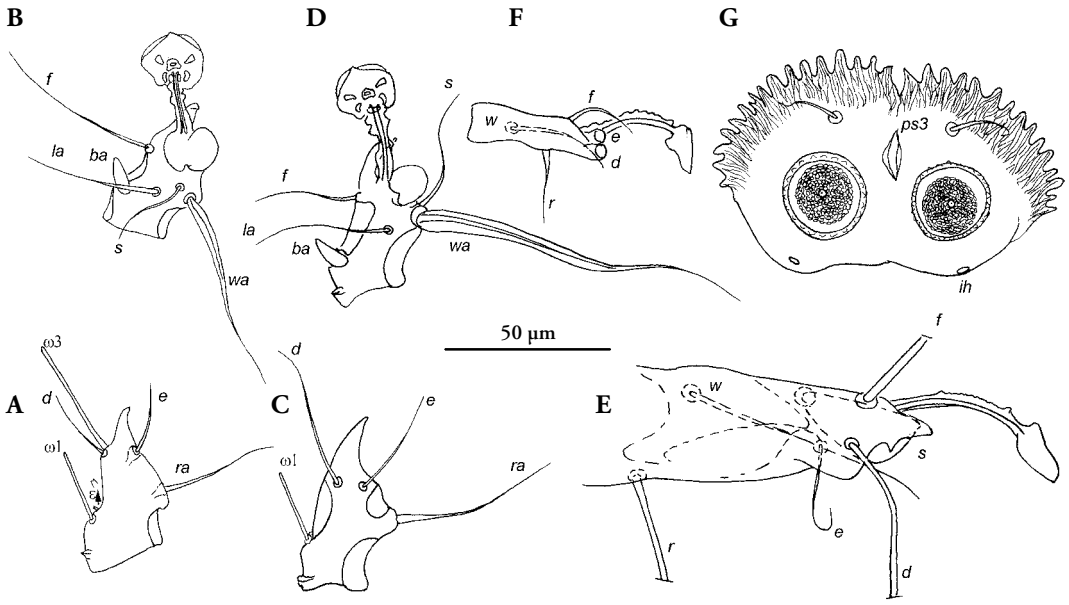

Fig. 6. *Lemuralges intermedius*, male. – A, tarsi I in dorsal view; B, same in ventral view; C, tarsi II in dorsal view; D, same in ventral view; E, tarsi III in dorsal view; D, tarsi IV in dorsal view; G, anal area.

Genus *Lemuralges* Fain

Fain, 1963c: 113, 1966: 100; OConnor 1984: 188; Bochkov & OConnor 2006: 6.

Type species. *Lemuralges intermedius* Fain, 1963 by original designation.

Species included

Lemuralges intermedius.

Hosts and distribution

Lepilemuridae, Lemuridae, and Indriidae; Madagascar.

Diagnosis

Both sexes. Ventral apophyses of subcapitulum absent. Spurs of coxal fields I–II absent. Projections of femora I–II absent. Dorsal harpoon-like projection of tibiae I–II absent. Ventral spur of tarsi I–II absent.

Male. Hysteronotal shield almost completely striated and granulated, excluding median part. Ventral expansion of hysteronotal shield absent. Latero-dorsal apodemes of hysteronotal shield present. Supranal apodeme present, distinctly developed. Coxal fields III closed. Postgenital shield absent. Adanal shields fused to each other, forming arch-like shield. Adanal membrane distinctly developed, its anterior margin with hyaline protuberances. Opisthosomal lobes distinctly developed, widely separated from each other. Legs IV strongly shortened. Pretarsi III present. Dorso-apical projection of tibiae III present. Tarsal apices III acute, with short basal projection. Setae *s*III membranous.

Female. Dorso-median setae of idiosoma short. Setae *1a* moderately developed. Setae *ps2* located anterior of seta *ps3* bases. Setae *4a* moderately developed. Epigynum moderately developed, situated far anteriorlybetween coxal fields I. Lateral sclerites of vulva distinctly developed. Hysteronotal shield absent. Ventral spur of tarsi III–IV absent. Pretarsi III and IV distinctly elongated, longer than the respective tarsi.

Lemuralges intermedius Fain

Figs 5–8

Lemuralges intermedius Fain, 1963c: 113, 1966: 100, figs 8–11; Bochkov & OConnor 2006: 4 [Holotype in BMNH].

Hosts. *Lepilemur ruficaudatus* (type host), *Eulemur fulvus* (Geoffroy, 1796), *Hapalemur griseus* (Link, 1795)(Lemuridae), *Propithecus verreauxi* Grandidier, 1867 (Indriidae) (Fain 1963c, 1966).

Type material examined. 1♂ and 1 tritonymph paratypes (IRSNB) from *Lepilemur ruficaudatus* (BMNH 94.1.22.2.3), Madagascar, Fort Dauphin, 25°02'S, 47°00'E (unknown coll.).

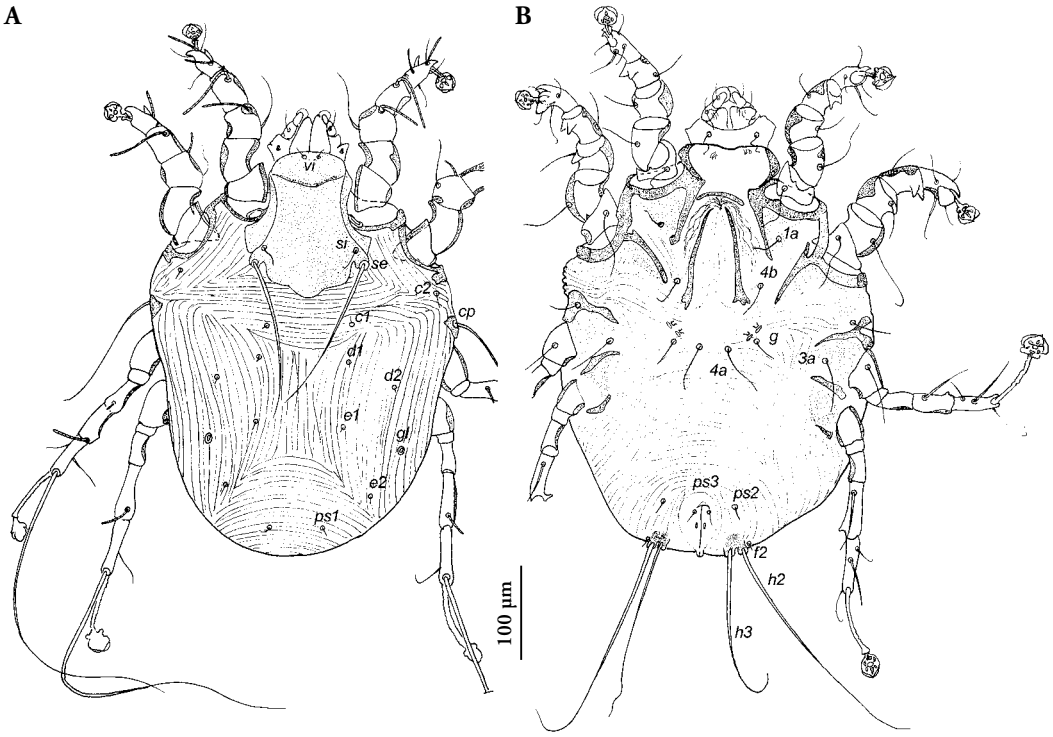

Fig. 7. *Lemuralges intermedius*, female. – A, dorsal view; B, ventral view.

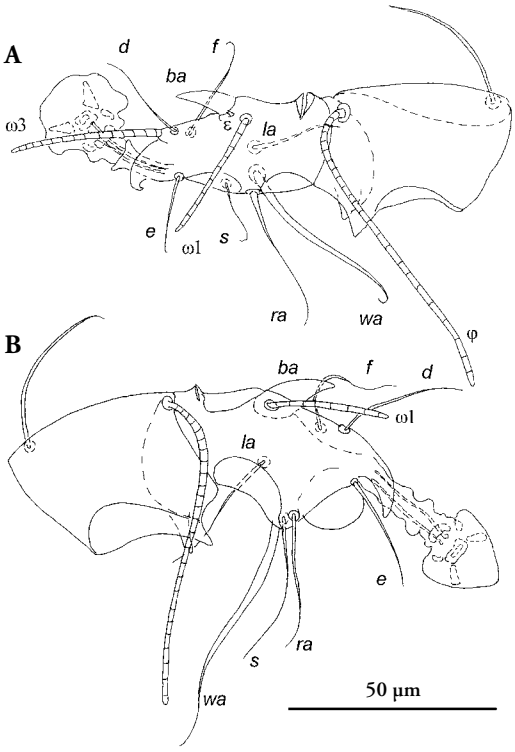

Fig. 8. *Lemuralges intermedius*, female. – A, tarsus and tibia I in dorsal view; B, tarsus and tibia II in dorsal view.

