

Systematic review of feather mites of the genus *Sturnotrogus* MIRONOV, 1989 (Astigmata: Pteronyssidae) from starlings (Passeriformes: Sturnidae) in Africa and Europe

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Abstract

We present an improved diagnosis of the genus *Sturnotrogus* MIRONOV, 1989 and a key and diagnoses to species detected or potentially expected on starlings (Sturnidae) in Africa and Europe. Two species groups, *truncatus* and *subtruncatus*, are recognized within the genus. Five new species of the genus *Sturnotrogus* are described from starlings in Africa: *Sturnotrogus acridotheres* sp. n. from *Acridoteres tristis* (LINNAEUS, 1766), *S. lamprotornis* sp. n. from *Lamprotornis splendidus* (VIEILLOT, 1822) (type host), *L. chalcurus* NORDMANN, 1835, *L. chalybaeus* (HEMPRICH & EHRENBERG, 1828), *L. iris* (OUSTALET, 1879), *L. nitens* (LINNAEUS, 1766), *L. purpuropterus* RUPPELL, 1845, *L. corruscus corruscus* NORDMANN, 1835, *L. chloropterus elisabeth* (STRESEMANN, 1924), *S. onychognathi* sp. n. from *Onychognathus morio* (LINNAEUS, 1766), *S. poeopterae* sp. n. from *Poeoptera lugubris* BONAPARTE, 1854, and *S. superbus* sp. n. from *Lamprotornis superbus* RUPPELL, 1845.

Host associations of the genus *Sturnotrogus* are summarized and briefly discussed. Representatives of the *truncatus* species group are associated with starling species distributed in Europe, Africa, and Central and Oriental Asia; species of the *subtruncatus* group occur on starlings and fan-tailed flycatchers of the genus *Rhipidura* VIGORS & HORSFIELD, 1827 (Rhipiduridae) in the Indo-Malayan region. It is hypothesized that Sturnidae are the original hosts of the genus *Sturnotrogus*, while Rhipiduridae are the secondary hosts.

Key words: Pteronyssidae, *Sturnotrogus*, systematics, host associations, Sturnidae.

Introduction

Feather mites of the family Pteronyssidae (Astigmata: Analgoidea), which currently includes over 150 species in 23 genera (FACCINI & ATYEO, 1981; GAUD & ATYEO, 1996; MIRONOV, 2001, 2005; MIRONOV & WAUTHY, 2005a), are mainly distributed on birds from the orders Passeriformes and Piciformes, with only a few species recorded from the Coraciiformes. As highly specialized permanent ectoparasites inhabiting plumage, pteronyssids are typical representatives of the feather mite morphotype adapted to inhabit vanes of large feathers. Within this family, the genus *Sturnotrogus* MIRONOV, 1989 is one of ten pteronyssid genera restricted to Passeriformes (FACCINI & ATYEO, 1981; MIRONOV, 2001). Up to now, this genus included eight species known from passerines from two avian families, six from starlings (Sturnidae) and two from fan-tailed flycatchers (Rhipiduridae). In

general appearance, representatives of the genus *Sturnotrogus* are medium-sized pteronyssids (adults about 300-500 µm in length) with relatively well-developed dorsal shields. Mites of this genus are commonly located on ventral surface the vanes of the primary flight feathers.

The genus *Sturnotrogus* was originally established (MIRONOV, 1989) for six species removed from the polyphyletic genus *Pteronyssoides* HULL, 1931, which even after the generic revision of Pteronyssidae (FACCINI & ATYEO, 1981) continued to incorporate almost all pteronyssids with free epimerites I in both sexes. At present, among pteronyssid genera restricted to passeriforms, the five genera, *Mouchetia* GAUD, 1961, *Pteronyssoides*, *Scutulanyssus* MIRONOV, 1985, *Sturnotrogus*, and *Timalinyssus* MIRONOV, 2001, constitute the *Pteronyssoides* generic group, which is characterized by free epimerites I. Within this group, *Sturnotrogus* is differentiated by the following combination of features: in males, the opisthosomal lobes are short and wide and are truncated apically, the terminal cleft is not expressed, and the opisthosomal membrane is a narrow entire band on the posterior margin of opisthosoma (between bases of setae *ps*₂); in females, the lateral sclerites (fragments of hysteronotal shield) are always clearly outlined and have a lanceolate form, the opisthosomal sclerite is a large unpaired plate or (if this sclerite is not split from the hysteronotal shield) the opisthosomal area of the hysteronotal shield is not dissected medially. Regarding the status of the genus, in the review of supraspecific feather mite taxa of the world by GAUD & ATYEO (1996), *Sturnotrogus* was decreased in rank and treated as a subgenus of the genus *Scutulanyssus*. We suggest that the decreasing of rank and inclusion into *Scutulanyssus* are groundless, because the authors of that review did not take into consideration the general structure of the female hysteronotal shield for determination of pteronyssid genera. In contrast to most feather mite families, the structure of the female hysteronotal shield varies greatly among different groupings of Pteronyssidae, and the general arrangement and form of hysteronotal shield fragments may be used for quite clear diagnoses of pteronyssid taxa at the generic rank (MIRONOV, 2001; MIRONOV & WAUTHY, 2005a; MIRONOV & GALLOWAY, 2006).

The two initially discovered species of *Sturnotrogus* were described by TROUSSERT (1885) in the context of the genus *Pteronyssus* ROBIN, 1877: *Pteronyssus truncatus* TROUSSERT, 1885 was described from the common starling, *Sturnus vulgaris* (LINNAEUS, 1758) in Europe, and *Pteronyssus subtruncatus* TROUSSERT, 1885 from the hill myna, *Gracula religiosa* (LINNAEUS, 1766), in Indonesia. For over 80 years, experts recognized only these two pteronyssid species on starlings. HULL (1931; 1934) placed these species in the genus *Pteronyssoides*, which was established for pteronyssids with free epimerites I. GAUD and co-authors (GAUD & MOUCHET, 1959; GAUD & TILL, 1961; GAUD, 1977) reported "*Pteronyssoides subtruncatus*" from two starling species, *Acridotheres tristis* (LINNAEUS, 1766) and *Poeoptera lugubris* BONAPARTE, 1854 in Africa; however, these authors actually dealt with new species (see remarks for new species from each respective host). Later, GAUD (1968) described two species from Rennell Island, one from the Rennell starling, *Aplonis insularis* MAYR, 1931, and one from the Rennell fan-tailed flycatcher, *Rhipidura rennelliana* MAYR, 1931 (Rhipiduridae). The latter case represented the first record of *Sturnotrogus* species from rhipidurids. Finally, three more species were described from starlings, two from Asia (MIRONOV, 1987, 1989) and one from Africa (MIRONOV & KOPIJ, 2000), and one more species was found on rhipidurids in Vietnam (MIRONOV, 1993).

In the course of our investigations of feather mites associated with African passerines (MIRONOV & WAUTHY, 2005a-d, 2006a-c), we detected five new *Sturnotrogus* species on starlings and re-examined most material of this genus used by previous experts. In the present paper, we give an emended diagnosis of the genus *Sturnotrogus* and a systematic review of all species associated with starlings in Africa and Europe, including descriptions of new species. We also include in the review those *Sturnotrogus* species that have not yet been formally recorded from these continents but whose presence is quite expected, because their common hosts do occur in these areas.

Material and methods

The material used in the present study was received from three main sources: Musée royal de l'Afrique centrale (Tervuren, Belgium), Institut royal des Sciences naturelles de Belgique (Brussels, Belgium), and Zoological Institute of the Russian Academy of Sciences (St. Petersburg, Russia). Some type specimens and comparative materials were loaned from the Muséum national d'Histoire naturelle (Paris, France) and A. Mickiewicz University (Poznan, Poland).

An emended diagnosis of the genus and descriptions of new species are given in the standard form used for pteronyssid taxa (FACCINI & ATYEO, 1981; MIRONOV, 1992, 2001). The general morphological terms, and leg and idiosomal chaetotaxy follow GAUD & ATYEO

(1996). Regarding the terms used for hysteronotal shield fragments in females, we generally follow the scheme proposed by MIRONOV (1992) and MIRONOV and WAUTHY (2005a).

All measurements in the descriptions are given in micrometres (μm). A full set of measurements is given only for the holotype (male) and one paratype (female); the range of idiosomal size (length, width) is displayed for the rest of the paratype specimens.

Measuring technique for particular structures:

- (i) distance between different pairs of setae is the shortest distance between the transverse levels formed by setae of respective pairs;
- (ii) prodorsal shield length is measured along midline, and width is greatest width at posterior margin;
- (iii) hysterosoma is measured from the level of sejugal furrow to bases of setae *h3*;
- (iv) hysteronotal shield length in males is the greatest length from the anterior margin to bases of setae *h3*; width is measured at anterior margin;
- (v) distance between prodorsal and hysteronotal shield in both sexes and the length of transventral sclerite in males are measured along midline;
- (vi) central sclerite length in females is the greatest length; width is measured at anterior margin.

Specimen depositories and reference accession numbers are given using the following abbreviations: AMNH – American Museum of Natural History, New York, USA; AMU – A. Mickiewicz University, Poznan, Poland; GAUD - uncatalogued collection of Prof. J. GAUD in Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia; IRSNB – uncatalogued collection of Prof. A. FAIN, Institut royal des Sciences naturelles de Belgique, Brussels, Belgium; MRAC - Musée royal de l'Afrique centrale, Tervuren, Belgium; NU – Nebraska University, Lincoln, USA; TRT – Collection of E. TROUSSERT in Muséum national d'Histoire naturelle, Paris, France; UGA - University of Georgia, Athens, USA; ZISP – Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia. Where the collection number consists of two sections, the first section refers to the collection number of the mite specimen and its depository (if another depository is not specifically mentioned); the second is a collection number of the respective host specimen. Location data are given in their original form, as on slide specimens; where the country name or important location in the original label was missed, it is added to collection data text in rectangular brackets. Systematics and scientific names of birds follow DICKINSON (2003).

Taxonomy

Pteronyssidae Oudemans, 1941 ***Sturnotrogus* MIRONOV, 1989**

TYPE SPECIES: *Pteronyssus truncatus* TROUSSERT, 1885.

DIAGNOSIS: *Both sexes:* Epimerites I free. Unpaired seta *vi* present. Prodorsal shield as narrow trapezoid, extending beyond row of scapular setae, not encompassing setae *c1*; scapular setae *se* in lateral incisions of the shield (Figs. 1A, 3A). Setae *c2* hair-like, short, length less than half the distance between setae *se*. Setae *c3* lanceolate, spiculiform, or setiform (Figs. 2C, 5D, 6D). Setae *dp2* of palps hair-like, simple. Setae *ba* of tarsi I-II hair-like, short. Genual solenidion $\sigma 1$ longer than tarsal solenidion $\omega 1$ on legs I; genual solenidion $\sigma 2$ absent. Tarsus III with 5 setae. Ventral membrane of tarsus I about 1/2- 2/3 of the length of the segment. Surface of coxal fields I, II covered with striated tegument.

Male: Opisthosomal lobes short and wide, truncate or bluntly rounded. Posterior margin of opisthosomal lobes between bases of setae *ps2* with narrow entire opisthosomal membrane; free margin of the membrane straight or shallowly concave or with small median incision, but membrane is never interrupted (Figs. 2A, B, 4C, 12C). Terminal cleft not expressed. Supranal concavity short, open posteriorly. Setae *c2* in antero-medial angle of humeral shields or mesal to it (Figs. 1A, 4A). Setae *ps1* anterior to or at the level of setae *h3*. Hysteronotal shield without sclerotized ridges; anterior angles acute or blunt-angular. Coxal fields III open. Transventral sclerite and epiandrium present. Epiandrium usually horseshoe-shaped and fused with posterior margin of transventral sclerite; branches of epiandrium encompass genital apparatus. Anal discs circular, large, with finely striated membrane. Adanal shield represented by pair of poorly sclerotized plates or absent. Adanal membranes present. Setae *h3* long setiform comparable in length to setae *h2*. Tarsus III elongated, slightly curved, commonly with claw-like apex. Setae *r* longer than tarsus III, seta *w* spiculiform, seta *s* narrowly lanceolate or spiculiform, seta *f* thickened (Figs. 2G, H). Tarsus IV without dorsobasal spine, longer than tibia IV; setae *d*, *e* modified into barrel-shaped suckers (Fig. 2I).

Female: Idiosoma moderately elongated, without opisthosomal lobes. Arrangement of hysteronotal shield fragments in one of two patterns: (1) large approximately rectangular central sclerite, pair of lateral opisthosomal sclerites and large unpaired opisthosomal sclerite (*truncatus* group) (Fig. 3A); (2) main body of hysteronotal shield entire, i.e. not split into central sclerite and opisthosomal sclerite, lateral sclerites completely or incompletely split from hysteronotal shield (*subtruncatus* group) (Fig. 13D). Lateral sclerites always lanceolate in form, in most known species (except for *S. subtruncatus*) clearly separated from the main body of hysteronotal shield. Hysteronotal gland openings *gl* on anterior end of lateral sclerites. Epigynum bow-shaped or semicircular, with pair of short lateral extensions, tips of epigynum not touching epimerites IIIa; sclerotized folds of oviporus short (Fig. 3B). External copulatory tube absent.

HOSTS: Passeriformes: Sturnidae and Rhipiduridae.

SPECIES INCLUDED: The genus includes 13 species arranged in two species groups based on the structure of the hysteronotal shields in males and females (see Table 1 and diagnoses of species groups).

REMARK: The genus *Sturnotrogus* is most similar to the genus *Scutulanysus*, and differs from it by the following combination features: in males, the opisthosomal lobes are truncated apically, terminal cleft is not expressed, and the opisthosomal membrane is a narrow entire band on the posterior margin of opisthosoma between bases of setae *ps2*; in females, the lateral opisthosomal sclerites are always clearly outlined and have a lanceolate form, the opisthosomal sclerite is a large unpaired plate, or (if this sclerite is not split from the hysteronotal shield) the opisthosomal area of hysteronotal shield is not dissected medially. In the males of *Scutulanysus*, opisthosomal lobes have a clearly convex posterior margin, terminal cleft is small but clearly expressed, opisthosomal membrane is present only on terminal margin of lobes and interrupted in terminal cleft; in the females, opisthosomal sclerites are paired or (if this fragment is not split from the hysteronotal shield) the opisthosomal part of hysteronotal shield has a deep median incision, lateral sclerites are of irregular form, separated or fused with opisthosomal sclerites.

