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Review of tapeworms of rodents in the Republic of Buryatia, with emphasis on anoplocephalid cestodes

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Abstract

Examination of ca. 500 rodents [*Microtus* spp., *Myodes* spp., *Cricetulus barabensis* (Pallas), *Apodemus peninsulae* Thomas] from 14 localities in the Republic of Buryatia (Russian Federation) revealed a minimum of 11 cestode species representing *Anoplocephaloides* Baer, 1923 *s. str.* (1 species), *Paranoplocephala* Lühe, 1910 *s.l.* (5 species), *Catenotaenia* Janicki, 1904 (2 species), *Arostrilepis* Mas-Coma & Tenora, 1997 (at least 2 species) and *Rodentolepis* Spasskii, 1954 (1 species). At least 5 of these species are previously unknown from the region. The taxonomic and phylogenetic position of Buryatian *Paranoplocephala* species was defined by cytochrome oxidase I (COI) sequences (mtDNA). The phylogenetic analysis also confirmed the status of *Parandrya* Gulyaev & Chechulin, 1996 as a junior synonym of *Paranoplocephala s.l.* The species diversity of anoplocephalid cestodes was significantly lower in Buryatia and North-East Siberia (6-7 species) than in Europe (17 species). The connections of the anoplocephalid fauna of Buryatia seem to be closer with Beringia (North-East Siberia and Alaska) than with Europe. The present study demonstrated high spatial variation (patchiness) among study sites in cestodes of Buryatian rodents, with the exception of the ubiquitous *Arostrilepis horrida* (von Linstow, 1901)-complex.

Keywords

Cestoda, Anoplocephalidae, Catenotaeniidae, Hymenolepididae, *Paranoplocephala*, voles, Buryatia

Introduction

The rodent fauna of the Republic of Buryatia (Russian Federation) represents a mixture of Asian, northern Palaearctic and Holarctic species. Of the Buryatian rodents, the grey-sided vole *Myodes rufocanus* (Sundevall) (syn. *Clethrionomys rufocanus*), the red vole *Myodes rutilus* (Pallas) (syn. *Clethrionomys rutilus*) and the root vole *Microtus oeconomus* (Pallas) are distributed throughout northern Eurasia, the latter two extending into north-western North America. More southern Palaearctic elements include the reed vole *Microtus fortis* Büchner, Maximowicz's vole *Microtus maximowiczii* (Schrenk), the striped dwarf hamster *Cricetulus barabensis* (Pallas) and the Korean field mouse *Apodemus peninsulae* Thomas. Biogeographically the location of Buryatia is interesting because the east-west taiga corridor between the Lake Baikal and Mongolian steppe has probably been a major migration pathway for the Palaearctic fauna and flora (de Lattin 1967; Mikkola 1988).

The helminths of rodents in the Lake Baikal basin, including Buryatia, have been the subject of two major faunistical studies, i.e. those of Machul'skii (1958) and Zhaltsanova (1992). In addition, four recent descriptions of new species of anoplocephalid cestodes have included material from Buryatia (Chechulin and Gulyaev 1998; Gulyaev and Chechulin 1996; Gulyaev and Krivopalov 2003; Haukisalmi et al. 2007a). In terms of species diversity, anoplocephalid cestodes are the dominant helminth group in arvicoline rodents in Buryatia and elsewhere. However, some of the anoplocephalid cestodes previously reported from Buryatian rodents [i.e. *Paranoplocephala macrocephala* (Douthitt, 1915) and *P. microti* (Hansen, 1947)] are now known to be restricted to the Nearctic region (Haukisalmi and Henttonen 2003; Haukisalmi et al. 2004). Moreover, the apparently widespread *Paranoplocephala omphalodes* (Hermann, 1783) has been shown to include multiple species (Haukisalmi et al. 2004), and it is not known which of these species occur in Buryatia. Similar taxonomical problems are present in catenotaeniid cestodes. For example, *Catenotaenia pusilla* (Goeze, 1782) probably does not occur in *Microtus* Schrank and *Apodemus* Kaup in Buryatia, because it is presently regarded as a specific parasite of *Mus musculus* (L.) (Tenora and Murai 1975).

The present study reviews the cestode fauna of Buryatian rodents based on new extensive collections and includes recent advances in the taxonomy of anoplocephalid cestodes. The Buryatian cestode fauna of rodents is compared with those of Europe and north-eastern Siberia. Mitochondrial DNA sequences are used for defining the taxonomic and phylogenetic position of the *Paranoplocephala* species of Buryatian voles.

Material and methods

Rodents were trapped at 14 study sites of Buryatia in August in 2004 and 2005. The location of Buryatia, study sites therein, and the rodent material sampled from each locality are given in Fig. 1 and Table 1.