Additional material. 2♀ and 1 tritonymph (IRSNB) from *Propithecus verreauxi*, same locality as paratypes (unknown coll.); 1♂ and 1 tritonymph (IRSNB) from *Eulemur fulvus* (MNH 91.11.30.31), same locality as paratypes (unknown coll.).

Genus *Gaudalges* Fain

Gaudalges Fain, 1963a: 154, 1963c: 56; OConnor 1984: 188; Bochkov & OConnor 2006: 5.

Type species. *Makialges propitheci* Gaud & Till, 1957 by original designation.

Species included

Gaudalges propitheci, G. caparti Fain, 1963, *G. haymani* Fain, 1963, *G. brevisetosus* Bochkov & OConnor, 2006

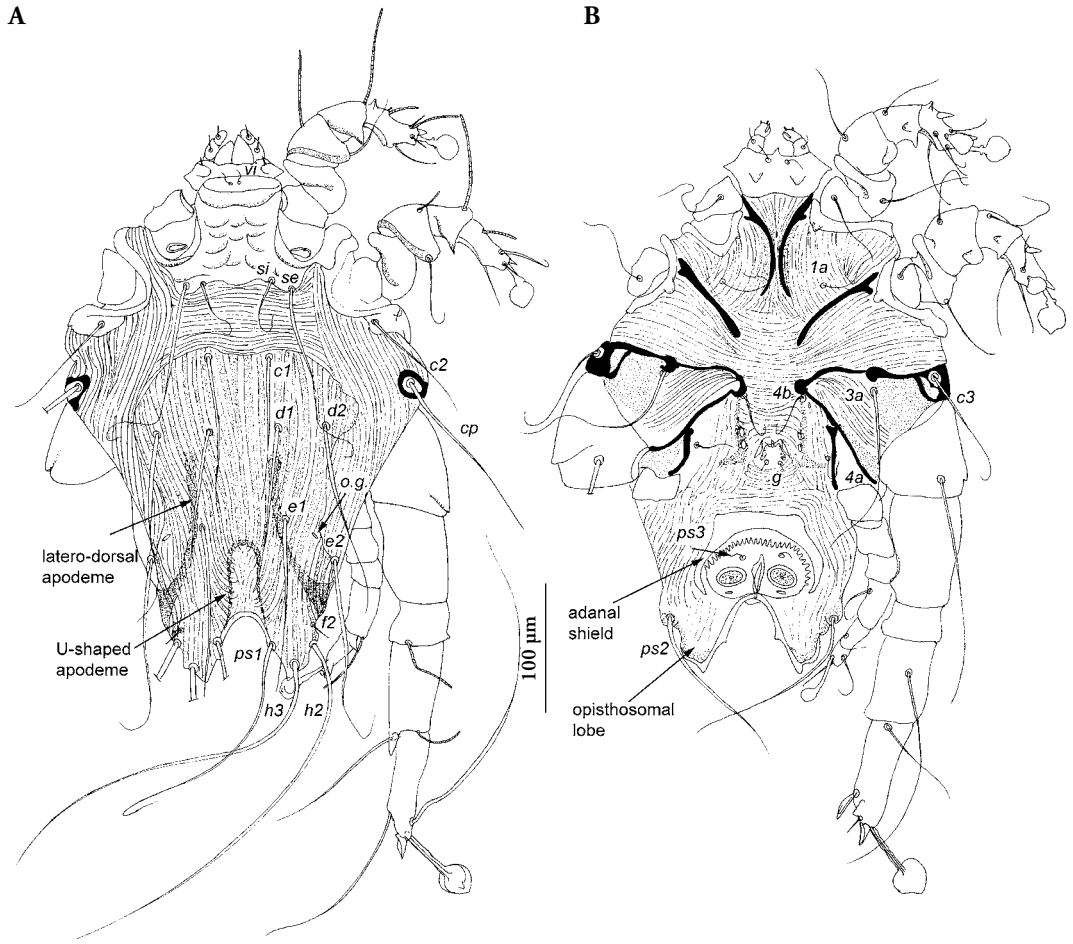

Fig. 9. *Gaudalges propitheci*, male. – A, dorsal view; B, ventral view.

Hosts and distribution
Lemuridae, Indriidae; Madagascar.

Diagnosis
Both sexes. Ventral apophyses of subcapitulum present. In some species propodonotal shield ornamented. Spurs of coxal fields I–II absent. Projections of femora I–II absent. Dorsal harpoon-like projection of tibiae I–II absent. Ventral spur of tarsi I–II absent.
Male. Hysteronotal shield in male completely striated and granulated. Ventral expansion of hysteronotal shield absent. Latero-dorsal apodemes of hysteronotal shield present. Supranal apodeme of hysteronotal shield distinctly developed, entire. Coxal fields III closed. Postgenital shield present. Adanal shields forming arch-like shield. Adanal membrane well developed, with membranous protuberances. Opisthosomal lobes distinctly developed, widely separated from each other. Legs IV strongly shortened. Pretarsi III present. Dorso-apical projection of tibiae III present. Tarsal apices III acute, with small basal projection. Dorso-basal projection of tarsi III present. Setae *s*III modified, membranous.
Female. Dorso-median setae of idiosoma short or moderately developed. Setae *1a* moderately developed. Setae *ps2* located anterior to seta *ps3* bases. Setae *4a* moderately developed. Epigynum strongly enlarged, arch-like and sometimes bearing bases of setae *4b*. Lateral sclerites of vulva distinctly or moderately developed. Hysteronotal shield absent. Length of pretarsi III–IV may be equal to or longer than respective tarsi. Ventral spur of tarsi III–IV present.

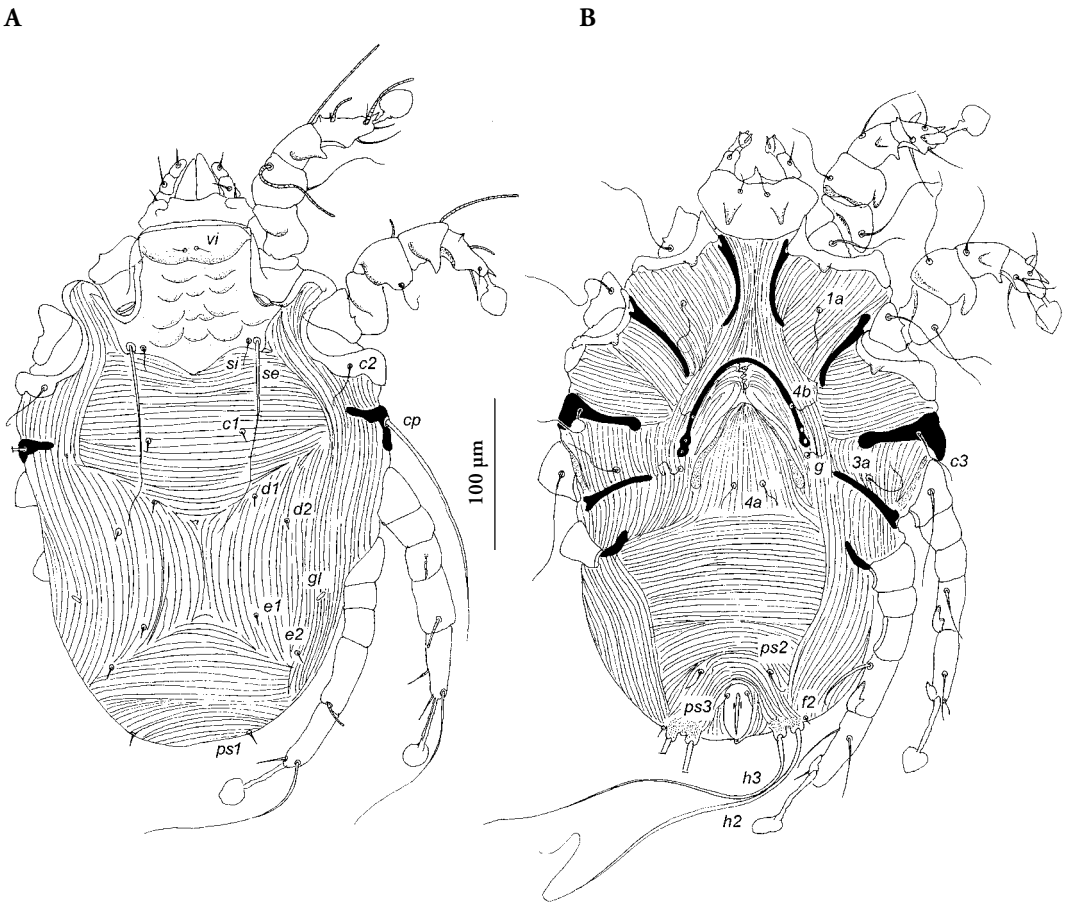

Fig. 10. *Gaudalges propitheci*, female. – A, dorsal view; B, ventral view.