Key to African and European species of *Sturnotrogus*

Females

1. Opisthosomal shield not separated from the main body of hysteronotal shield (*subtruncatus* group) (Fig. 13D) *S. subtruncatus* (TROUESSART, 1885)
 - Hysteronotal shield separated by transverse band of soft striated tegument into central sclerite and opisthosomal sclerite (*truncatus* group) (Fig. 3A) 2
2. Central sclerite noticeably elongated, 2-2.5 times longer than wide at anterior margin (Fig. 3A, 13B, C) 3
 - Central sclerite 1.5-1.8 times longer than wide at anterior margin (Figs. 8A-C) 5
3. Central sclerite approximately 2.2-2.5 times longer than wide (Figs. 3A, 13C); length of idiosoma longer, 415-450. 4.
 - Central sclerite approximately 2 times longer than wide (Fig. 13B); length of idiosoma shorter, 360-405 *S. superbis* sp.n.
4. Posterior margin of opisthosoma between setae *h3* with sclerotized median extension; setae *c3* lanceolate, wide, 22-30 x 6.5-7 (Figs. 3A, B)
 - *S. truncatus* (TROUESSART, 1885)
 - Posterior margin of opisthosoma without median sclerotized extension; setae *c3* narrowly lanceolate, with thin acute apex, 35-45 x 3-3.3 (Figs. 13C) *S. creatophorae* MIRONOV & KOPIJ, 2001
5. Anterior angles of central sclerite not extended laterally (Fig. 8B) *S. lamprotornis* sp. n.

- Central sclerite with anterior angles extended laterally (Figs. 8A, C, D) 6
- 6. Anterior angles of central sclerite acute. Setae *el* approximately at the transverse level of openings *gl* (Fig. 8D) *S. pastoris* (MIRONOV, 1987)
- Anterior angles bluntly rounded, often with irregular margin. Setae *el* distinctly posterior to the level of openings *gl* (Figs. 8A, 13A) 7
- 7. Setae *c3* distinctly lanceolate, wide, 25-30 x 6-6.5. Openings *gl* closer to level of setae *d2* than to level of setae *el* (Fig. 8A) *S. acridotheres* sp. n.
- Setae *c3* spiculiform or narrowly lanceolate with very thin apex, 38-55 x 3-3.5. Openings *gl* closer to level of setae *el* than to level of setae *d2* (Fig. 8C) 8
- 8. Lateral sclerites narrow, 3-3.5 times longer than wide. Anterior margin of opisthosomal sclerite straight (Fig. 8C). Idiosoma longer, 425-475. *S. onychognathi* sp. n.
- Lateral sclerites noticeably thickened in anterior part because of strongly convex inner margin, 2-2.5 times longer than greatest wide. Anterior margin of opisthosomal sclerite concave (Fig. 13A). Idiosoma shorter, 355-375 *S. poeopterae* sp. n.

Males

1. Idiosoma wide and short, approximately 1.2-1.3 times longer than wide. Anterior angles of hysteronotal shield blunt-angular. Gland furrows clearly demark antero-lateral fragments from the main body of hysteronotal shield. Opisthosomal membrane with small median incision (Figs. 12A-C). (*subtruncatus* group) *S. subtruncatus* (TROUESSART, 1885)
- Idiosoma relatively elongated, 1.4-2 times longer than wide. Anterior angles of hysteronotal shield acute. No pieces separated or demarked from antero-lateral parts of hysteronotal shield. Opisthosomal membrane with straight or slightly concave margin (Figs. 1A, 4A, 5A). (*truncatus* group) 2
2. Setae *c3* distinctly lanceolate and relatively wide and short, 25-30 x 5-6.5 (Figs. 2C, 4D) 3
- Setae *c3* spiculiform or narrowly lanceolate, 35-55 x 2.5-3.5 (Figs. 5D, 6D) 4
3. Bases of setae *ps3* not surrounded by small triangular sclerites. Setae *cl* approximately equidistant from prodorsal and hysteronotal shields or close to posterior margin of prodorsal shield. Seta *s* of tarsus III clearly extends beyond apex of the segment. Idiosoma noticeably elongated, 1.6-1.85 longer than wide (Figs. 1A, B, 2B, G, H) *S. truncatus* (TROUESSART, 1885)
- Bases of setae *ps3* on small triangular sclerites. Setae *cl* closer to anterior margin of hysteronotal shield than to prodorsal shield. Seta *s* of tarsus III scarcely extending beyond apex of the segment. Idiosoma 1.4-1.5 times longer than wide (Figs. 4A-E) *S. acridotheres* sp. n.
4. Anterior angles of hysteronotal shield strongly elongated; anterior margin of this shield deeply concave. Seta *s* of tarsus III situated on inner margin of the segment (Figs. 7A, E, 11A, E) 5
- Anterior angles of hysteronotal shield acute but not elongated; anterior margin of this shield straight or slightly concave. Seta *s* of tarsus III situated on ventral surface of the segment, noticeably distant from inner margin (Figs. 5A, E, F) 6
5. Lateral margins of hysteronotal shield with small irregular incisions at level of setae *cp*; setae *ps3* commonly on small sclerites (Figs. 7A, C) *S. pastoris* (MIRONOV, 1987)
- Lateral margins of hysteronotal shield without incisions; setae *ps3* commonly on soft tegument (Figs. 11A, C) *S. creatophorae* MIRONOV & KOPIJ, 2000
6. Length of idiosoma 340-370; width of opisthosoma (distance between setae *ps2*) 100-110 7
- Length of idiosoma 275-320; width of opisthosoma 65-75 8
7. Posterior margin of opisthosomal membrane straight. Opisthosoma with almost rectangular posterolateral angles. Setae *c3* shorter, 45-50 in length (Figs. 5A-F) *S. lamprotornis* sp. n.
- Posterior margin of opisthosomal membrane shallowly concave. Opisthosoma with rounded posterolateral angles. Setae *c3* longer, 55-60 in length (Figs. 6A-F) *S. onychognathi* sp. n.
8. Tips of epiandrium commonly extend to level of setae *4a* (Fig. 9B). Adanal membranes without sclerotized rib (Fig. 9C) *S. poeopterae* sp. n.
- Tips of epiandrium not extending to level of setae *4a* (Fig. 10B). Adanal membranes with sclerotized rib (Fig. 10C) *S. superbus* sp. n.

Group *truncatus*

DIAGNOSIS: In male, hysteronotal shield with acute anterior angles (Figs. 1A, 7A, 11A); in female, central and opisthosomal sclerites are clearly separated, lateral sclerites lanceolate in form and always clearly separated from the main body of hysteronotal shield (Figs. 3A, 8A-D, 13A-C).

Included species: *Sturnotrogus acridotheres* sp. n., *S. creatophorae* MIRONOV & KOPIJ, 2000, *S. lamprotornis* sp. n., *S. minimus* MIRONOV, 1989, *S. onychognathi* sp. n., *S. pastoris* (MIRONOV, 1987), *S. poeopterae* sp. n., *S. superbus* sp. n., and *S. truncatus* (TROUESSART, 1885),

1. *Sturnotrogus truncatus* (TROUESSART, 1885) (Figs. 1A, B, 2A-L, 3A, B)

Pteronyssus truncatus TROUESSART, 1885: 49; CANESTRINI, 1886: 272; CANESTRINI & KRAMER, 1899: 80; VITZTHUM, 1929: 97; RADFORD, 1958: 157.

Pteronyssus quadratus var. *truncatus*: BERLESE, 1886: fasc. 26, No. 3; BONNET & TIMON-DAVID, 1934: 258.

Pteronyssoides truncatus: HULL, 1934: 202, RADFORD, 1953: 205; GAUD & TILL, 1961: 276; FACCINI & ATYEO, 1981: 54.

Pteronyssoides (Scutulanysus) truncatus: MIRONOV, 1985: 202, Fig. 16g, 17g, 18g.

Sturnotrogus truncatus: MIRONOV, 1989: 120, Fig. 12, 1-3.

MATERIAL EXAMINED: 2 male, 2 female syntypes (TRT 41F1) ex *Sturnus vulgaris* LINNAEUS, 1758, [France], Maine et Loire, no other data; 3 males, 3 females (GAUD), same host, [France], Rennes, XII.1969, coll. unknown; 3 males, 4 females (GAUD), same host, The Netherlands, X.1953, coll. unknown; 3 males (AMU 032, slides A, B), same host, Poland, Slonsk, 1.VII.1983, coll. J. Dabert; 2 males, 2 females (AMU, no number), same host, Poland, near Poznan, Jezioro, 22.V.2002, coll. unknown; 15 males, 18 females, (ZISP 1466), same host, Russia, Kaliningrad Province, Rybachy, 16.X.1979, S.V. Mironov; 4 males, 4 females (ZISP 1465), same host, Russia, Leningrad Province, Gumbaritsy, 2.X.1981, S.V. Mironov; 10 males, 8 females (ZISP 1467), same host, Russia, [Astrakhan Province], Volga delta, Damchik, 13.III.1940, V. Dubinin; 4 males, 3 females (ZISP 1463), same host, Russia, Novosibirsk Province, Chany Lakes, no date, B. Bykhovskiy; 10 males, 12 females (ZISP 1830), same host, Russia, [Primorye, Khankajskii District], Gornokhankajsk, 25.V.1954, L. Mulyarskaya; 1 male, 2 females (ZISP 1459), same host, Kazakhstan, North Kazakhstan Province, Konyukhovskii District, 15.IX.1951, Bezukladnikov; 12 males, 8 females (ZISP 1832), same host, Tadzhikistan, Tigrovaya Balka reserve, 22.XII.1940, E. Sosnina; 3 males, 2 females (MRAC 180 397), same host, Morocco, Rabat, XII.1966, R. Dupuy; 6 males, 5 females (MRAC 180 401 and 180 402), same host, Morocco, Christian, I.1949, coll. unknown; 5 males, 6 females (MRAC 180 398 and 180 399) ex *St. unicolor* TEMMINCK, 1820, Morocco, Hazagan, VII.1950, coll. unknown; 3 males, 3 females (MRAC 180 400), same host, Morocco, Fes, I.1949, coll. unknown.

DIAGNOSIS: *Both sexes*: setae *c3* distinctly lanceolate 22-30 x 6.5-7 (Fig. 2C). *Male*: Hysteronotal shield without incision on lateral margin, anterior angles acute but not elongated, opisthosomal lobes truncate, margin of opisthosomal membrane straight, without incisions, setae *ps3* on soft tegument, adanal membranes with sclerotized rib (Figs. 1A, B, 2A, B), idiosoma 330-380 long, 1.7-1.85 longer than wide, width of opisthosoma (distance between setae *ps2*) 80-90. *Female*: Hysteronotal shield split into central and opisthosomal sclerites, central sclerite 2.2-2.5 longer than wide and its anterior angles not extended (Fig. 3A), anterior margin of opisthosomal sclerite slightly concave, lateral sclerites narrow (3 or more times longer than wide), openings *gl* much closer to the level of setae *e1* than to level of setae *d2*, idiosoma 435-480 long, 1.9-2.1 longer than wide.

REMARK: *Sturnotrogus truncatus*, the type species of the genus, was originally described from the common starling *St. vulgaris* in France (TROUSSERT, 1885); now it is widely known from this host in numerous locations

of Europe and Asia (TROUSSERT, 1885; CANESTRINI & KRAMER, 1899; VITZTHUM, 1929; HULL, 1934; DUBININ, 1950, DUBININ & SOSNINA, 1952; SHUMILO, 1960; GAUD & TILL, 1961; ČERNÝ, 1964; FACCINI & ATYEO, 1981, RAZOWSKI, 1997; MIRONOV, 1985, 1989, 1996, 1997), and also from individuals introduced to Canada (H.C. PROCTOR, personal communication). GAUD and PETITOT (1948) reported *S. truncatus* from the common myna, *Acridotheres tristis*, in Indochina, but after the examination of materials collected from that host in Saint Helene Island, GAUD (1977) referred mites associated with *A. tristis* to *S. subtruncatus*. Re-examination of materials from Saint Helene Island and Indochina shows that these authors actually dealt with a quite different *Sturnotrogus* species, which we describe below as a new species, *S. acridotheres*. GAUD & TILL (1961) also reported *S. truncatus* from *Ptilostomus afer* (LINNAEUS, 1766) (Corvidae) in Africa; however, this material actually also represented another new species (see *S. lamprotornis*). We suggest that *Sturnus vulgaris* and its close relative, the spotless starling *St. unicolor* (a newly recorded host), are original and principal hosts of *S. truncatus*.

2. *Sturnotrogus acridotheres* sp. n. (Figs. 4A-D, 8A)

Pteronyssoides truncatus: sensu GAUD & PETITOT, 1948: 339, Fig. 1, 2 (misidentification).

Pteronyssoides subtruncatus: sensu GAUD, 1977: 265 (misidentification).

TYPE MATERIAL: Male holotype, 2 male and 7 female paratypes (MRAC 129 080, 10 slides) ex *Acridotheres tristis* (LINNAEUS, 1766): ST. HELENE ISLAND: XII.1965, Belgian Zoological Mission, P. BASILEVSKY, P. BENOIT, and N. LELEUP.

OTHER MATERIAL EXAMINED: 5 males, 1 female (GAUD), ex *A. tristis*, [Cambodia], Siem Reap Province, VII.1946, J. Gaud; 8 males, 3 females (GAUD), same host, [Vietnam, Lam Dong Province, Di Linh District], Djiring, V.1946, J. Gaud.

DIAGNOSIS: *Both sexes*: setae *c3* clearly lanceolate, short, 25-30 x 6-6.5 (Fig. 4D). *Male*: Hysteronotal shield without incision on lateral margins, anterior angles acute but not extended, posterior margin of opisthosomal lobes truncate, opisthosomal membrane with small blunt-angular incision, setae *ps3* on small triangular sclerites, rib of adanal membranes poorly developed (Fig. 4C), idiosoma 340-350 long, 1.4-1.5 times longer than wide, width of opisthosoma 100-110. *Female*: Hysteronotal shield split into central and opisthosomal sclerites, central sclerite with anterior angles slightly extended and rounded, 1.1-1.2 times longer than wide, anterior margin of opisthosomal sclerite straight or slightly sinuous, lateral sclerites narrow, openings *gl* approximately equidistant from levels of setae *e2* and *e1* (Fig. 8A), idiosoma 415-450 long, 1.6-1.7 longer than wide.

DESCRIPTION: Male holotype: Idiosoma length x width 350 x 245 (340-345 X 215-225 in 2 paratypes). Length of hysterosoma 230. Prodorsal shield: posterior margin slightly convex, length along median line 94, width at posterior margin 112, setae *se* separated by 89 (Fig. 4A). Setae *c2* thin hair-like, situated mesal to anteromedian angle of humeral shields; setae *c3* lanceolate, 30 in length, 6.5 in width. Hysteronotal shield: anterior margin almost straight, length along midline 220, width 154. Distance between prodorsal and hysteronotal shields along midline about 30. Opisthosomal lobes truncate, terminal membrane with shallow median incision. Length of supranal concavity 32. Dorsal measurements: *c2:d2* 80, *d2:e2* 92, *d2:gl* 24, *gl:e1* 16-17, *e2:h3* 35, *e2:e2* 76, *h2:h2* 81, *h3:h3* 46. Transventral sclerite 11 in length along median line. Tips of epiandrium extending to base of genital apparatus; genital arch 28 x 16. Adanal shields as pair of poorly sclerotized plates. Setae *ps3* on small triangular sclerites. Adanal membranes with longitudinal sclerotized rib. Diameter of anal discs 22. Ventral measurements: *ps2:ps2* 102, *ps3:ps3* 38, *ps3:h3* 40. Tarsus III 60 long, setae *w* 33 long; setae *s* 20 long, not extending beyond apex of the segment. Tarsus IV subequal in length to tibia IV.