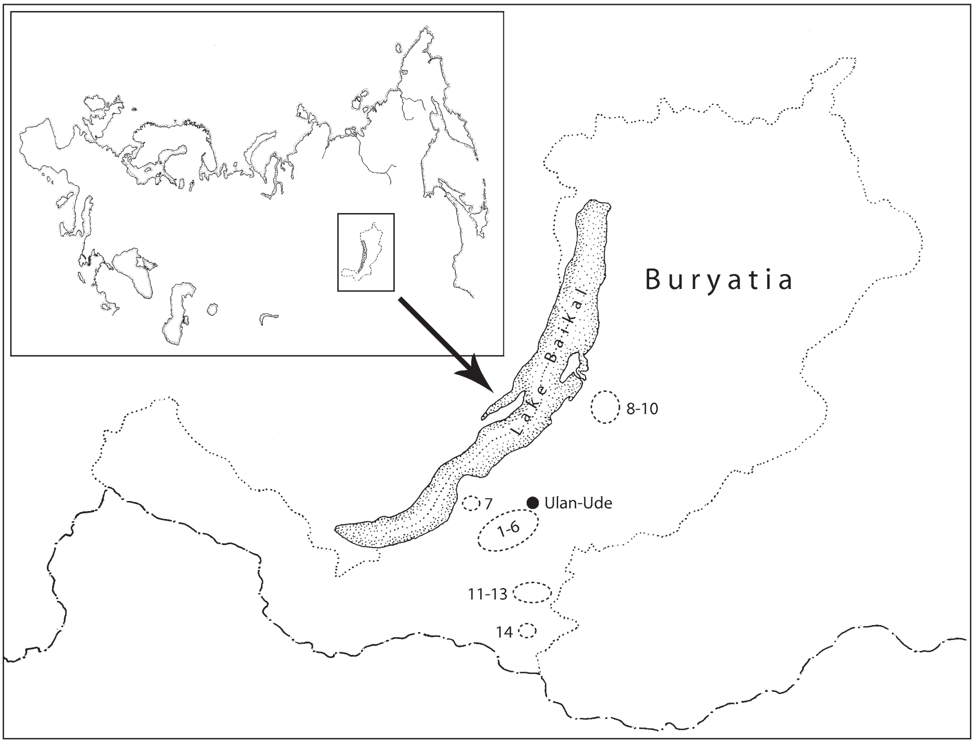

Fig. 1. Study sites in Buryatia. 1-6, Kamensk, Pasolskaya, Ganzurinov, Nizhnaya Ivolga, Verhnaya Berezovka, Utochkina Pad; 7, Maloje Kolesova; 8-10, Barguzin River, Shapen'kovo, Nesteriha; 11-13, Muhorshibir, Sharaldai, Zabaikalsk; 14, Tseremushki.

Table 1. Prevalence (%) of cestodes in various host species and study sites in Buryatia (if $N \geq 10$). If $N < 10$, presence has been shown by "+". Cestode species are: *Anoplocephaloides* cf. *dentata* (*Aden*), *Paranoplocephala* cf. *omphalodes* (*Pomp*), *P. blanchardi* (*Pbla*), *P. feodorovi* (*Pfeo*), *P. buryatiensis* (*Pbur*), *P. longivaginata* (*Plon*), *Catenotaenia* sp. 1 (*Cat1*), *Catenotaenia* sp. 2 (*Cat2*), *Arostrilepis horrida s.l.* (*Ahor*) and *Rodentolepis* sp. (*Rod*).

Host species **Locality**	**Aden**	**Pomp**	**Pbla**	**Pfeo**	**Pbur**	**Plon**	**Cat1**	**Cat2**	**Ahor**	**Rod**
***Apodemus peninsulae* (n=51)**								**2**		
Kamensk (n=8)								+		
Verhnaya Berezovka (n=8)										
Utochkina Pad (n=9)										
Barguzin River (n=8)										
Shapen'kovo (n=7)										
Muhorshibir (n=11)										
***Cricetulus barabensis* (n=83)**							**6**		**1**	**24**
Ganzurinov (n=22)							5			14
Nizhnaya Ivolga (n=1)										
Shapen'kovo (n=4)									+	