Gaudalges propitheci (Gaud & Till)

Figs 9–11

Makialges propitheci Gaud & Till, 1957: 142, fig. 2D, Pl. II – 7, 8.

Gaudalges propitheci, Fain 1963a: 155, 1963c: 57; Bochkov & OConnor 2006: 7, figs 1–3 [Syntypes in MNHN].

Hosts. *Propithecus verreauxi* (Gaud & Till 1957; Bochkov & OConnor 2006).

Material examined. 2♀ and 3♂ (UMMZ) from *Propithecus verreauxi*, Madagascar, Sud Majunga, 26.vi.1960 (unknown coll.); 2♀ and 2♂ (IRSNB) from same host, Madagascar, Ankazoabo Sud (E.R. Brygoo coll.).

Gaudalges haymani Fain

Gaudalges haymani Fain, 1963c: 113; Bochkov & OConnor 2006: 8, figs 4–7 [Holotype in BMNH].

Hosts. *Eulemur fulvus* (type host) (Fain 1963c); *Eulemur coronatus* (Gray, 1842) (Bochkov & OConnor 2006).

Type material examined. 2♀, 6♂, and 2 tritonymph paratypes (IRSNB) from *Eulemur fulvus* (MNH 91.11.30.31), Madagascar, Fort Dauphin, 25°02'S, 47°00'E (unknown coll.).

Additional material. 3♀ and 1♂ (BMOC 06–0324–003) (UMMZ) from *Eulemur coronatus* (AMNH 100609), Madagascar, Antsiranana Prov., 26 km N Vohimarina, 13°08'52"S, 49°55'03"E, 27.ix.1930 (A.L. Rand coll. #1086); 1♀ (BMOC 06–0324–005) (UMMZ) from *E. coronatus* (AMNH 100615), same data (A.L. Rand coll. #1072).

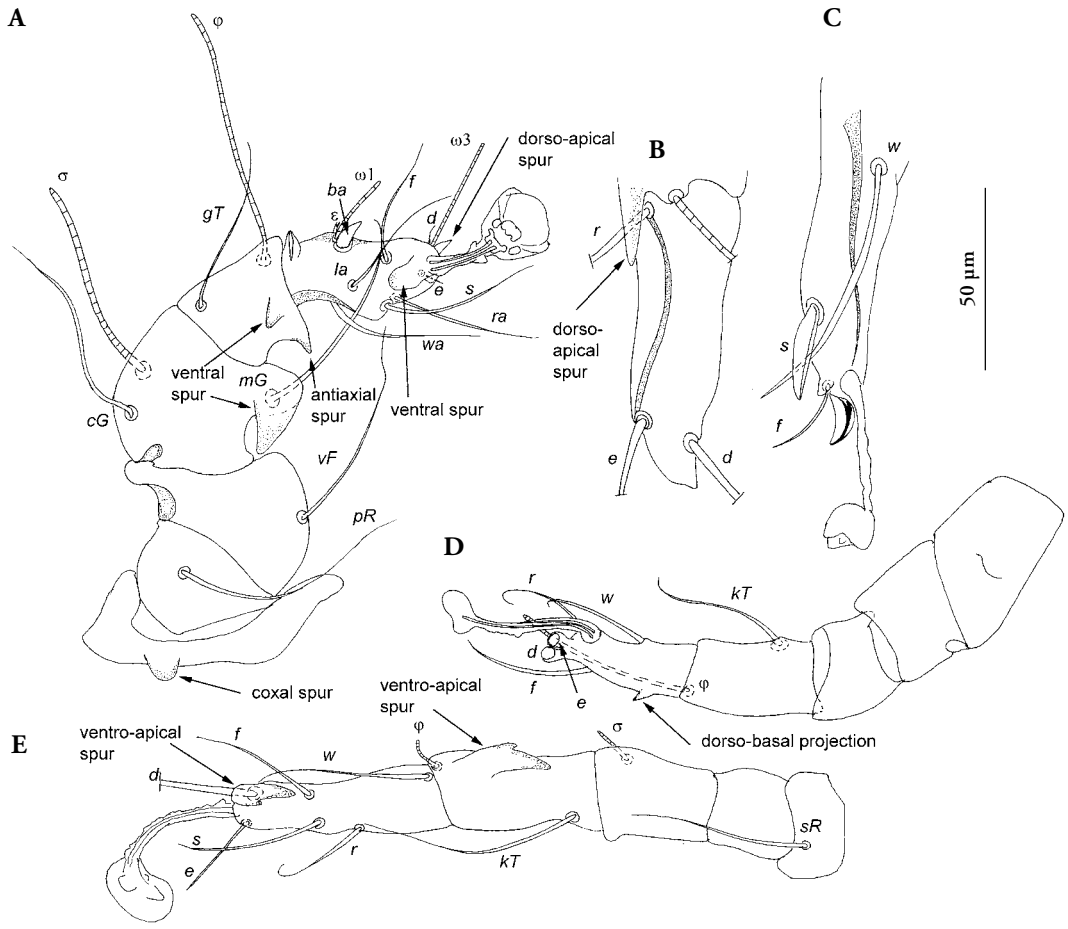

Fig. 11. *Gaudalges propitheci*, male, A-D. – A, leg I in ventral view; B, tarsi III in dorsal view; C, same in ventral view; D, leg IV in ventral view. Female, E, leg III in ventral view.

Gaudalges caparti Fain

Gaudalges caparti Fain, 1963a: 155, 1963c: 57, figs 36–39; Bochkov & OConnor 2006: 11, figs 8–11 [Holotype in MRAC].

Hosts. *Eulemur coronatus* (type host) (Fain 1963a, c), *Hapalemur griseus* (Lemuridae) (Bochkov & OConnor 2006).

Type material examined. 5♀, 4♂, and 2 tritonymph paratypes (IRSNB) from *Eulemur coronatus*, Madagascar, Nosy-Be Isl., 13°20' S, 48°15' E, 15.ix.1959 (unknown coll.).

Additional material. 27♀ and 11♂ (BMOC 06–0324–001) (UMMZ) from *Hapalemur griseus* (AMNH), Madagascar, Fianarantsoa Prov., Manombo, 23°02'S, 47°44'E, 25.ix.1929 (A.L. Rand coll. #406); 14♀, 9♂, 3 protonymphs, and 1 tritonymph (BMOC 06–0324–002) (UMMZ) from same host (AMNH 100630), Madagascar, Toamasina Prov., 20 km SW Maroantsetra, Manombia, 15°31'S, 49°38'E, 4.vii.1930 (A.L. Rand coll.).

Gaudalges brevisetosus Bochkov & OConnor

Gaudalges brevisetosus Bochkov & OConnor, 2006: 15, figs 12–14 [Holotype in AMNH].

Hosts. *Eulemur coronatus* (Bochkov & OConnor 2006).

Type material examined. Holotype ♀ and 1♀ paratype (BMOC 06–0324–004) (AMNH) from *Eulemur coronatus* (AMNH 100618), Madagascar, Antsiranana Prov., 26 km N Vohimarina, 13°08'52"S, 49°55'03"E, 27.ix.1930 (A.L. Rand coll. #1072);