Female paratype: Idiosoma length x width 440 x 260 (in other 7 series 415-450 x 245-275). Length of hysterosoma 305. Prodorsal shield as in the male, 103 x 127, setae *se* separated by 102. Setae *c2* short hair-like, situated on striated tegument. Setae *c3* lanceolate 27 x 6.5. Arrangement of hysteronotal shield fragments: central sclerite, pair of lateral opisthosomal sclerites, and opisthosomal sclerite. Central sclerite with slightly extending anterior angles, length along midline 172, width at anterior margin 152. Lateral opisthosomal sclerites with rounded posterior end. Opisthosomal sclerite with almost straight anterior margin, posterior margin convex, poorly sclerotized, greatest length 86, greatest width 134. Posterior margin of opisthosoma between setae *h3* straight, without terminal extension. Setae *d2* on lateral margins of central sclerite, setae *e1* closer to the level of openings *gl* than to level of setae *d2*. Setae *ps1* approximately at the level of setae *h2*. Dorsal measurements: *c2:d2* 124, *d2:e2* 97, *d2:gl* 34, *gl:e1* 24, *e2:h3* 60, *h2:h2* 118, *h3:h3* 83. Epigynium bow-like, 32 x 108.

REMARK: The new species described above was previously recorded by GAUD & PETITOT (1948) as *Pteronyssoides truncatus* from the common myna, *Acridotheres tristis*, in Cambodia and Vietnam; further, GAUD (1977) detected this species from the same host on Saint Helene Island and re-identified all material from the common myna as *Pteronyssoides subtruncatus*. Re-examination of the materials of Gaud from Saint Helene Island and Indochina has shown that *A. tristis* actually bears a new species, which is quite different from true *S. subtruncatus*.

ETYMOLOGY: The specific epithet derives from the generic name of the type host and is a noun in a genitive case.

3. *Sturnotrogus lamprotornis* sp. n. (Figs. 5A-F, 8B)

TYPE MATERIAL: Male holotype and 3 female paratypes (MRAC 180 380) ex *Lamprotornis splendidus* (VIEILLOT, 1822): CAMEROON, 1959, collector unknown; 8 male and 8 female paratypes (MRAC 180 381, 180 382), same data.

OTHER MATERIAL EXAMINED: 7 males, 5 females (MRAC 180 374, 180 375) ex *L. chalcurus*, NORDMANN, 1835, Cameroon, Adomaoua, IV.1951, collector unknown; 1 male, 1 female (MRAC 180388) ex *L. chalybaeus* (HEMPRICH & EHRENBERG, 1828), Kenya, Njoro, VII.1964, collector unknown; 1 male, 3 females (MRAC 180392) ex *L. nitens* (LINNAEUS, 1766), South Africa, Cape Province, East London, X.1966, collector unknown; 2 males, 1 female (MRAC 147367, 3 slides) ex *L. splendidus*, Cameroon, Yaoundé 22.V.1959, collector unknown; 4 males, 2 females (MRAC 148138, 6 slides), same host, Cameroon, no other data; 7 males (IRSNB) ex *L. purpuropterus* RUPPELL, 1845, Rwanda, Akanyaru, 18.II.1955, A. Fain; 2 males (IRSNB), same data except 9.I.1955; 2 females (IRSNB), same data except 15.X.1955; 2 males, 2 females (NU 8267, deposited in ZISP) ex *L. iris* (OUSTALET, 1879), West Africa, Sierra Leone, 12.IX.1961, Fr. Allison; 1 male (UGA 3338 AMNH 210 863, deposited in ZISP) ex *L. corruscus corruscus* NORDMANN, 1835, Kenya, Saukuri, 10.III.1923, K. Caldwell; 1 female (UGA 3348 AMNH 668 723, deposited in ZISP) ex *L. chloropterus elisabeth* (STRESEMANN, 1924), Mozambique, N. Mozambique, Lalana, Suli river, 28.V.1925, H.C. Müller; 9 males, 3 females (MRAC 180 383 – 180 386, 4 sides) ex *Ptilostomus afer* (LINNAEUS, 1766) (Corvidae), Senegal, VI.1955, collector unknown.

DIAGNOSIS: Both sexes: setae *c3* spiculiform, 40-50 x 3-3.5 (Fig. 5D). **Male:** Hysteronotal shield without incision on lateral margins, anterior angles acute but not elongated, opisthosomal lobes truncate, margin of opisthosomal membrane straight, without incision, setae *ps3* on soft tegument, rib of adanal membranes poorly developed (Figs. 5A-C), idiosoma 340-370 long, 1.3-1.4 times longer than wide, width of opisthosoma 105-110. **Female:** Hysteronotal shield split into central and opisthosomal sclerites, central sclerite 1.4 times longer than wide, its anterior angles rectangular, not extended, anterior margin of opisthosomal sclerite concave, openings *gl* and setae *e1* approximately at the same transverse level, lateral sclerites with rounded posterior end (Fig. 8B), idiosoma 425-445 long, about 1.55-1.6 longer than wide.

DESCRIPTION: Male holotype: Idiosoma length x width 358 x 260 (340-370 x 245-280 in 8 paratypes). Length of hysterosoma 230. Prodorsal shield: posterior margin straight, length along median line 96, width at posterior margin 110, setae *se* separated by 84. Setae *c2* thin hair-like, situated mesal to anteromedian angle of humeral shields; setae *c3* spiculiform, 48 in length, 3.5 in width.

Hysteronotal shield: anterior margin slightly concave, greatest length 202, width 146. Distance between prodorsal and hysteronotal shields along midline about 60. Opisthosomal lobes truncate, terminal membrane with straight margin without any incision. Length of supranal concavity 35. Dorsal measurements: $c2:d2$ 71, $d2:e2$ 92, $d2:gl$ 35, $gl:e1$ 16-18, $e2:h3$ 46, $e2:e2$ 80, $h2:h2$ 87, $h3:h3$ 56. Transventral sclerite 13 in length along median line. Tips of epiandrium extending to base of genital apparatus; genital arch 27 x 14. Adanal shields as pair of poorly sclerotized plates. Setae $ps3$ on soft tegument. Adanal membranes with poorly developed sclerotized rib. Diameter of anal discs 23-24. Ventral measurements: $ps2:ps2$ 106, $ps3:ps3$ 42, $ps3:h3$ 53. Tarsus III 60 long; setae w 24 long; setae s , 21 long, situated on ventral side of the segment and not extending beyond its apex. Tarsus IV subequal in length to tibia IV.

Female paratype: Idiosoma length x width 442 x 285 (in other 10 paratypes 425-440 x 265-275). Length of hysterosoma 310. Prodorsal shield as in the male, 112 x 132, setae se separated by 104. Setae $c2$ short hair-like, situated on striated tegument. Setae $c3$ spiculiform, slightly thickened in medial part, 42 x 3.5. Arrangement of hysteronotal shield fragments: central sclerite, pair of lateral opisthosomal sclerites, and opisthosomal sclerite. Central sclerite roughly rectangular, anterior margin slightly narrower than posterior, length along midline 160, width at anterior margin 114. Lateral opisthosomal sclerites with rounded posterior end. Opisthosomal sclerite with slightly concave anterior margin, posterior margin convex, with pair of poorly sclerotized incisions, greatest length 88, greatest width 130 (Fig. 8B). Posterior margin of opisthosoma between setae $h3$ slightly convex. Setae $d2$ off lateral margins of central sclerite, setae $e1$ almost at the level of openings gl . Setae $ps1$ approximately at the level of setae $h2$. Dorsal measurements: $c2:d2$ 104, $d2:e2$ 121, $d2:gl$ 60, $gl:e1$ 9-10, $e2:h3$ 56, $h2:h2$ 120, $h3:h3$ 90. Epigynium bow-like, 28 x 102.

REMARKS: 1. In females collected from *Lamprotornis chloropterus* and *L. iris*, the anterior margin of opisthosomal sclerite is almost straight rather than in the type series and in specimens from remaining host species.

2. The material of *S. lamprotornis* from the piapiac, *Ptilostomus afer* (LINNAEUS, 1766) (Corvidae), in our opinion represents a case of accidental contamination. Based on this material, GAUD and TILL (1961) reported this species as *Pteronyssoides truncatus* from *Pt. afer* in Senegal.

ETYMOLOGY: The specific epithet derives from the generic name of the type host and is a noun in apposition.

4. *Sturnotrogus onychognathi* sp. n. (Figs. 6A-F, 8C)

TYPE MATERIAL: Male holotype (MRAC 180 395) ex *Onychognathus morio* (LINNAEUS, 1766), SOUTH AFRICA: Transvaal, IV.1972, collector unknown; female paratype (MRAC 180 394), same data.

OTHER MATERIAL EXAMINED: 3 males and 3 females (NU 3568) ex *O. morio*, South Africa: Transvaal, Potchefstroom, 1-6.IV.1953, F. Zumpt (material in ZISP).

DIAGNOSIS: *Both sexes*: setae $c3$ setiform, 50-58 x 2.5-3.5 (Fig. 6D). *Male*: Hysteronotal shield without incision on lateral margins, anterior angles acute, slightly elongated, opisthosomal lobes with slightly convex posterior margin, opisthosomal membrane with shallowly concave margin, setae $ps3$ on soft tegument, adanal membranes without rib, idiosoma 350-365 long, 1.3-1.4 times longer than wide, width of opisthosoma (distance between setae $ps2$) 105-112. *Female*: Hysteronotal shield split into central and opisthosomal sclerites, central sclerite 1.2-1.3 times longer than wide, its anterior angles slightly extended and rounded, anterior margin of opisthosomal sclerite straight, openings gl closer to the level of setae $e1$ than to the level of setae $d2$, lateral sclerites with rounded posterior end, idiosoma 425-472 long, about 1.55-1.6 longer than wide.

DESCRIPTION: *Male holotype*: Idiosoma length x width 360 x 265 (in 3 specimens of other series 350-365 x 260-275). Length of hysterosoma 230. Prodorsal shield: posterior margin almost straight, length along median line 96, width at posterior margin 103, setae se separated by 83. Setae $c2$ thin hair-like, situated slightly mesal to anteromedian angle of humeral shields; setae $c3$ setiform, 58 in length, 2.5 in width. Hysteronotal shield: anterior margin slightly concave, sinuous; greatest length 208, width 154. Distance between prodorsal and hysteronotal shields along midline about 55. Opisthosomal lobes slightly convex, terminal membrane with straight margin without any incision. Length of supranal concavity 32. Dorsal measurements: $c2:d2$ 81, $d2:e2$ 98, $d2:gl$ 27, $gl:e1$ 14-15, $e2:h3$ 38, $e2:e2$ 80, $h2:h2$ 94, $h3:h3$ 58. Transventral sclerite 15 in length along median line. Tips of epiandrium extending to base of genital apparatus; genital arch 28 x 16. Adanal shields as pair of poorly sclerotized plates. Setae $ps3$ on soft tegument. Adanal membranes without sclerotized rib. Diameter of anal discs 24. Ventral measurements: $ps2:ps2$ 110, $ps3:ps3$ 50, $ps3:h3$ 50. Tarsus III 58 long; setae w 26 long; setae s 21 long, situated on ventral side of the segment and not extending beyond its apex. Tarsus IV subequal in length to tibia IV.

Female paratype: Idiosoma length x width 472 x 290 (in 3 specimens of other series 425-430 x 260-275). Length of hysterosoma 330. Prodorsal shield as in the male, 112 x 132, setae se separated by 104. Setae $c2$ short hair-like, situated on striated tegument. Setae $c3$ setiform, slightly thickened, 54 x 3.5. Arrangement of hysteronotal shield fragments: central sclerite, pair of lateral opisthosomal sclerites, and opisthosomal sclerite. Central sclerite roughly rectangular, with slightly extending anterior angles, anterior margin straight, length along midline 165, width at anterior margin 140. Lateral opisthosomal sclerites with rounded posterior end. Opisthosomal sclerite with straight anterior margin, posterior margin with pair of poorly sclerotized areas, greatest length 100,

greatest width 144. Posterior margin of opisthosoma between setae *h3* straight. Setae *d2* off lateral margins of central sclerite, setae *e1* closer to the level of openings *gl* than to the level of setae *e2*. Setae *ps1* approximately at the level of setae *h3*. Dorsal measurements: *c2:d2* 122, *d2:e2* 112, *d2:gl* 56, *gl:e1* 14-16, *e2:h3* 64, *h2:h2* 150, *h3:h3* 100. Epigynium bow-like, 30 x 115.

ETYMOLOGY: The specific epithet derives from the generic name of the type host and is a noun in a genitive case.

Sturnotrogus pastoris (MIRONOV, 1987) (Figs. 7A-E, 8D)

Pteronyssoides (Scutulanyssus) pastoris MIRONOV, 1987: 529, Fig. 1.

Sturnotrogus pastoris: MIRONOV, 1989: 120, Fig. 12, 4-6.

MATERIAL EXAMINED: Male holotype, 2 male, 3 female paratypes (ZISP 926) ex *Sturnus roseus* (LINNAEUS, 1758): Kazakhstan: Djambul Province, Chokpak, 4.IX.1984, S.V. Mironov; 1 male, 1 female (ZISP 2612), same host, Tajikistan, Gissar Ridge, 6.VI.1951, L. Mulyarskaya; 1 male, 1 female (ZISP 2611), same host, Turkmenistan, near Ashkhabad, 11.V.1972, D. Kurbanova; 7 male, 4 female (ZISP 2613) ex *St. cineraceus* Temminck, 1835, Russia, Primorye, Sudzukhin Reserve, 16.IV.1945, coll. unknown.

DIAGNOSIS: *Both sexes*: setae *c3* narrowly lanceolate, 30-38 x 3-4 (Fig. 7D). *Male*: Hysteronotal shield commonly with small irregular incision on lateral margins, anterior angles acute and elongated, opisthosomal lobes with slightly convex posterior margin, opisthosomal membrane with slightly concave posterior margin bases of setae *ps3* on small sclerites, adanal membranes without rib, idiosoma 335-360 long, 1.5-1.6 longer than wide, width of opisthosoma (distance between setae *ps2*) 80-90. *Female*: Hysteronotal shield split into central and opisthosomal sclerites, central sclerite about 1.2-1.3 times longer than wide, its anterior angles extended and acute (angles may be split from the main part of central sclerite), lateral margins with small incision at level of trochanters III; anterior margin of opisthosomal sclerite straight or slightly sinuous, openings *gl* and setae *e1* almost at the same transverse level, lateral sclerites with acute posterior tip, idiosoma 430-445 long, about 1.7-1.8 longer than wide.