Host species **Locality**	**Aden**	**Pomp**	**Pbla**	**Pfeo**	**Pbur**	**Plon**	**Cat1**	**Cat2**	**Ahor**	**Rod**
Muhorshibir (n=4)										
Sharaldai (n=49)							8			33
Zabaikalsk (n=3)										+
***Myodes rufocanus* (n=132)**	**2**				**14**				**22**	
Kamensk (n=7)					+				+	
Pasolskaya (n=35)	6				43				6	
Maloje Kolesova (n=1)										
Verhnaya Berezovka (n=6)	+								+	
Utochkina Pad (n=10)					10				20	
Shapen’kovo (n=8)									+	
Muhorshibir (n=44)					3				30	
Tseremushki (n=21)									33	
***Myodes rutilus* (n=56)**						**11**			**30**	
Pasolskaya (n=6)						+				
Maloje Kolesova (n=9)										
Verhnaya Berezovka (n=3)						+			+	
Utochkina Pad (n=1)						+				
Shapen’kovo (n=21)									52	
Muhorshibir (n=19)						5			42	
Tseremushki (n=7)						+				
***Microtus fortis* (n=129)**	**3**	**12**	**2**	**1**	**2**				**29**	
Kamensk (n=24)		13			4				50	
Pasolskaya (n=2)									+	
Maloje Kolesova (n=12)		25	17	8					17	
Barguzin River (n=30)		20								
Shapen’kovo (n=25)	4								60	
Nesteriha (n=13)	23								23	
Muhorshibir (n=16)		6			13				6	
Zabaikalsk (n=7)		+							+	
***Microtus oeconomus* (n=26)**		**12**							**27**	
Ganzurinov (n=8)		+								
Nizhnaya Ivolga (n=9)		+							+	
Utochkina Pad (n=1)										
Shapen’kovo (n=5)									+	
Tseremushki (n=3)										

We used snap-traps (Finnish metal mouse trap), which were set in the late afternoon and evening, and checked early next morning. In the field, rodents were placed in a Styrofoam box with coolers, kept in a refrigerator in a laboratory, and dissected the same day. The cestodes found were first allowed to relax in tap water, then fixed flat (without pressure) in 70% ethanol, and those used for morphology stained later with Mayer’s haemalum, Semichon’s acetocarmine or ironacetocarmine, cleared in eugenol and mounted in Canada balsam. Voucher specimens (whole-mounts) of all identified cestode species from Buryatia have been deposited in the Museum of Southwestern Biology, University of New Mexico, USA (MSB) and the United States National Parasite Collection, Maryland, USA (USNPC).

Most of the comparative cestode materials from Chukotka, North-East Siberia, were collected in connection with the Beringian Coevolution Project (BCP; see Cook et al. 2005; Hoberg et al. 2003).

Seven specimens of *Paranoplocephala* Lühe, 1910 from Buryatia were sequenced for the partial cytochrome oxidase I (COI) gene and embedded in a larger COI sequence data set of *Paranoplocephala* spp., originating primarily from Wickström et al. (2005). GenBank numbers for the COI sequences are given in Fig. 2. For the extraction, amplification and sequencing of DNA, see Wickström et al. (2003, 2005) and Haukisalmi et al. (2004).

Altogether 43 COI sequences (569-679 bp) of *Paranoplocephala* spp. were aligned using Clustal X (Thompson et al. 1997) with sequences of *Andrya rhopalocephala* (Riehm, 1881) and *Neandrya cuniculi* (Blanchard, 1891), the latter two species from lagomorphs used as an outgroup. A neighbour-joining distance phylogram was constructed in PAUP* (version 4.0 b10; Swofford 2002) using Kimura 2-parameter distances. Bootstrap support for the topology was estimated through 10 000 pseudoreplicates.

Results

Anoplocephalidae

Anoplocephaloides cf. *dentata* (Galli-Valerio, 1905)

The names *Paranoplocephala dentata* (Galli-Valerio, 1905), *Anoplocephaloides dentata* (Galli-Valerio, 1905) and *Paranoplocephala brevis* Kirshenblat, 1938 have been variously used for small, wedge-shaped cestodes parasitizing voles of the genera *Microtus* and *Chionomys* Miller (and occasionally other hosts) in the Palaearctic region. The position of *A. dentata* within the genus *Anoplocephaloides* Baer, 1923, as suggested by Rausch (1976), has been generally accepted. Following Spasskii (1951), *P. brevis* has been consistently regarded as a junior synonym of *A. dentata*. Thus, all *A. dentata*-like cestodes in the Palaearctic voles have been considered a single species, with the exception of *Anoplocephaloides dentatoides* Sato, Kamiya, Tenora & Kamiya, 1993 from *Myodes rufocanus* from Hokkaido, Japan (see Sato et al. 1993).