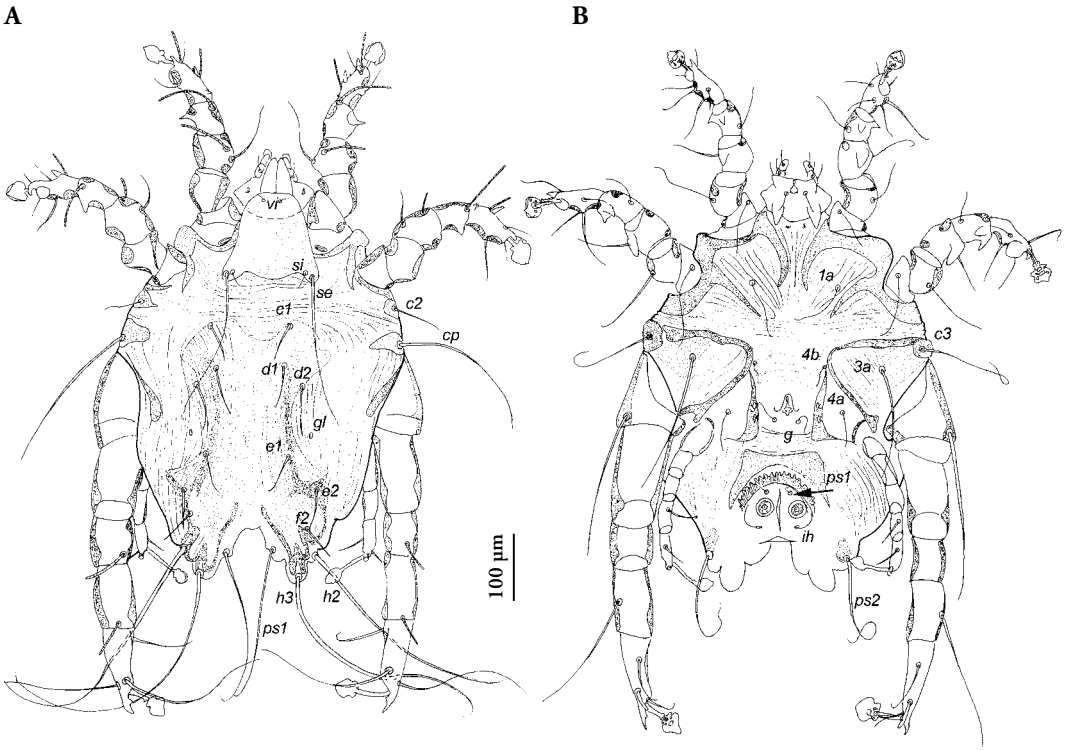

Fig. 12. *Daubentonialges brygooi*, male. – A, dorsal view; B, ventral view.

1♀ paratype (BMOC 06–0324–003) (UMMZ) from same host and data (A.L. Rand coll. #1086); 1♂ paratype (BMOC 06–0324–005) (UMMZ) from *E. coronatus* (AMNH 100615), same data (A.L. Rand coll. # 1061).

Genus *Daubentonialges* Fain

Daubentonialges Fain, 1972: 539; OConnor 1984: 188; Bochkov & OConnor 2006: 6.

Type species. *Daubentonialges brygooi* Fain, 1972 by original designation.

Species included

Daubentonialges brygooi.

Hosts and distribution

Daubentoniidae; Madagascar.

Diagnosis

Both sexes. Ventral apophyses of subcapitulum present. Spurs of coxal fields I–II absent. Projections of femora I–II absent. Dorsal harpoon-like projection of tibiae I–II absent. Ventral spur of tarsi I–II: absent.

Male. Hysteronotal shield completely striated and granulated. Ventral expansion of hysteronotal shield absent. Latero-dorsal apodemes of hysteronotal shield present. Supranal apodeme represented by pair of sclerites. Coxal fields III closed. Postgenital shield absent. Adanal shields fused to each other forming arch-like shield. Adanal membrane distinctly developed, with membranous protuberances. Opisthosomal lobes distinctly developed, widely separated from each other. Legs IV strongly shortened. Pretarsi III present. Dorso-apical projection of tibiae III absent. Tarsal apices III acute, with short basal projection. Setae *s*III widened.

Female. Dorso-median setae of idiosoma moderately developed. Setae *1a* moderately developed. Setae *ps2* located anterior of seta *ps3* bases. Setae *4a* moderately developed. Epigynum enlarged, arch-like, bearing bases of setae *4b*. Lateral sclerites of vulva distinctly developed. Hysteronotal shield absent. Pretarsi III–IV longer than respective tarsi. Ventral spur of tarsi III–IV present.

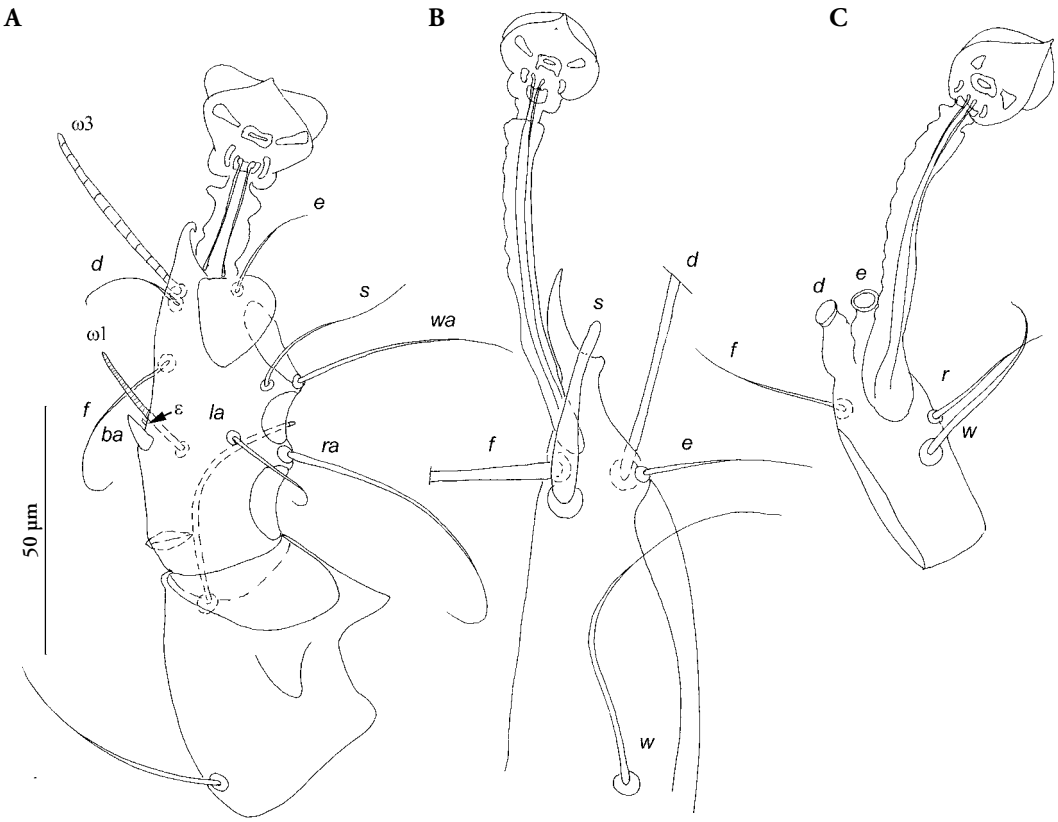

Fig. 13. *Daubentonialges brygooi*, male. – A, tibia and tarsus I in ventral view; B, tarsus III in ventral view; C, tarsus IV in ventral view.

Daubentonialges brygooi Fain

Figs 12–15

Daubentonialges brygooi Fain, 1972: 540, figs 1–4; Bochkov & OConnor 2006: 4 [Holotype in IRSNB, not in MNHN as mentioned in original description]

Hosts. *Daubentonia madagascariensis* (Gmelin, 1788) (Daubentoniidae) (Fain 1972).

Type material examined. Holotype ♂, 3♀, 2♂, and 1 tritonymph paratypes (IRSNB) from *Daubentonia madagascariensis*, Madagascar, Maroantsetra, 15°26' S, 49°44' E, ix.1970 (E.R. Brygoo coll.).

Genus *Cheirogalalges* Fain

Cheirogalalges Fain, 1963c: 115, 1966: 110; OConnor 1984: 188; Bochkov & OConnor 2006: 6.

Type species. *Cheirogalalges evansi* Fain, 1963, by original designation.

Species included

Cheirogalalges evansi.

Hosts and distribution

Cheirogaleidae; Madagascar.

Diagnosis

Ventral apophyses of subcapitulum present, situated laterally. Idiosoma twice longer than wide. Spurs of coxal fields I–II: absent. Coxae II bearing lateral sclerotized projections. Projections of femora I–II present. Dorsal harpoon-like projection of tibiae I–II present. Ventral spur of tarsi I–II present.

Male. Hysteronotal shield completely striated and granulated. Ventral expansion of hysteronotal shield absent. Latero-dorsal apodemes of hysteronotal shield in male absent. Supranal apodeme absent. Coxal fields III open. Postgenital shield weakly developed. Adanal shields fused to each other forming shield with irregular margins. Adanal membrane weakly developed. Opisthosomal lobes strongly reduced. Legs III 1.3 times longer than legs IV. Pretarsi III absent. Dorso-apical projection of tibiae III absent. Tarsal apices III acute, without basal projection. Setae *s*III filiform.