REMARK: This species is known only from two starling species, the rosy starling *St. roseus* (type host) and white-cheeked starling *St. cineraceus* TEMMINCK, 1835, in Central Asia and Primorye region (Russia), respectively (MIRONOV, 1987). Although this species has not been formally recorded from the territory of Africa and Europe, it is possible to expect it on the rosy starling in the southern and eastern parts of Europe and in northern Africa.

6. *Sturnotrogus poeopterae* sp. n. (Figs. 9A-F, 13A)

Pteronyssoides subtruncatus: sensu GAUD & MOUCHET, 1959: 513 (misidentification).

TYPE MATERIAL: Male holotype, 1 male and 3 female paratypes (MRAC 180 377) ex *Poeoptera lugubris* BONAPARTE, 1854: CAMEROON: Yaoundé, II.1956, coll. unknown; 2 male, 2 female paratypes (MRAC 180 376), same data.

DIAGNOSIS: *Both sexes*: setae *c3* setiform, 40-45 x 2.5-3.5 (Fig. 9D). *Male*: Hysteronotal shield without incision on lateral margins, anterior angles acute, slightly elongated, opisthosomal lobes with slightly convex posterior margin, opisthosomal membrane with shallow incision, idiosoma 275-285 long, 1.45-1.6 longer than wide, width of opisthosoma 65-70, setae *ps3* on soft tegument, adanal membranes without rib. *Female*: Hysteronotal shield split into central and opisthosomal sclerites, central sclerite 1.4-1.5 times longer than wide, its anterior angles slightly extended and rounded, anterior margin of opisthosomal sclerite concave, openings *gl* closer to the level of setae *e1* than to that of setae *d2*, lateral sclerites with acute posterior end, idiosoma 355-375 long, about 1.65-1.75 longer than wide.

DESCRIPTION: *Male holotype*: Idiosoma length x width 285 x 195 (275-285 x 170-185 in 3 paratypes). Length of hysterosoma 178. Prodorsal shield: posterior margin straight, length along median line 76, width at posterior margin 78, setae *se* separated by 63. Setae *c2* thin hair-like, situated mesal to anteromedian angle of humeral shields; setae *c3* thick setiform, 42 in length, 3.5 in width. Hysteronotal shield: anterior margin slightly concave, greatest length 160, width 115. Distance between prodorsal and hysteronotal shields along midline about 40. Opisthosomal lobes with slightly convex posterior margin, terminal membrane margin with shallow incision. Length of supranal concavity 27. Dorsal measurements: *c2:d2* 50, *d2:e2* 76, *d2:gl* 22, *gl:e1* 14-15, *e2:h3* 35, *e2:e2* 58, *h2:h2* 56, *h3:h3* 35. Transventral sclerite 9 in length along midline. Tips of epiandrium not extending to base of genital apparatus (left and right tips of epiandrium are unequal in length in the holotype and some paratypes); genital arch 20 x 10. Adanal shields as pair of poorly sclerotized plates. Setae *ps3* on soft tegument. Adanal membranes without sclerotized rib. Diameter of anal discs 15-16. Ventral measurements: *ps2:ps2* 65, *ps3:ps3* 23, *ps3:h3* 40. Tarsus III 46 long; setae *w* 23 long; setae *s* 16 long, situated on ventral side of the segment and slightly extended beyond its apex. Tarsus IV subequal in length to tibia IV.

Female paratype: Idiosoma length x width 365 x 215 (in 4 other paratypes 355-375 x 200-220). Length of hysterosoma 248. Prodorsal shield as in the male, 78 x 96, setae *se* separated by 76. Setae *c2* short hair-like, situated on striated tegument. Setae *c3* setiform, slightly thickened in medial part, 40 x 2.5. Arrangement of hysteronotal shield fragments: central sclerite, pair of lateral opistho-

somal sclerites, and opisthosomal sclerite. Central sclerite roughly rectangular, with slightly extending anterior angles, anterior margin straight, lateral margins with small incision at level of trochanters III, length along midline 140, width at anterior margin 95. Lateral opisthosomal sclerites with acute posterior end. Opisthosomal sclerite with slightly concave anterior margin, posterior margin concave and poorly sclerotized, greatest length 75, greatest width 115. Posterior margin of opisthosoma between setae *h3* concave. Setae *d2* on lateral margins of central sclerite, setae *e1* closer to the level of openings *gl*, than to the level of setae *e2*. Setae *ps1* approximately at the level of setae *h2*. Dorsal measurements: *c2:d2* 78, *d2:e2* 97, *d2:gl* 38, *gl:e1* 19-21, *e2:h3* 51, *h2:h2* 105, *h3:h3* 80. Epigynium bow-like, 26 x 86.

REMARK: This species was recorded by GAUD & MOUCHET (1959) under the name *Pteronyssoides subtruncatus* from *Poeoptera lugubris* in Cameroon.

ETYMOLOGY: The specific epithet derives from the generic name of the type host and is a noun in apposition.

7. *Sturnotrogus superbus* sp.n. (Fig. 10A-F, 13B)

TYPE MATERIAL: Male holotype, 2 male, 2 female paratypes (MRAC 180 390) ex *Lamprotornis superbus* RUPPELL, 1845: KENYA: Njoro, VI.1964, coll. unknown; 3 male, 3 female paratypes (MRAC 180 389), same data.

DIAGNOSIS: *Both sexes*: setae *c3* setiform or spiculiform, 40-45 x 2.5-3.5 (Fig. 10D). *Male*: Hysteronotal shield without incision on lateral margins, anterior angles acute, slightly elongated, opisthosomal lobes with slightly convex posterior margin, opisthosomal membrane shallowly concave, setae *ps3* on soft tegument, adanal membranes with poorly developed rib, idiosoma 285-320 long, 1.35-1.55 longer than wide, width of opisthosoma 70-75. *Female*: Hysteronotal shield split into central and opisthosomal sclerites, central sclerite about 2 times longer than wide, its anterior angles slightly extended and rounded, anterior margin of opisthosomal sclerite concave, openings *gl* closer to the level of setae *e1* than to that of setae *d2*, lateral sclerites with acute posterior end, idiosoma 360-405 long, about 1.65-1.8 longer than wide.

DESCRIPTION: *Male holotype*: Idiosoma length x width 315 x 215 (285-320 x 185-235 in 5 paratypes). Length of hysterosoma 198. Prodorsal shield: posterior margin straight, length along median line 86, width at posterior margin 82, setae *se* separated by 67. Setae *c2* thin hair-like, situated mesal to anteromedian angle of humeral shields; setae *c3* thick setiform, 45 in length, 2.5 in width. Hysteronotal shield: anterior margin slightly concave, greatest length 178, width 122. Distance between prodorsal and hysteronotal shields along midline about 60. Opisthosomal lobes with almost straight posterior margin, terminal membrane margin slightly concave. Length of supranal concavity 28. Dorsal measurements:

c2:d2 50, *d2:e2* 76, *d2:gl* 22, *gl:e1* 14-15, *e2:h3* 35, *e2:e2* 58, *h2:h2* 56, *h3:h3* 35. Transventral sclerite 11 in length along midline. Tips of epiandrium extending to midlevel of genital apparatus; genital arch 24 x 12. Adanal shields as pair of poorly sclerotized plates. Setae *ps3* on soft tegument. Adanal membranes with oblique sclerotized rib. Diameter of anal discs 18. Ventral measurements: *ps2:ps2* 72, *ps3:ps3* 36, *ps3:h3* 41. Tarsus III 48 long; setae *w* 26 long; setae *s* 20 long, situated on ventral side of the segment and slightly extended beyond its apex. Tarsus IV subequal in length to tibia IV.

Female paratype: Idiosoma length x width 375 x 210 (in 4 other paratypes 360-405 x 200-245). Length of hysterosoma 260. Prodorsal shield as in the male, 94 x 108, setae *se* separated by 84. Setae *c2* short hair-like, situated on striated tegument. Setae *c3* thin spiculiform, 40 x 2.5. Arrangement of hysteronotal shield fragments: central sclerite, pair of lateral opisthosomal sclerites, and opisthosomal sclerite. Central sclerite rectangular, elongated; anterior margin straight, anterior angles not extended, lateral margins slightly convex, length along midline 144, width at anterior margin 70. Lateral opisthosomal sclerites with acute posterior end. Opisthosomal sclerite with concave anterior margin, posterior margin with pair of poorly sclerotized areas, greatest length 67, greatest width 114. Posterior margin of opisthosoma between setae *h3* slightly sinuous. Setae *d2* off lateral margins of central sclerite, setae *e1* approximately equidistant from levels of opening *gl* and setae *e2*. Setae *ps1* approximately at the level of setae *h2*. Dorsal measurements: *c2:d2* 94, *d2:e2* 103, *d2:gl* 50, *gl:e1* 25-28, *e2:h3* 43, *h2:h2* 100, *h3:h3* 70. Epigynium bow-like, 29 x 87.

ETYMOLOGY: The specific epithet derives from the species name of the type host and is a noun in apposition.

8. *Sturnotrogus creatophorae* MIRONOV & KOPIJ, 2000 (Figs. 11A-E, 13C)

Sturnotrogus creatophorae MIRONOV & KOPIJ, 2000: 328, Fig. 5c, d, 6a, c.

MATERIAL EXAMINED: 1 male, 1 female paratypes (ZISP 4202) ex *Creatophora cinerea* (MEUSCHEN, 1787), South Africa, Free State, Pellisier, 20.V.1989, R.A. EARLE.

DIAGNOSIS: *Male*: setae *c3* narrowly lanceolate with filiform apex 45-53 x 2.5-3 (Fig. 11D), hysteronotal shield without incision on lateral margins, anterior angles acute and greatly elongated, opisthosomal lobes with almost straight posterior margin, opisthosomal membrane with slightly concave posterior margin, setae *ps3* on soft tegument, adanal membrane without rib, idiosoma 315-340 long, 1.5-1.6 longer than wide, width of opisthosoma 82-90. *Female*: setae *c3* narrowly lanceolate 35-40 x 3-3.5, hysteronotal shield split into central and opisthosomal sclerites, central sclerite about 2.2-2.3 times longer than wide, its anterior angles rectangular, anterior margin of opisthosomal sclerite strongly concave, openings *gl*

much closer to the level of setae *e1* than to that of setae *d2*, lateral sclerites with rounded posterior end, idiosoma 410-425 long, about 1.8-1.9 longer than wide.

REMARK: This species is known only from the type host, *Creatophora cinerea* in South Africa (MIRONOV & KOPIJ, 2000).

Group *subtruncatus*

DIAGNOSIS: In males, hysteronotal shield with blunt-angular or rounded anterior angles (Fig. 12A); in females: central and opisthosomal sclerites are not separated, lateral sclerites separated or not separated from the main body of hysteronotal shield (Fig. 13D).

INCLUDED SPECIES: *Sturnotrogus albicollis* MIRONOV, 1993, *S. ostraconotus* (GAUD, 1968), *S. subtruncatus* (TROUSSERT, 1885), *S. stroggylus* (GAUD, 1968). Only *S. subtruncatus* occurs in the geographic region of our present interest, three other species are associated with hosts restricted to the Indo-Malayan region.

9. *Sturnotrogus subtruncatus* (TROUSSERT, 1885) (Figs. 12A-E, 13D)

Pteronyssus truncatus var. *subtruncatus* TROUSSERT, 1885: 49; CANESTRINI & KRAMER, 1899: 81; RADFORD, 1958: 157.

Pteronyssoides truncatus var. *subtruncatus*: RADFORD, 1953: 205.

Pteronyssoides subtruncatus: GAUD & MOUCHET, 1959: 513 (misidentification); GAUD & TILL, 1961: 276 (misidentification); GAUD, 1977: 265 (misidentification); FACCINI & ATYEO, 1981: 54.

Sturnotrogus subtruncatus: MIRONOV, 1989: 118.

MATERIAL EXAMINED: 6 male, 3 female syntypes (TRT 37H14) ex *Gracula religiosa* LINNAEUS, 1758, [Indonesia], "Java, Sumatra, Malacca", no other data; 3 males, 2 females (IRSNB), same host, Belgium, Antwerp, Avicenna, XII.1965, A. FAIN.

DIAGNOSIS: *Both sexes*: setae *c3* thick setiform 28-38 x 2.5-3 (Fig. 12D). *Male*: Hysteronotal shield with convex anterior margin, angles blunt-angular, small antero-lateral pieces of this shield demarked, lateral margin without incisions, opisthosoma lobes truncate with rounded posterolateral angles, margin of opisthosomal membrane straight, with small median incisions, setae *ps3* on soft tegument, adanal membranes without rib, idiosoma 310-330 long, 1.2-1.3 longer than wide, width of opisthosoma 92-98. *Female*: Hysteronotal shield entire (main body of this shield not split into central and opisthosomal sclerites, laterals sclerites outlined but not split off), anterior angles of hysteronotal shield rounded, posterior quarter of this shield with pair of short longitudinal grooves, lateral margins with pair of narrow incisions anterior to setae *f2*, openings *gl* closer to level of setae *e1* than to level of setae *d2*, idiosoma 360-380 long, 1.5-1.6 longer than wide.

REMARK: This species was originally described from the hill myna, *Gracula religiosa*, in Indonesia (TROUSSERT, 1885). Subsequently, it was reported in Africa (GAUD & TILL, 1961; GAUD, 1977) from *Acridothères tristis* and *Poeoptera lugubris*. Our re-examination of these materials from Africa has shown that each of these two hosts actually bears another species, which we described above as new species, *S. acridotheres* and *S. poeopterae*, respectively. These misidentifications may be apparently explained by the following reasons: *Sturnotrogus subtruncatus* has never been redescribed or even figured based on the materials from *G. religiosa*, and *Sturnotrogus* specimens collected from other hosts were not compared with type specimens or adequate materials from the type host.

In Europe, we have formally detected *S. subtruncatus* in the sample collected from its type host, *G. religiosa*, imported to Belgium. Nevertheless, we believe that this species may be also expected on the hill myna in wild condition in some locations of Africa, where it has been recently introduced, particularly in Saint Helene Island.

Discussion

In total, the genus *Sturnotrogus* now includes 13 species (Table 1) recorded from 23 host species; most of known *Sturnotrogus* species (11) are associated with starlings (Sturnidae) from various areas of the Old World, mainly from Eurasia and Africa, and two species are known from fan-tailed flycatchers of the genus *Rhipidura* VIGORS & HORSFIELD, 1827 (Rhipiduridae) in Southeast Asia and Indonesia. In host specificity, most species are monoxenous or oligoxenous, i.e. associated with one or with a few species of one genus; only *Sturnotrogus lamprotornis* is recorded from a large number (eight) species, all of the genus *Lamprotornis* TEMMINCK, 1820. In relation to this, it is quite interesting to point out that representatives of such a morphologically homogenous genus are dispersed on avian hosts of two phylogenetically distant families. Sturnidae and Rhipiduridae belong to different parvorders of oscines, Passerida and Corvida, respectively (SIBLEY et al., 1988; ERICSON et al., 2002; ERICSON & JOHANSON, 2003; BARKER et al., 2004). Although the pattern of host associations of *Sturnotrogus* species in the context of respective avian families is obviously the result of co-speciation with hosts, it is quite unlikely that distribution on such distantly related taxa as starlings and fan-tailed flycatchers could be the result of co-speciation with a common ancestral host. Analysis of host associations within species groups, recognized in the course of our taxonomic study, allows us to hypothesize the original and secondary hosts of *Sturnotrogus*.

The *truncatus* group apparently represent a derived grouping within the genus, because females are characterised by the hysteronotal shield split into fragments (Figs. 8A-C). In most families of Analgoidea, females are characterized by the relatively large and entire hysteronotal shield, while only in females of Pteronyssidae does one

see such reduction and splitting of the female hysterontal shields, which is a very characteristic evolutionary trend displayed within many pteronyssid genera (GAUD, 1990; MIRONOV, 2001, 2003; MIRONOV & WAUTHY, 2005a, 2006b). Representatives of the *truncatus* group are restricted exclusively to sturnids and are associated with the most derived genera of this family: *Acridotheres* VIEILLOT, 1816, *Creatophora* LESSON, 1847, *Lamprotornis*, *Onychognathus* HARTLAUB, 1849 and *Sturnus* LINNAEUS, 1758, which are distributed mainly in Afrotropic and Palearctic regions (SIBLEY & AHLQUIST, 1984). Within the *subtruncatus* group, which appears to be more primitive because the hysterontal shield in females is entire (Fig. 13d), two species are known from sturnids, and two species from rhipidurids. Representatives of the *subtruncatus* group live on the relatively primitive sturnid genera, *Aplonis* GOULD, 1836 and *Gracula* LINNAEUS, 1758, distributed mainly in the Indo-Malayan region, in the same range as *Rhipidura* species. It is also necessary to stress that many relatives of sturnids within Passerida have pteronyssid genera related to *Sturnotrogus* (genera of the *Pteronyssoides* group), whereas no close relatives of rhipidurids within Corvida have mites related to *Sturnotrogus* (MIRONOV & WAUTHY, 2005a, 2006b; MIRONOV & GALLOWAY, 2006). Based on these data, it is most reasonable to conclude that

sturnids are the original hosts of the genus, while rhipidurids are the secondary hosts, and *Sturnotrogus* species were probably transferred onto the ancestor of fan-tailed flycatchers from some sturnids that originated in the Indo-Malayan region. Taking into account that Sturnidae currently includes about 114 species arranged in 23 or more genera (DICKINSON, 2003) and all members of this family are potential hosts of the genus *Sturnotrogus*, it is possible to expect a number of new *Sturnotrogus* species on starlings in tropical areas of the Old World that would help to understand better the pattern of host parasite associations and co-speciation process with these hosts.

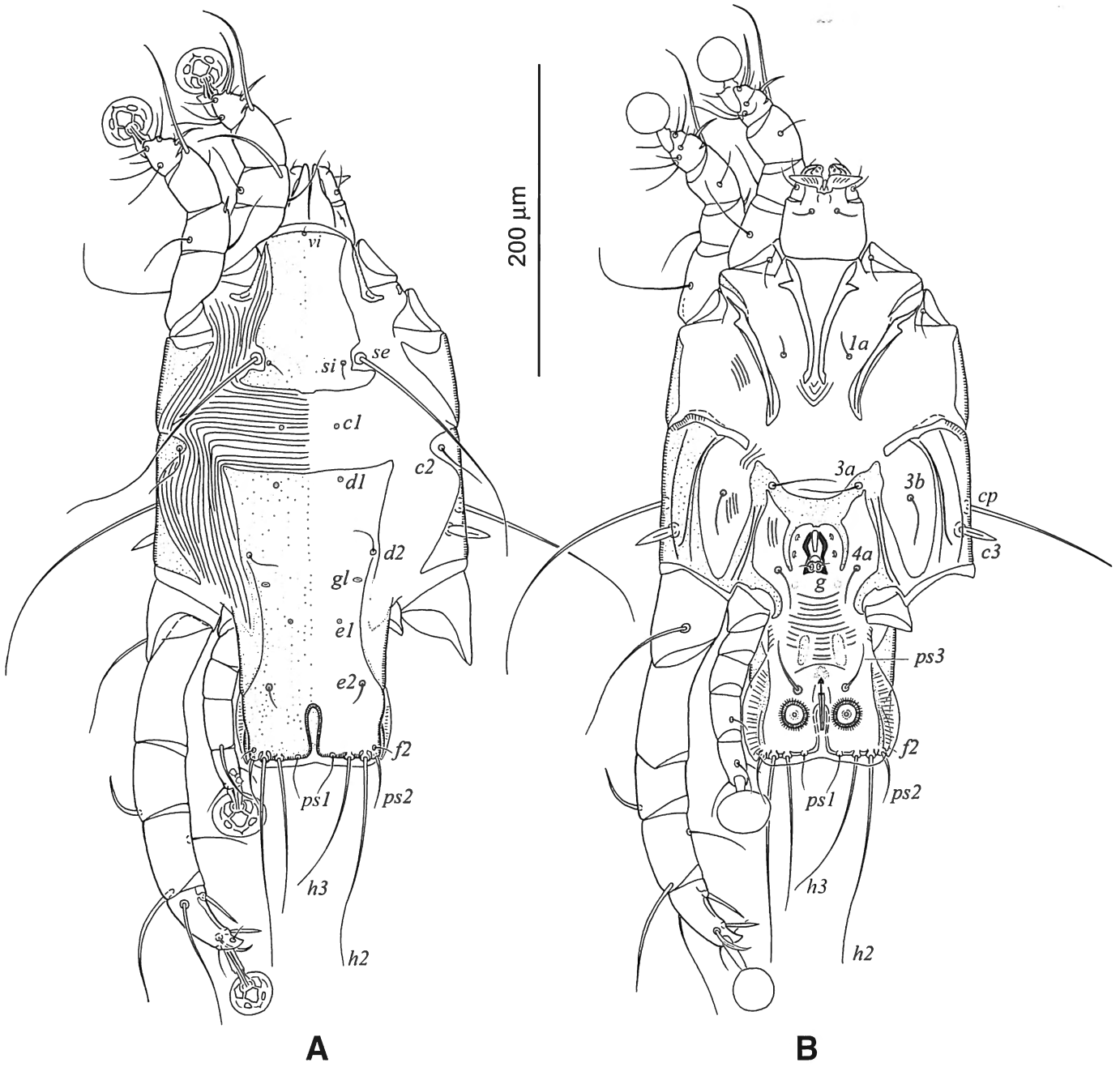
Acknowledgements

The authors wish to thank Prof. Dr. A. Fain (Institut royal des Sciences naturelles de Belgique, Brussels, Belgium), Dr. H. André (Musée royal de l'Afrique centrale, Tervuren, Belgium), Dr. M. Judson (Muséum national d'Histoire naturelle, Paris, France) and Dr. J. Dabert (A. Mickiewicz University, Poznan, Poland) for loaning materials used in the present study, and Dr. H.C. Proctor (University of Alberta, Edmonton, Canada) for critically reviewing the manuscript. This research was supported by a grant from the Belgian Scientific Policy to SVM. The present investigation was based in part on the material belonging to the collection UFC ZIN No 2-2.20 (Collection of Zoological Institute RAS, St. Petersburg, Russia).

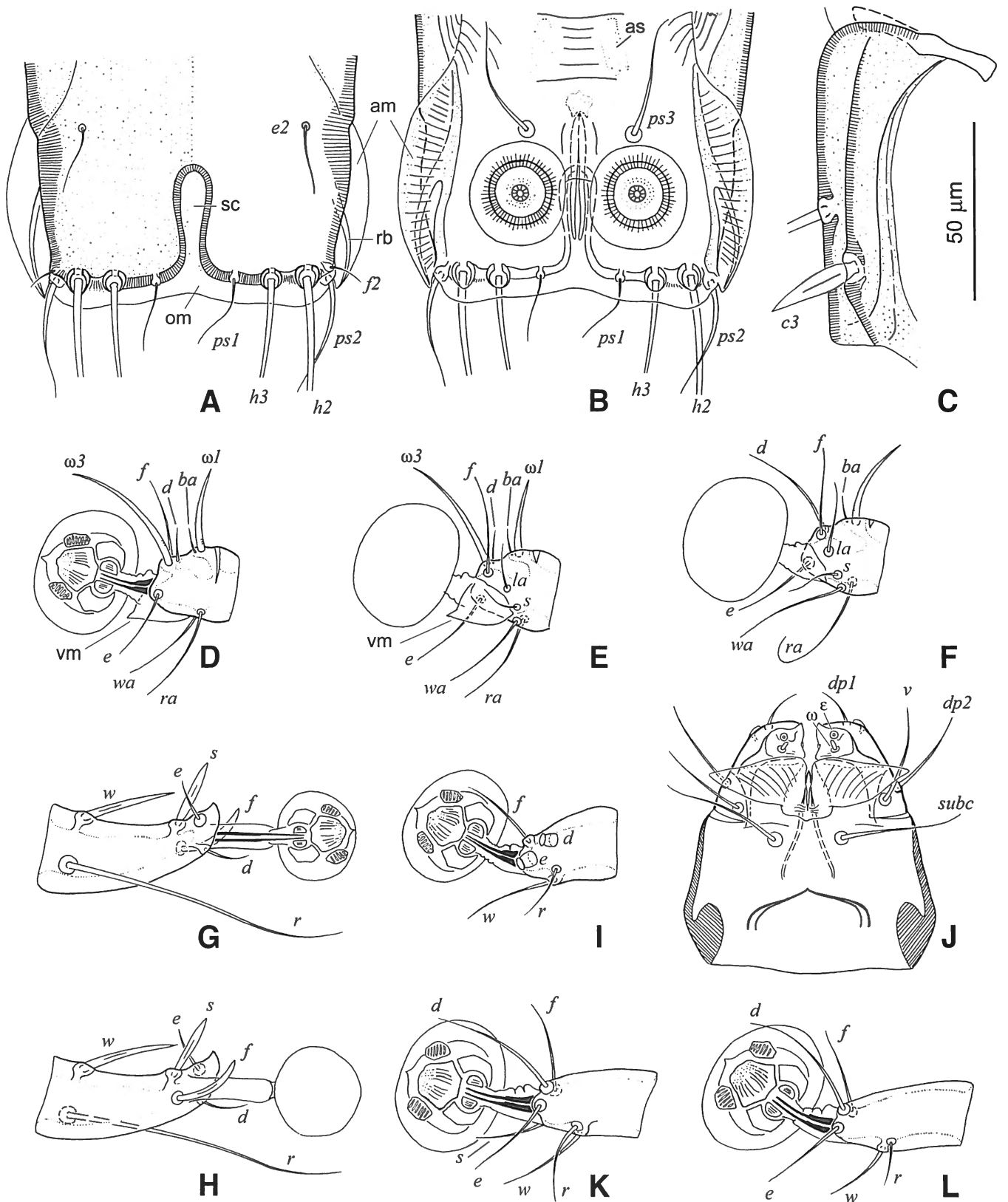
Table 1 — Host associations and distribution of *Sturnotrogus* species

Mite species and species group	Host species	Host family	Distribution	Reference
<i>truncatus</i> group				
<i>S. acridotheres</i>	* <i>Acridotheres tristis</i>	Sturnidae	Cambodia, Vietnam, St. Helene Is.	present study
<i>S. creatophorae</i>	* <i>Creatophora cinerea</i>	Sturnidae	South Africa	Mironov & Kopij, 2000
<i>S. lamprotornis</i>	<i>Lamprotornis chalcurus</i>	Sturnidae	Cameroon	present study
	<i>L. chalybaeus</i>	Sturnidae	Kenya	present study
	<i>L. chloropterus elisabeth</i>	Sturnidae	Mozambique	present study
	<i>L. corruscus corruscus</i>	Sturnidae	Kenya	present study
	<i>L. iris</i>	Sturnidae	Sierra Leone	present study
	<i>L. nitens</i>	Sturnidae	South Africa	present study
	<i>L. purpuropterus</i>	Sturnidae	Rwanda	present study
	* <i>L. splendidus</i>	Sturnidae	Cameroon	present study
	† <i>Ptilostomus afer</i>	Corvidae	Senegal	Gaud & Till, 1961; present study
<i>S. minimus</i>	* <i>Sturnus sturninus</i>	Sturnidae	Russia (Primorye)	Mironov, 1993
<i>S. onychognathi</i>	* <i>Onychognathus morio</i>	Sturnidae	South Africa	present study
<i>S. pastoris</i>	* <i>Sturnus roseus</i>	Sturnidae	Kazakhstan, Tajikistan	Mironov, 1987
	<i>St. cinereus</i>	Sturnidae	Russia (Primorye)	Mironov, 1987
<i>S. poeopterae</i>	* <i>Poeoptera lugubris</i>	Sturnidae	Cameroon	present study
<i>S. superbus</i>	* <i>Lamprotornis superbus</i>	Sturnidae	Kenya	present study
<i>S. truncatus</i>	* <i>Sturnus vulgaris</i>	Sturnidae	Europe, Morocco, Russia (European part, West Siberia, Primorye), Kazakhstan, Tadjikistan, Canada (Alberta)	Trouessart, 1885; Faccini & Atyeo, 1981; Mironov, 1987; present study
	<i>St. unicolor</i>	Sturnidae	Morocco	present study
<i>subtruncatus</i> group				
<i>S. albicollis</i>	* <i>Rhipidura albicollis</i>	Rhipiduridae	Vietnam	Mironov, 1993
<i>S. ostraconotus</i>	* <i>Rhipidura rennelliana</i>	Rhipiduridae	Rennell Is.	Gaud, 1968
<i>S. stroggylus</i>	* <i>Aplonis insularis</i>	Sturnidae	Rennell Is.	Gaud, 1968
<i>S. subtruncatus</i>	* <i>Gracula religiosa</i>	Sturnidae	Indonesia, Belgium**	Trouessart, 1885; present study