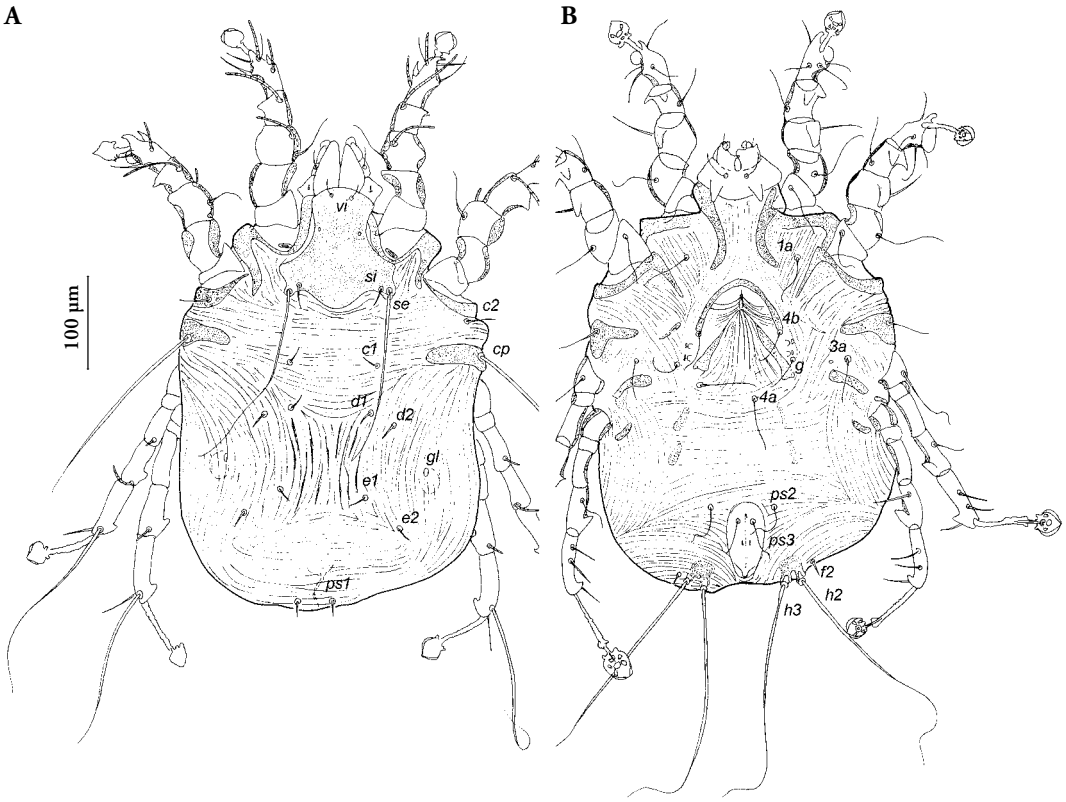

Fig. 14. *Daubentonialges brygooi*, female. – A, dorsal view; B, ventral view.

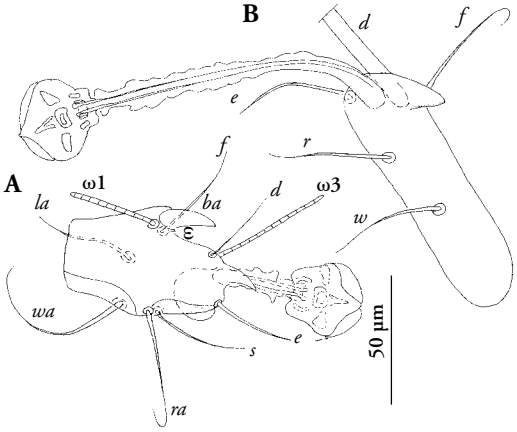

Fig. 15. *Daubentonialges brygooi*, female. – A, tarsus I in dorsal view; B, tarsus IV in ventral view.

Female. Unknown.

Tritonymph. Dorso-median setae of idiosoma short. Setae *1a* moderately developed. Setae *ps2* located posterior to level of seta *ps3* bases. Setae *4a* moderately developed. Pretarsi III–IV not longer than respective tarsi. Ventral spur of tarsi III–IV present.

Cheirogalalges evansi Fain

Figs 16–18

Cheirogalalges evansi Fain, 1963c: 115, 1966: 110, figs 19–22, 24–26; Bochkov & OConnor 2006: 4 [Holotype in MNH].

Hosts. *Cheirogaleus medius* Geoffroy, 1812 (type host), *C. major* Geoffroy, 1812 (Cheirogaleidae) (Fain 1963c, 1966).

Type material examined. 1♂ paratype (IRSNB) from *Cheirogaleus major* (MNH 85.10.8.1), Madagascar, unknown locality (unknown coll.); 1 tritonymph paratype (IRSNB) from *Cheirogaleus* sp. (MNH 94.1.22.4.5), Madagascar, unknown locality (unknown coll.).

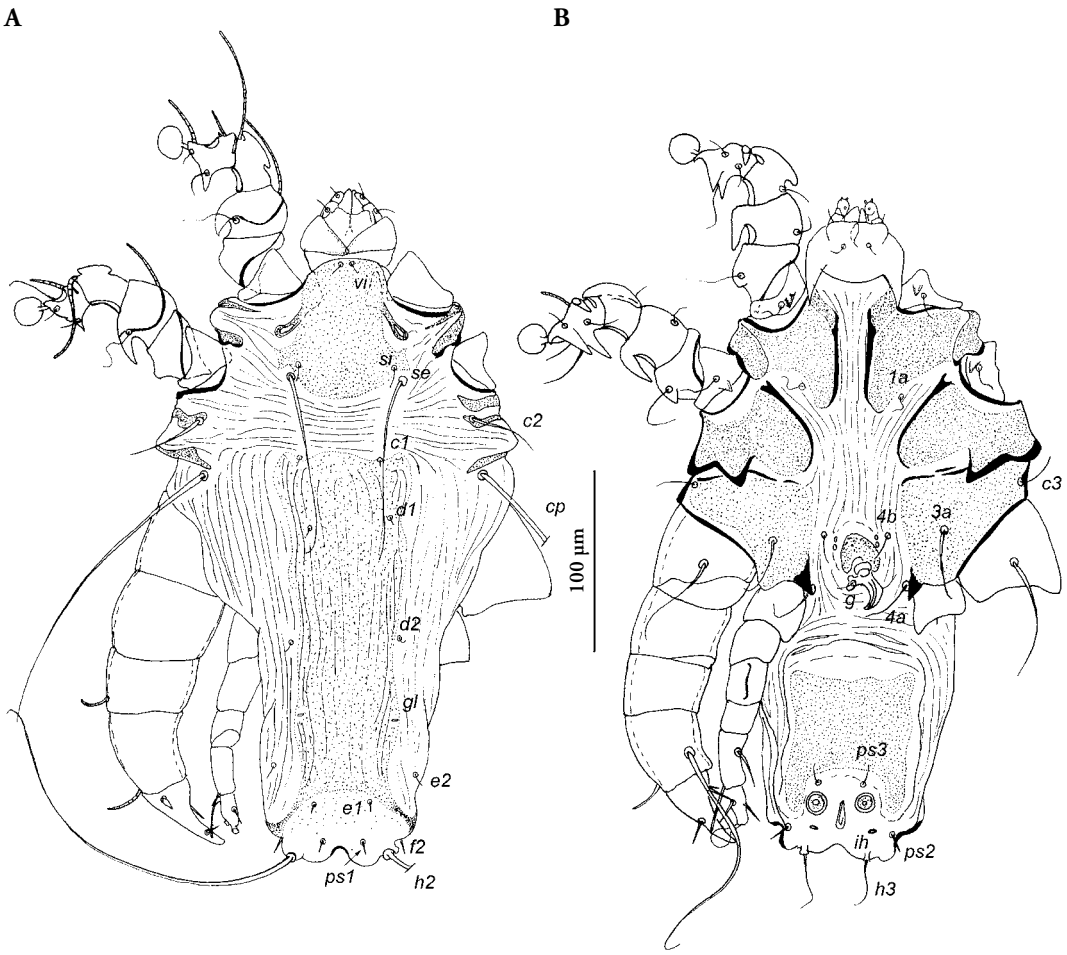

Fig. 16. *Cheirogalalges evansi*, male. – A, dorsal view; B, ventral view.

Genus *Galagalges* Fain

Galagalges Fain, 1963b: 244, 1963c: 105, 1966: 112; OConnor 1984: 188; Bochkov & OConnor 2006: 19.
Type species. *Galagalges congolensis* Fain, 1963, by original designation.

Species included
Galagalges congolensis.

Hosts and distribution
Galagidae; Tropical Africa.

Diagnosis
Ventral apophyses of subcapitulum present. Idiosoma strongly elongated. Setae *d2* and *e1* absent. Spurs of coxal fields I–II present. Projections of femora I–II present. Dorsal harpoon-like projection of tibiae I–II present. Ventral spur of tarsi I–II present. Setae *e*III–IV and *f*III–IV absent.