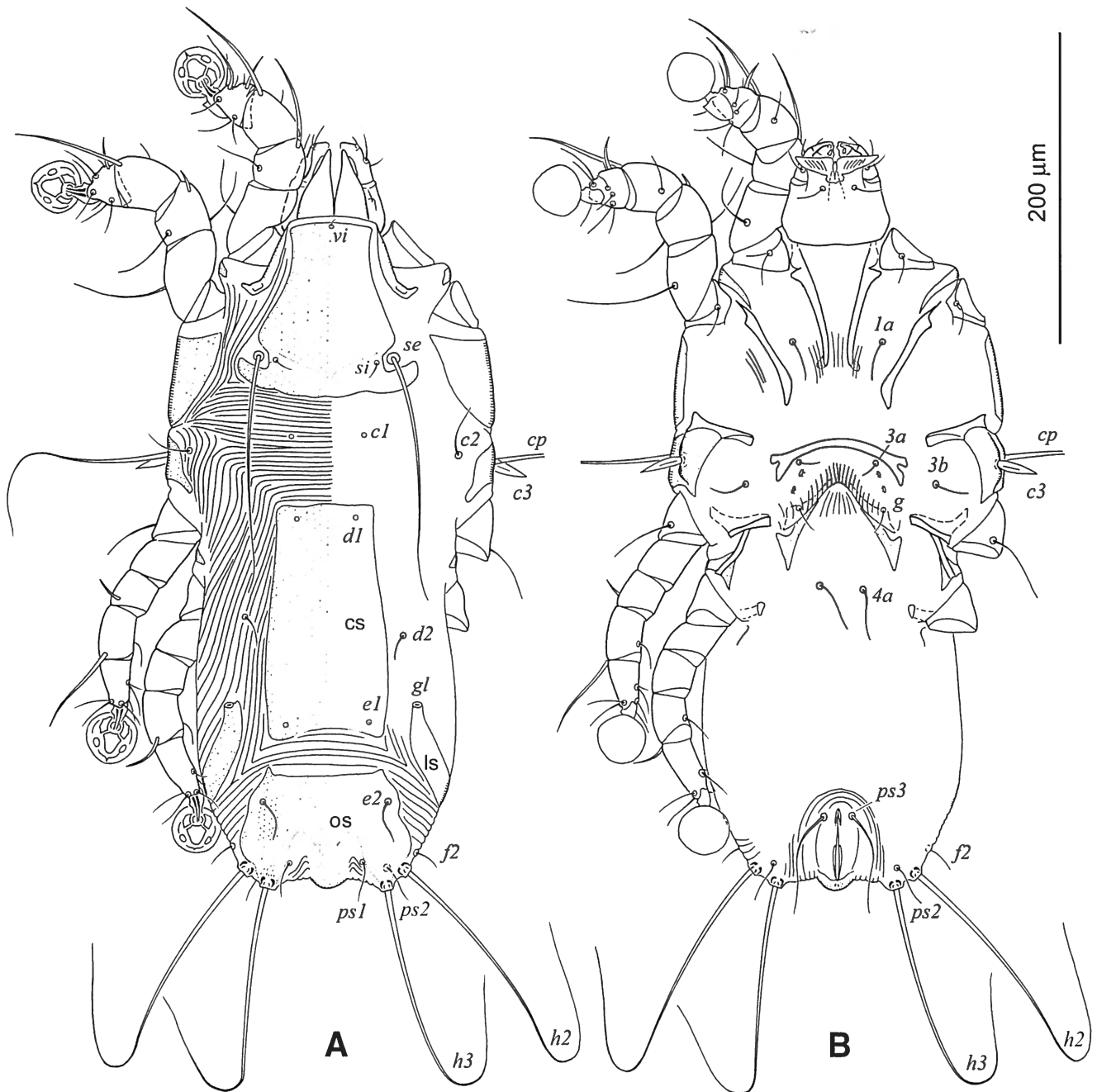
(*) Type host; (**) mite recorded from the imported host specimen; (†) probably accidental contamination.



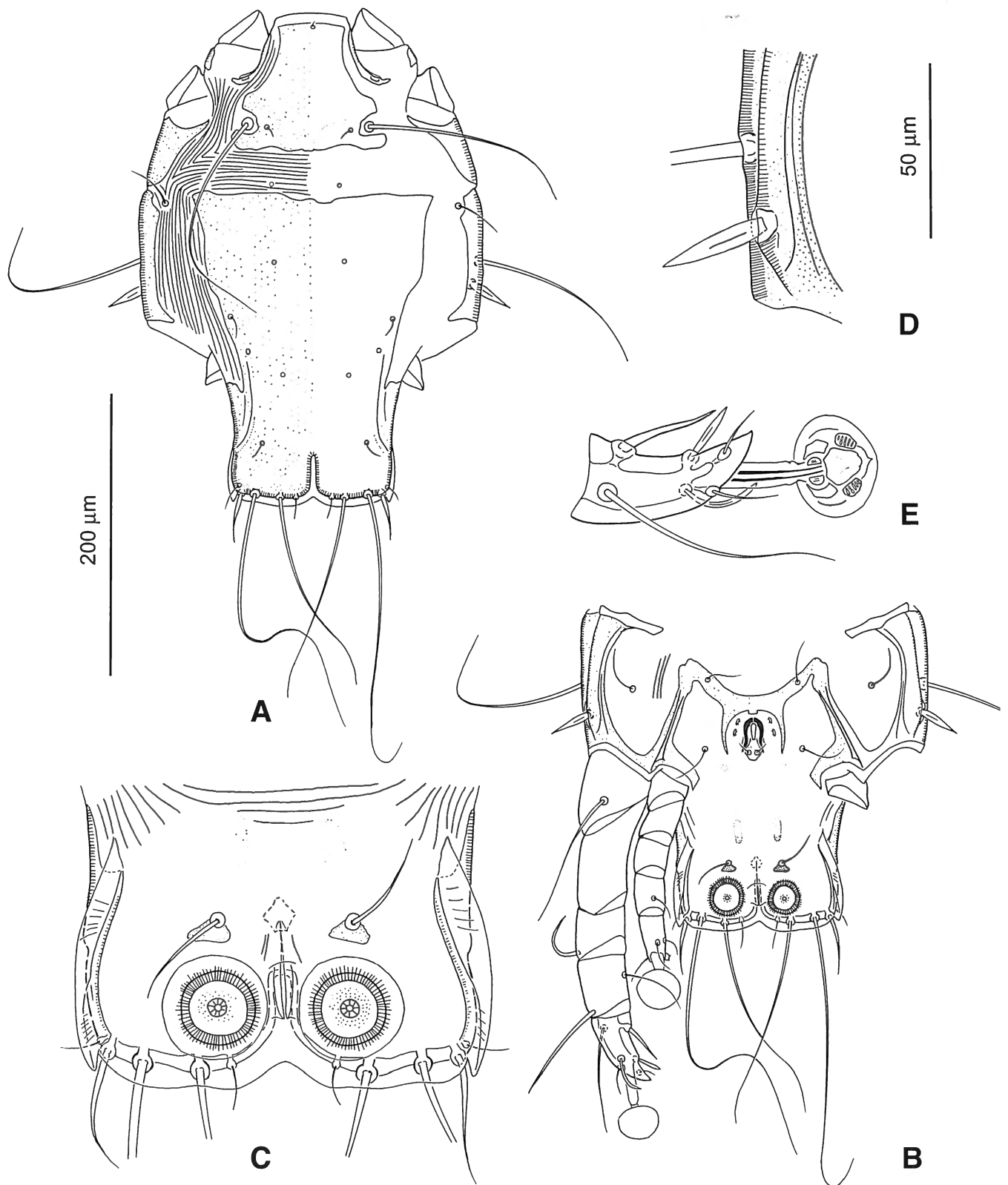
Figs. 1A-B — *Sturnotrogus truncatus*, male. A. Dorsal view. B. Ventral view.



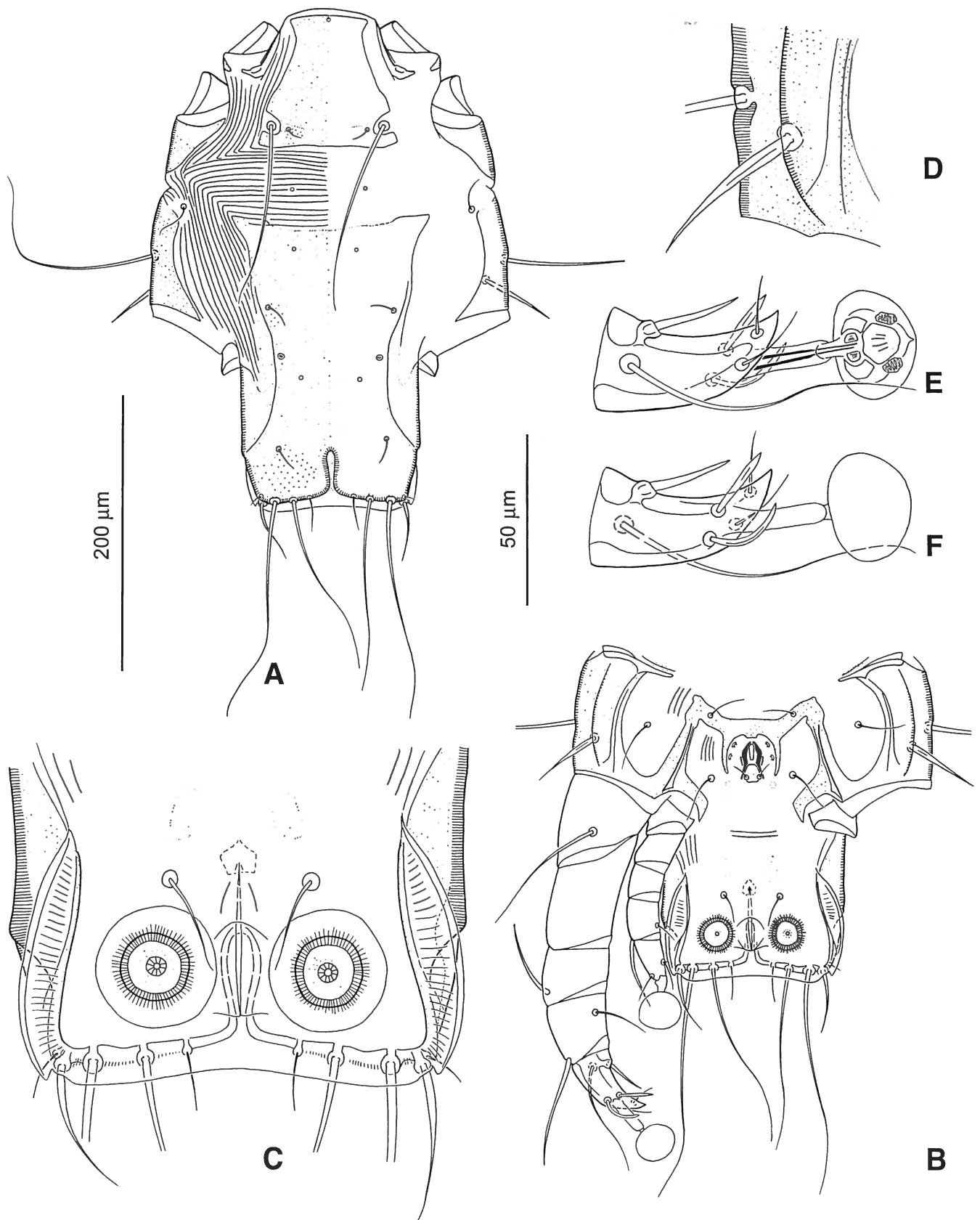
Figs. 2A-L — *Sturnotrogus truncatus*, details. A-I. Male. J-L Female. A. Opisthosoma, dorsal view. B. Opisthosoma, ventral view. C. Humeral shield, ventral view. D. Tarsus I, dorsal view. E. Tarsus I, ventral view. F. Tarsus II, ventral view. G. Tarsus III, dorsal view. H. Tarsus III, ventral view. I. Tarsus IV, dorsal view. J. Gnathosoma, ventral view. K. Tarsus III, dorsal view. L. Tarsus IV, dorsal view. am – adanal membrane, as – adanal shield, om – opisthosomal membrane, rb – rib of adanal membrane, sc – supranal concavity, vm – ventral membrane of tarsus I.



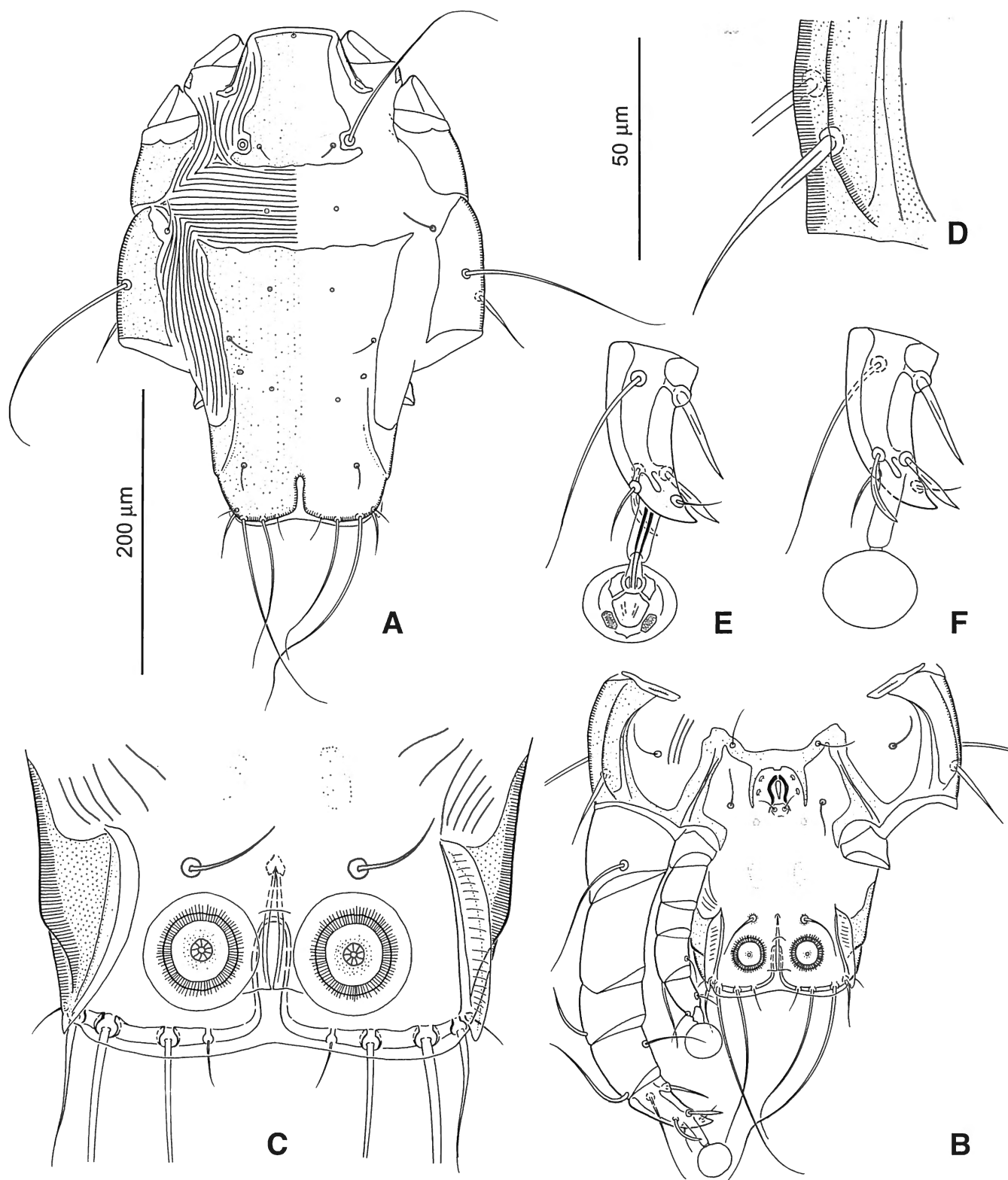
Figs. 3A-B — *Sturnotrogus truncatus*, female. A. Dorsal view. B. Ventral view. Fragments of hysteronotal shield: cs – central sclerite, ls – lateral opisthosomal sclerite, os – opisthosomal sclerite.



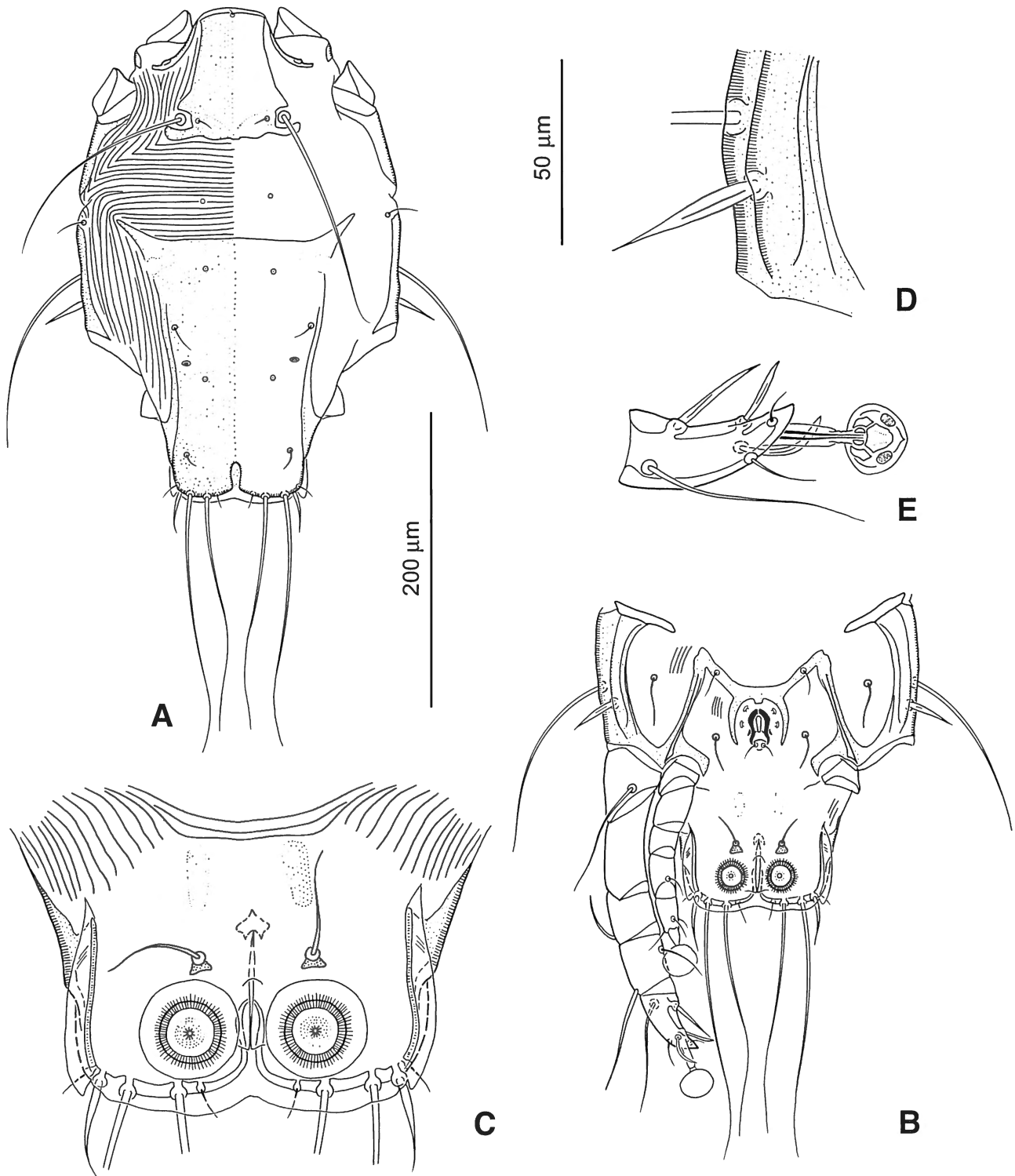
Figs. 4A-E — *Sturnotrogus acridotheres*, male. A. Idiosoma, dorsal view. B. Hysterosoma, ventral view. C. Opisthosoma, ventral view. D. Seta c3. E. Tarsus III, dorsal view.



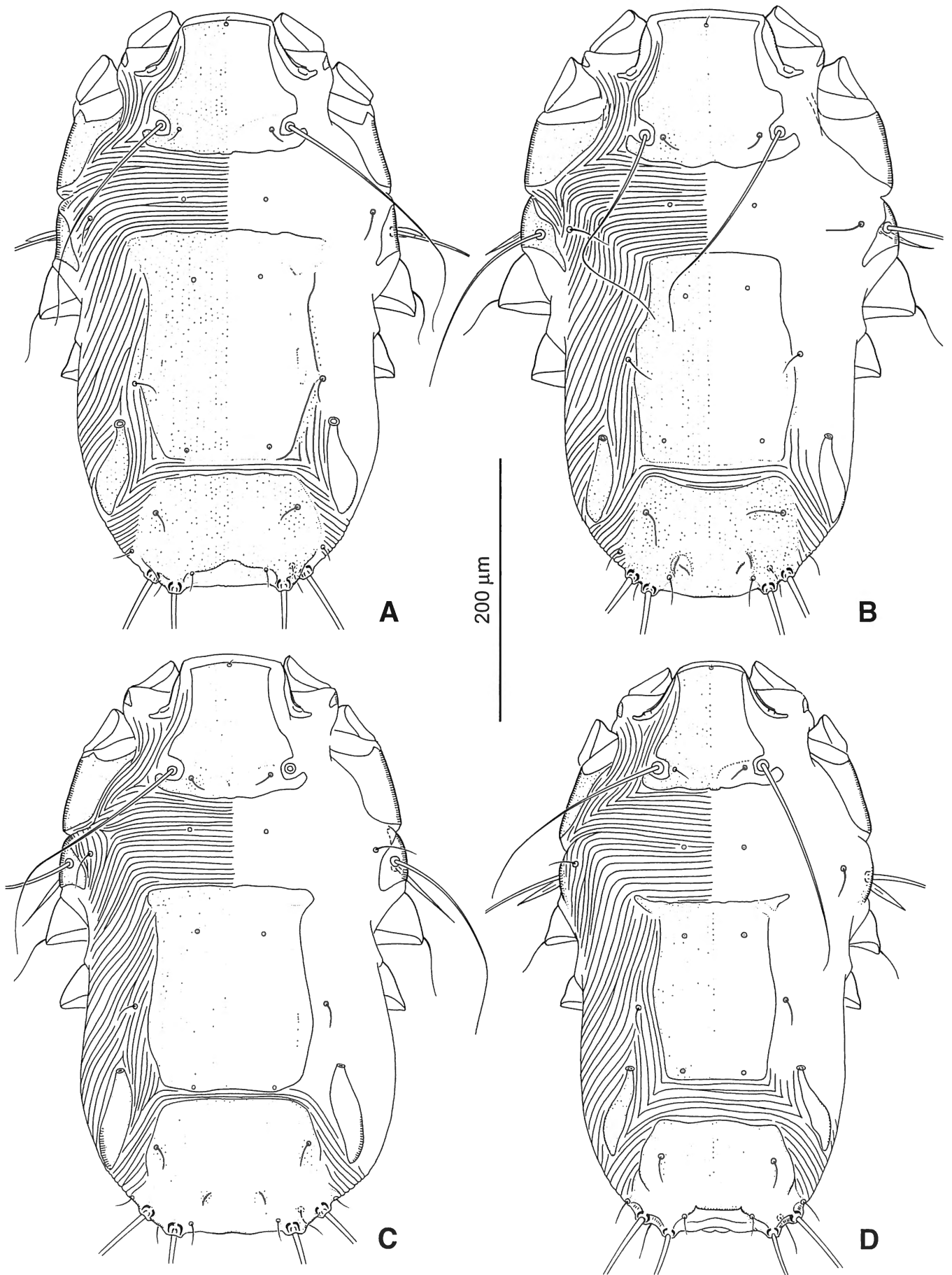
Figs. 5A-F — *Sturnotrogus lamprotornis*, male. A. Idiosoma, dorsal view. B. Hysterosoma, ventral view. C. Opisthosoma, ventral view. D. Seta *c*₃. E. Tarsus III, dorsal view. F. Tarsus III, ventral view.



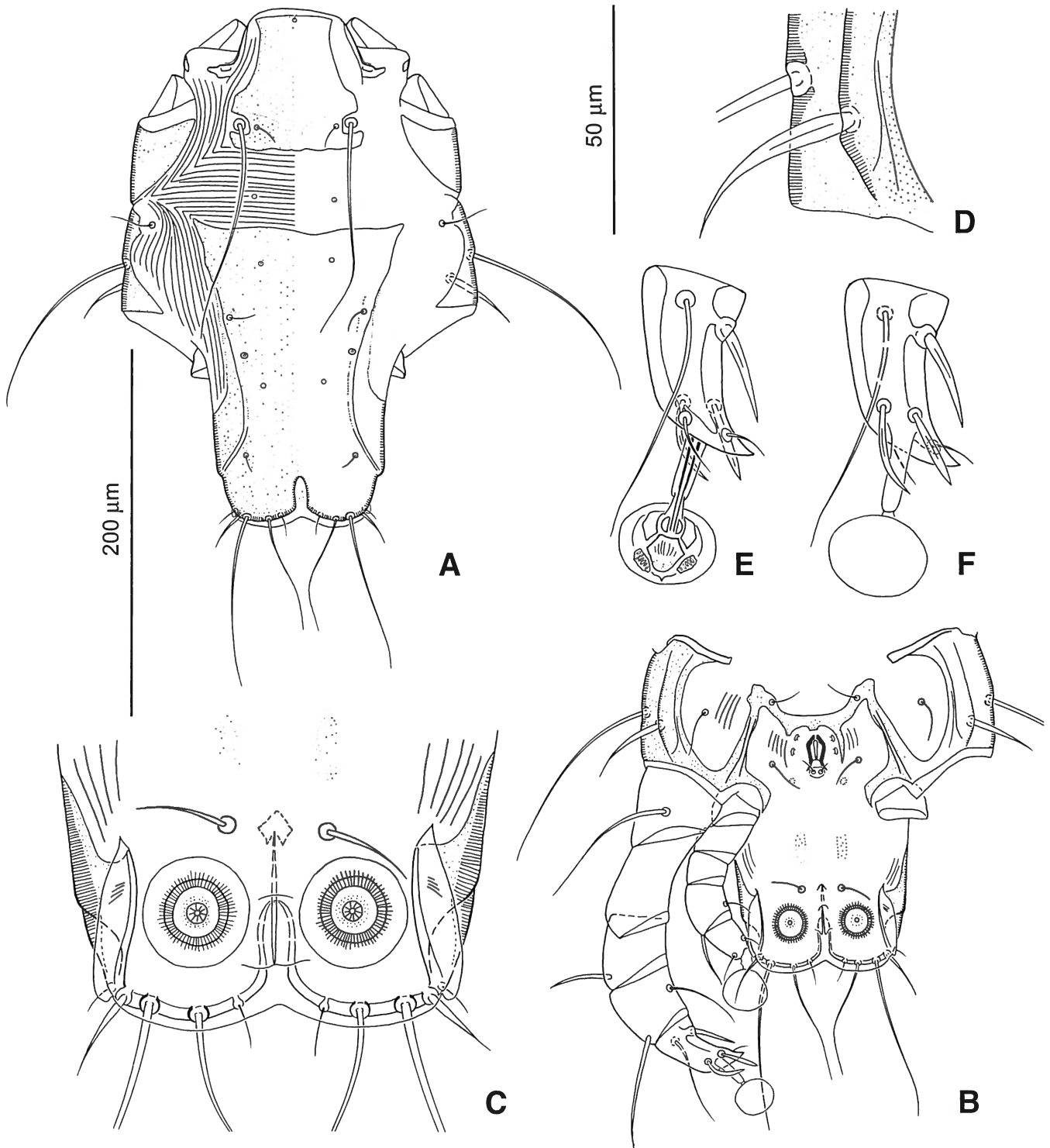
Figs. 6A-F — *Sturnotrogus onychognathi*, male. A. Idiosoma, dorsal view. B. Hysterosoma, ventral view. C. Opisthosoma, ventral view. D. Seta c3. E. Tarsus III, dorsal view. F. Tarsus III, ventral view.