Male. Hysteronotal shield transversally subdivided, without ornamentation. Ventral expansion of hysteronotal shield absent. Latero-dorsal apodemes of hysteronotal shield absent. Supranal apodeme absent. Posterior ends of apodemes Ia fused into a "sternum". Coxal fields III open. Postgenital shield distinctly developed. Adanal shields fused to each other, forming shield with irregular margins. Adanal membrane absent. Paranal suckers absent. Opisthosomal lobes absent. Legs III not widened, subequal in length to legs IV. Tarsi III of male strongly reduced. Pretarsi III represented by pretarsal stalk only. Dorso-apical projection of tibiae III absent. Tarsal apices III acute, without basal projection. Setae *s*III filiform.

Female. Unknown.

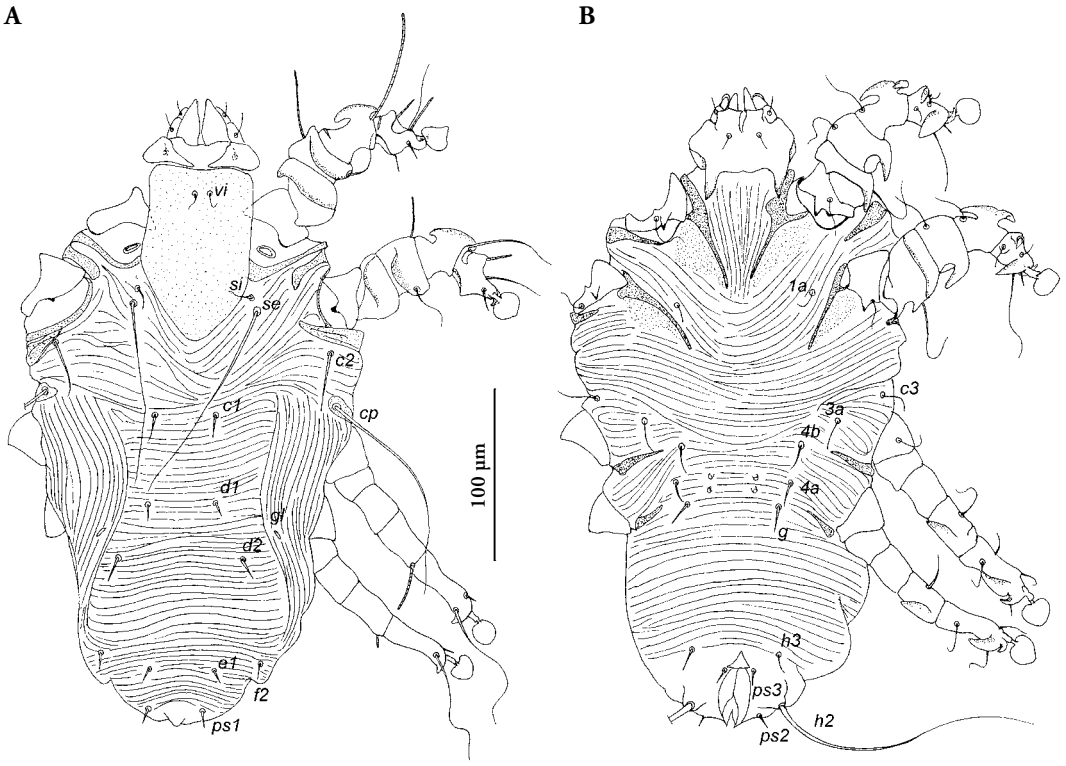

Fig. 17. *Cheirogalalges evansi*, tritonymph. – A, dorsal view; B, ventral view.

Tritonymph. Dorso-median setae of idiosoma short or moderately developed. Setae *1a* moderately developed. Setae *ps2* located posterior to level of seta *ps3* bases. Setae *4a* moderately developed. Pretarsi III–IV not longer than respective tarsi. Femora III–IV normally developed, not shorter than respective genua. Membranous projections of coxal fields II present. Ventral spur of tibiae III–IV absent. Ventral spur of tarsi III–IV absent.

Galagalges congolensis Fain

Figs 19–21

Galagalges congolensis Fain, 1963b: 244, figs 1–7, 1963c: 105, figs 15, 75, 78, 1966: 23, figs 27–30; Bochkov & OConnor 2006: 19 [Holotype in MRAC].

Hosts. *Galago moholi* Smith, 1836r (Galagidae) (Fain, 1963a, b, 1966).

Type material examined. 5♂, 2 tritonymph, and 1 protonymph paratypes (IRSNB) from *Galago moholi* (MRAC 31.204), Democratic Republic of Congo, Lubumbashi (as Élisabethville), 1961 (M. Poelman coll).

Key to genera and species of the subfamily Makialginae

Makialges lobatus is known only from tritonymph, it is not included.

1. Both sexes: body 1.3–2 times longer than wide; setae *d2* and *e2* present. Male: paranal suckers present; legs III distinctly wider and longer than legs IV 2
– Both sexes (females are unknown): body 3 times longer than wide; setae *d2* and *e2* absent. Male: paranal suckers absent; legs III and IV subequal . . . . . *Galagalges* (*G. congolensis*) (Figs 19, 20)
2. Male: latero-dorsal sclerites of hysteronotal shield present; opisthosomal lobes distinct; pretarsi III present. Female and tritonymph: setae *ps2* anterior to level of *ps3* bases 3
– Male: latero-dorsal sclerites of hysteronotal shield absent; opisthosomal lobes weakly developed; pretarsi III absent. Tritonymph (female unknown): setae *ps2* posterior to level of *ps3* bases . . . . . *Cheirogalalges* (*C. evansi*) (Figs 16–18)

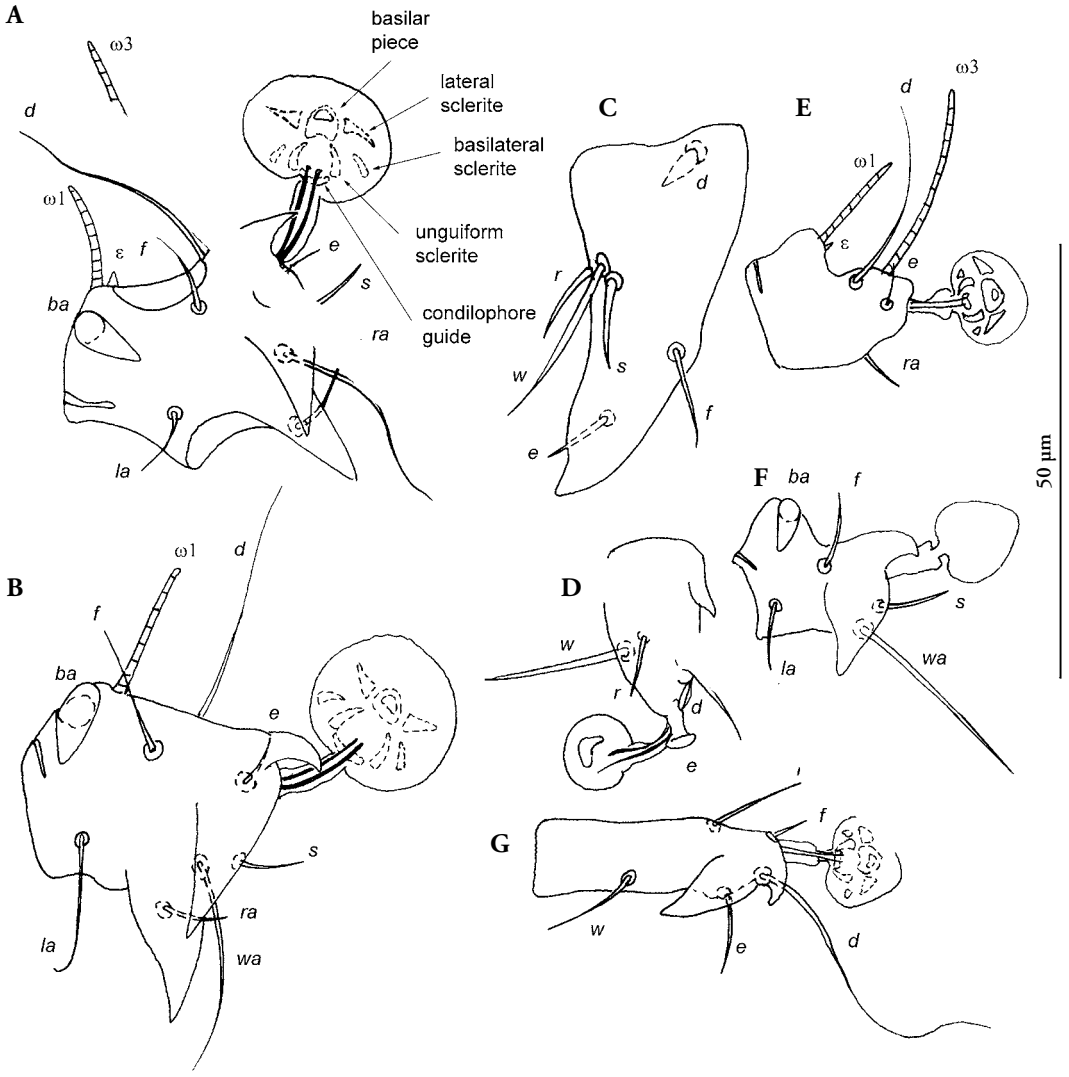

Fig. 18. *Cheirogalalges evansi*, male, A-D. – A, tarsus I in ventral view; B, tarsus II in ventral view; C, tarsus III in ventral view; D, tarsus IV in dorsal view. Tritonymph, E-G. – E, tarsus I in dorsal view; F, same in ventral view; G, tarsus IV in ventral view.