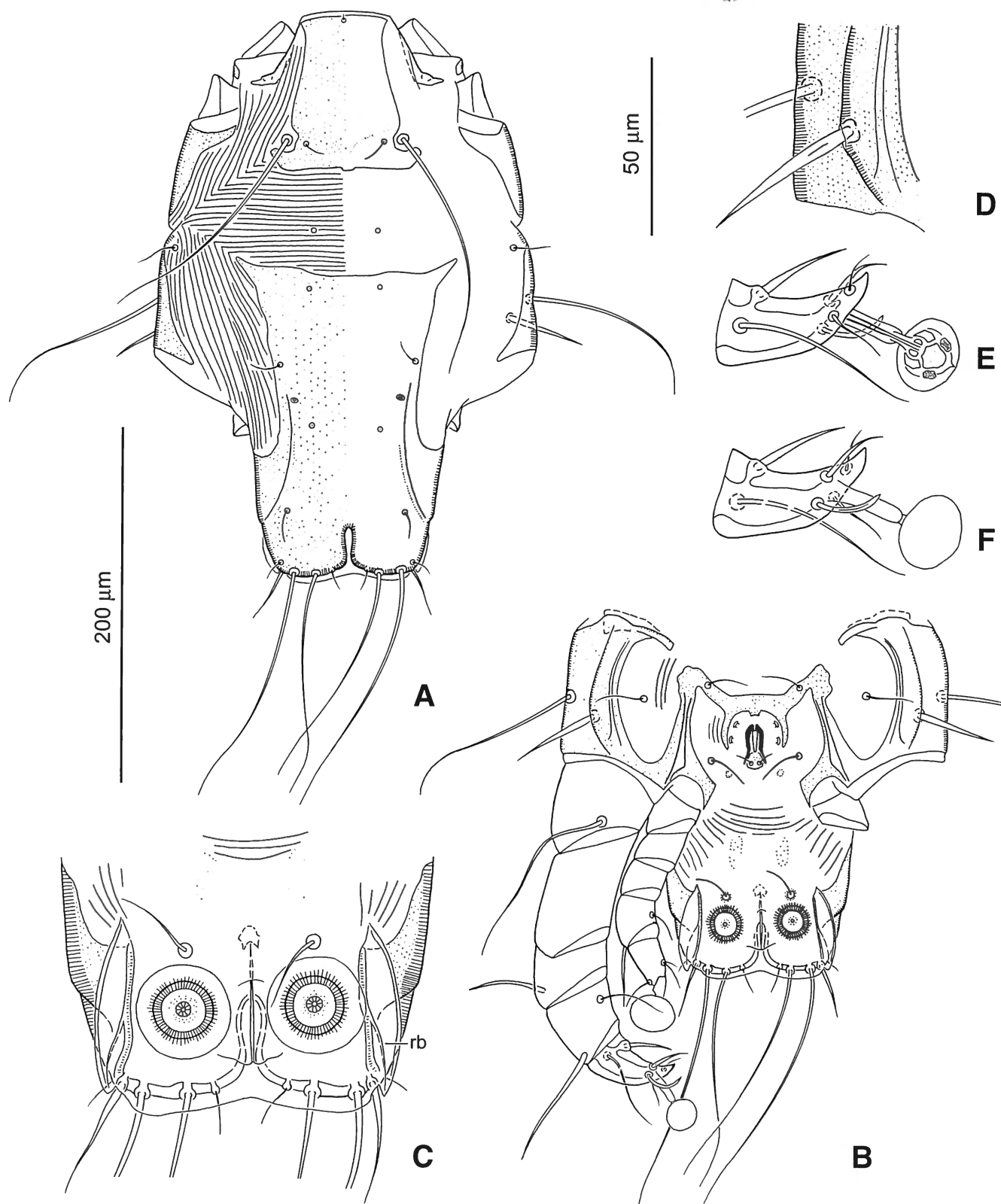
Figs. 7A-E — *Sturnotrogus pastoris*, male. A. Idiosoma, dorsal view. B. Hysterosoma, ventral view. C. Opisthosoma, ventral view. D. Seta c3. E. Tarsus III, dorsal view.



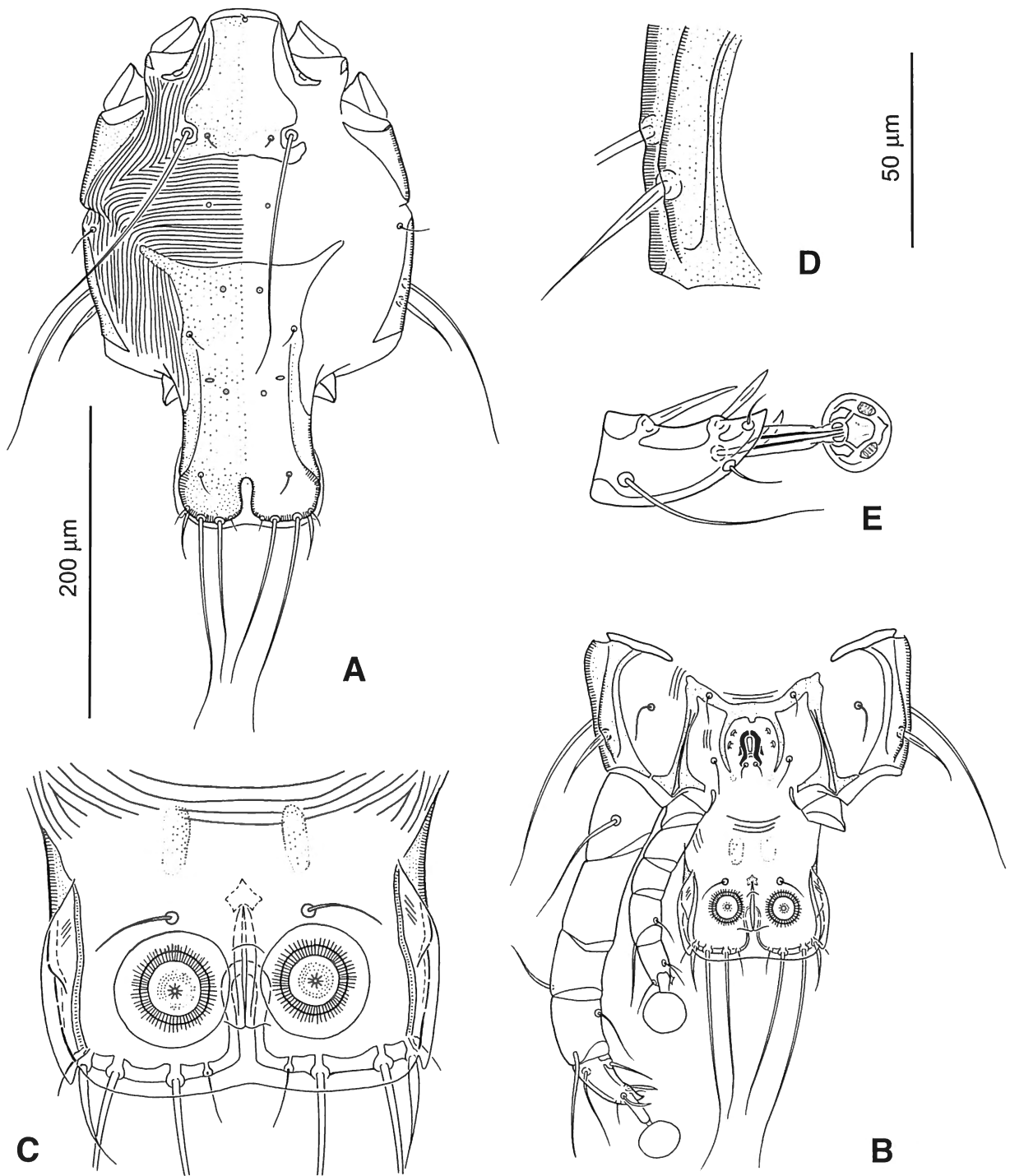
Figs. 8A-D — *Sturnotrogus* females, dorsal view of idiosoma. A. *Sturnotrogus acridotheres*. B. *S. lamprotornis*. C. *S. onychognathi*. D. *Sturnotrogus pastoris*.



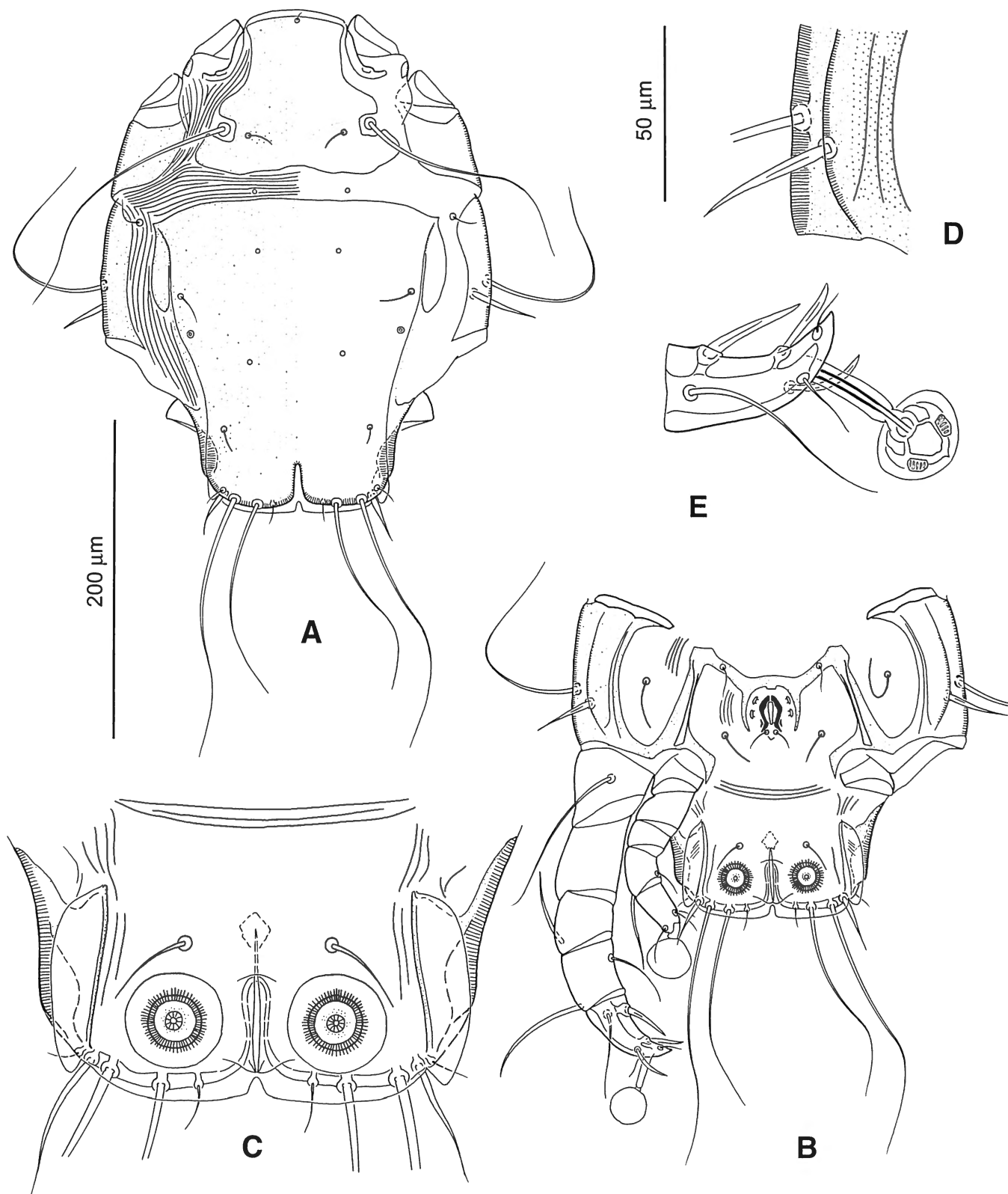
Figs. 9A-F — *Sturnotrogus poeopterae*. male. **A.** Idiosoma, dorsal view. **B.** Hysterosoma, ventral view. **C.** Opisthosoma, ventral view. **D.** Seta *c*₃. **E.** Tarsus III, dorsal view. **F.** Tarsus III, ventral view.



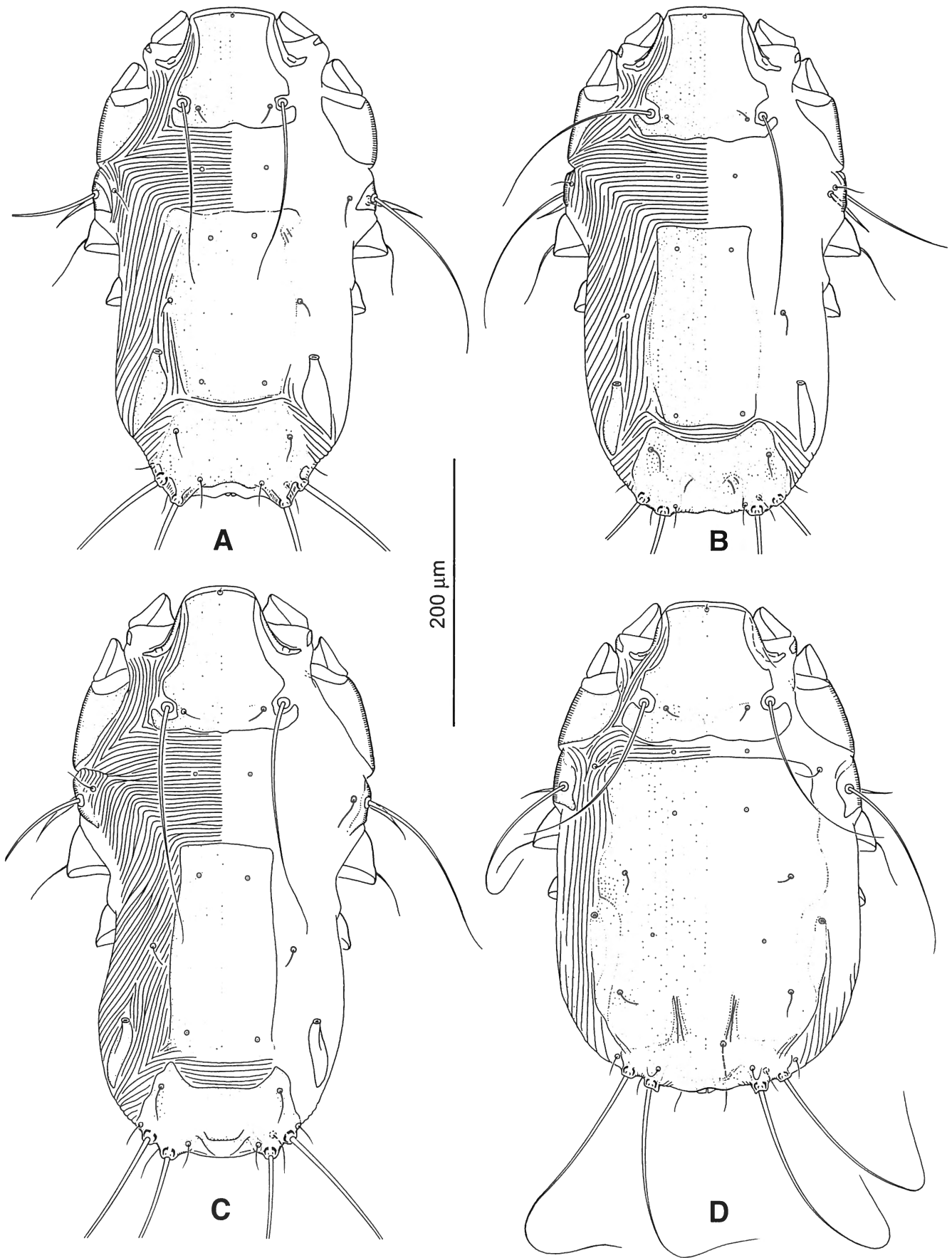
Figs. 10A-F — *Sturnotrogus superbus*, male. A. Idiosoma, dorsal view. B. Hysterosoma, ventral view. C. Opisthosoma, ventral view. D. Seta c3. E. Tarsus III, dorsal view. ff Tarsus III, ventral view. rb – rib of adanal membrane.



Figs. 11A-E — *Sturnotrogus creatophorae*, male. A. Idiosoma, dorsal view. B. Hysterosoma, ventral view. C. Opisthosoma, ventral view. D. Seta c3. E. Tarsus III, dorsal view.



Figs. 12A-E — *Sturnotrogus subtruncatus*, male. A. Idiosoma, dorsal view. B. Hysterosoma, ventral view. C. Opisthosoma, ventral view. D. Seta c3. E. Tarsus III, dorsal view.



Figs. 13A-D — *Sturnotrogus* females, dorsal view of idiosoma. A. *Sturnotrogus poeopterae*. B. *S. superbus*. C. *S. creatophorae*. D. *S. subtruncatus*.

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