3. Male: hysteronotal shield without ornamentation; adanal shields separated; adanal membrane indistinct or absent, without protuberances; opisthosomal lobes convergent but not fused; setae *s*III filiform. Female: hysteronotal shield present; setae *1a* and *4a* whip-like ..... *Makialges* 4
– Male: hysteronotal shield with distinct ornamentation; adanal shields fused into single arch-like shield; adanal membrane distinct, bearing protuberances; opisthosomal lobes widely separated; setae *s*III modified, not filiform. Female: hysteronotal shield absent; setae *1a* and *4a* moderately developed 5
4. Both sexes: spurs of coxal fields I and II present. Male: coxal fields III closed; pretarsi III reduced to small stalk; tarsi I and II with dorsal harpoon-like projection. Female: epigynum distinctly developed, bearing setae *4b*. Pretarsi IV reduced to small stalk .... *M. sternodons* (Figs 2–4)
– Both sexes: spurs of coxal fields I–II absent.

Fig. 19. *Galagalges congolensis*, male. – A, dorsal view; B, ventral view.

Male: coxal fields III open; pretarsi III normally developed; tarsi I–II without dorsal harpoon-like projection. Female: epigynum moderately developed, not bearing setae *4b*. Pretarsi IV normally developed ..... *M. lepilemuri* (Fig. 1).

5. Both sexes: coxal fields I–II with spurs. Male: tarsi IV with dorso-basal projection ..... *Gaudalges* 6
– Both sexes: coxal fields I–II without spurs. Male: tarsi IV without dorso-basal projection 9

6. Both sexes: propodonotal shield with ornamentation. Male: setae *c1, d1, d2,* and *e1* at least 60 long; setae *c1* and *d2* situated on hysteronotal shield; setae *h1* longer than 60; hysteronotal shield completely covered by longitudinal striations; anterior margin of hysteronotal shield only slightly concave; anal area surrounded by distinct protuberances; opisthosomal lobes distinct; opisthosomal cleft longer than 30 7
– Both sexes: propodonotal shield without ornamentation. Male: setae *c1, d1, d2*, and *e1*

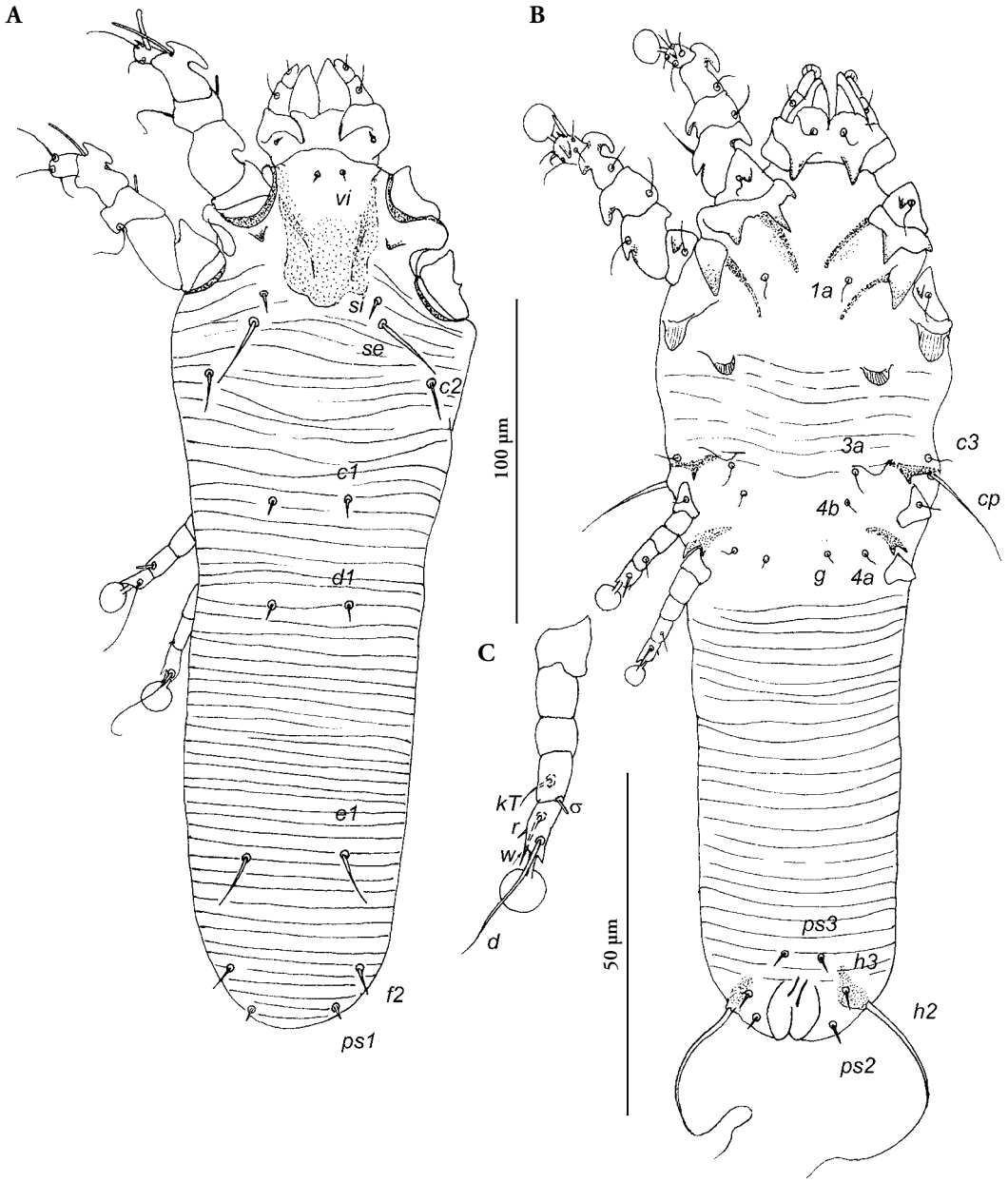

Fig. 20. *Galagalges congolensis*, male. – A, leg I in dorsal view; B, sketch of tarsi I in dorsal view; C, same in ventral view; D, leg II in dorsal view; E, leg III in ventral view; F, leg IV in dorsal view.

less than 30 long; setae *c1* and *d2* situated off hysteronotal shield; setae *h1* 30–40 long; hysteronotal shield covered by transverse striations only in posterior part; anterior margin of hysteronotal shield with wide median incision reaching level of setae *d1*; anal area surrounded by indistinct protuberances; opisthosomal lobes short; opisthosomal cleft less than 10 long ..... *G. brevisetosus*

7. Both sexes: propodonotal shield without arch-like fold in median part; striations between dorsal shields without verrucae. Male: propodonotal shield with elevations in median part; adanal shields fused to each

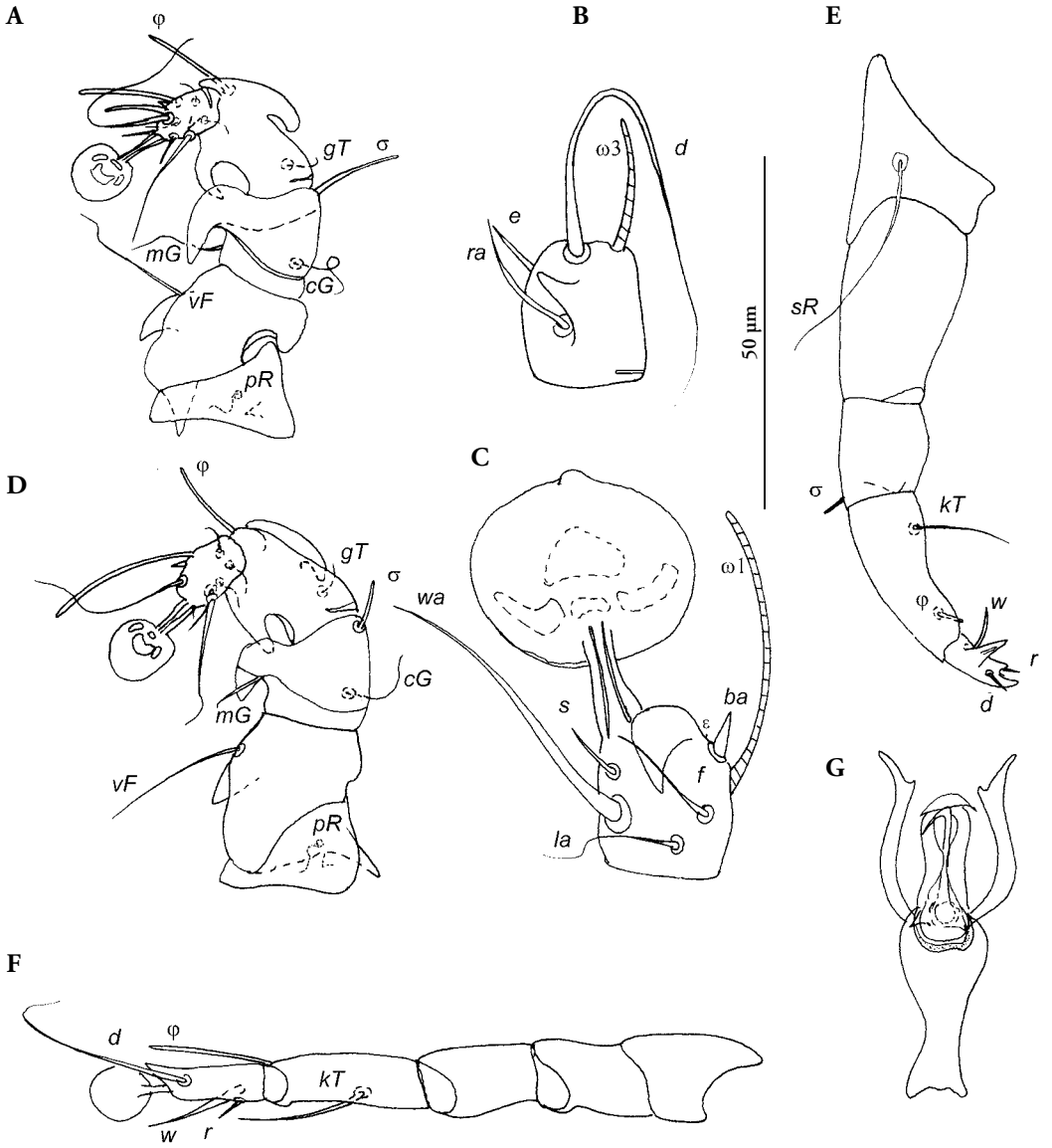

Fig. 21. *Galagalges congolensis*, tritonymph. – A, dorsal view; B, ventral view. Protonymph, C., leg IV in dorsal view. Scale bars: 100 µm for A-B, 50 µm for C.

other anteriorly; spurs on genu and tibia I–II weakly developed. Female: epigynum situated between levels of coxal fields II and III, bearing 2 pairs of genital papillae 8

– Both sexes: propodonotal shield with arch-like fold in median part; striations between dorsal shields with verrucae. Male: adanal shields separated from each other or jointed by narrow sclerotized band; spurs on genu and tibia I–II distinct. Female: Epigynum situated between levels of coxal fields I and II, genital papillae located posterior to epigynum . . . . . *G. caparti*

8. Ventral spurs of coxal fields I–II 10–11 long in males and about 9 long in females . . . . . *G. propitheci* (Figs 9–11)

– Ventral spurs of coxal fields I–II 17–18 long in males and about 18 long in females . . . . . *G. haymani*

9. Male: median area of hysteronotal shield

without ornamentation; tibia III with dorso-apical projection. Female: epigynum moderately developed, located between coxal fields I; tarsi III and IV without ventral projections ... *Lemuralges* (*L. intermedius*) (Figs 5–8)

– Male: hysteronotal shield completely ornamented; tibia III without dorso-apical projection. Female: epigynum large, located between coxal fields II; tarsi III and IV with ventral projections ..... *Daubentonialges* (*D. brygooi*) (Figs 12–15)

Acknowledgements

We thank Drs. Serge V. Mironov (Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia), Jacek Dabert (Adam Mickiewicz University, Poznan, Poland) and an anonymous referee for critical reading of the manuscript and valuable suggestions. We are deeply indebted to Dr. Barry M. OConnor (UMMZ), who made his material available to us. This research was supported by a grant from the Russian Foundation for Basic Research (RFFI N 08–04 00754_a) and by a grant from the European Distributed Institute of Taxonomy (EDIT) to AVB; by a grant from the National Science Foundation, US (DEB-0613769) to PBK.

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Received: 23 November 2009
Accepted: 16 March 2010

Book reviews

continued from page 212

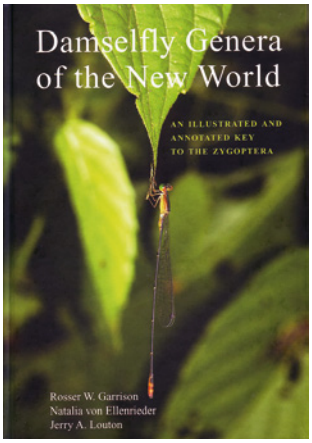
References to the website, where spread adult specimens are figured, cannot fill this gap, because not all morphological details can be seen on these pictures, even if they are very nice and sharp.

It is furthermore rather inconvenient and impractical to work at a computer screen and handling minute specimens under a microscope at the same time. The only colour photographs in this book are printed on the (identical) flyleaves, though one might have doubled the amount of species pictured by using a different set of specimens on both plates.

The book is well printed, but in a next edition the general layout should certainly be improved. One would hope that also many pictures could be added to the keys to genera and species.

Willy De Prins

R.W. Garrison, N. von Ellenrieder & J.A. Louton, 2010. **Damselfly genera of the New World. An illustrated and annotated key to the Zygoptera.** – The Johns Hopkins University Press, Baltimore: i-xiv + 1-490, 2586 figs + 24 colour plates. Price USD 65.00.



The study of the diversity of Odonata has made very significant progress during the last decades, and the results are the basis of new studies focusing on the reconstruction of the phylogeny and historical biogeography of dragonflies. Central and South America are regions from which many new taxa have been described recently, mainly, but not exclusively, of damselflies (suborder Zygoptera). The authors of the present book have contributed with a long series of papers since the 1980s, each typically including a careful revision of a genus or group of related genera. The fauna of Nearctic region is, as usual, much better known, and handbooks and field guides to smaller or larger areas of North America have become available since the 1990s. With about 1730 species in 207 genera, and many species still undescribed, identification of damselflies of the Neotropical region is still a difficult task for all entomologists without a reference collection. The present book intends to fill the gap of a reference work for the New World. It is the companion volume of a similar book on the dragonflies (suborder Anisoptera), published by the Johns Hopkins Press in 2006.

The book is, as promised in the title, an illustrated and annotated key to the genera of damselflies. The keys are relatively easy to use. The couplets are placed next to each other, and both alternatives of characters used are illustrated, and the characters are clearly indicated in the drawings. Illustrations of scanned wings, and a wide variety of line drawings of structures such as head in dorsal view, mesepisternum, last abdominal segments of females in lateral view, and the anal appendages of males of many species, all accurately depict relevant diagnostic characters. The genera are all treated in a fixed text-format, with type species, list of species included (original genus given if different), references, distribution (with map), generic diagnosis, status of classification, potential for new species, and habitat. Diagnostic characters of all species of many genera are illustrated, so identification to species level is frequently possible, even though no species descriptions are provided. The origin of all specimens illustrated is documented in a separate list of figures (p. 437–482). The distribution of each genus per country is also provided in a table (p. 430–435), and there is an appendix with additions and corrections for the Anisoptera volume. Of course, also this volume is not without errors. Going through my own database of the Odonata of the world (included in the Catalogue of Life), I found missing species (e.g., on p. 328 *Tuberculobasis williamsoni* Machado, 2009, or misspellings in names (e.g., on p. 213 *Agrion fummipenne* [*fumipenne*]; on p. 391 *Mecistogaster jocaste vicentius* [*vincentius*]), but such errors do not influence the usefulness of the book.

This is a remarkable piece of work. Odonatologists shall be grateful to the authors of this indispensable reference work. The quality of printing is high, and the price reasonable. Highly recommended.

Jan van Tol