A recent molecular phylogenetic analysis (Haukisalmi et al. 2009) suggested that *A. dentata*-like cestodes include at least five species (plus *A. dentatoides*) in the Holarctic region: four species in western Eurasia and one in the rest of Eurasia and Beringia (north-eastern Siberia and Alaska). Based on the cytochrome oxidase I (mtDNA) sequences, the *A. dentata*-like cestodes from Buryatia (hosts *Myodes rufocanus* and *Microtus fortis*) group strongly, and are therefore conspecific, with the Holarctic species

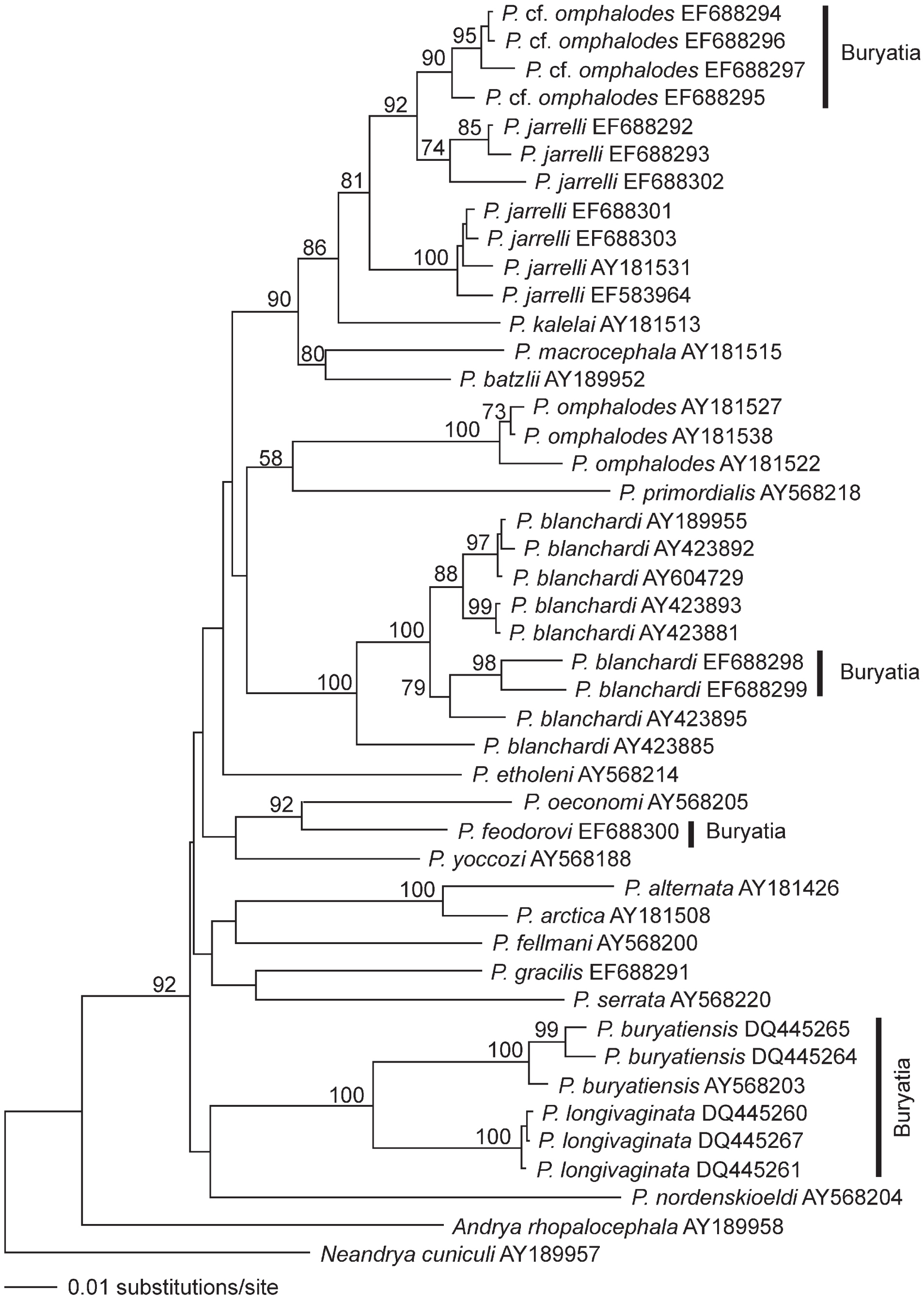

Fig. 2. A neighbour-joining reconstruction of partial cytochrome oxidase I (mtDNA) sequences of *Paranoplocephala* spp., *Andrya rhopalocephala* and *Neandrya cuniculi* from lagomorphs were used as an outgroup. The labels show the GenBank number for each sequence. Values at nodes show the percentage from 10000 bootstrap replicates.

(Haukisalmi et al. 2009). However, it is not yet known if this Holarctic species is conspecific with either of the two related species described in North America, i.e. *Anoplocephaloides infrequens* (Douthitt, 1915) and *A. troeschi* (Rausch, 1946) from *Geomys bursarius* (Shaw) (Geomyidae) and *Microtus pennsylvanicus* (Ord), respectively.

In the Palaearctic, *A. dentata*-like cestodes are characteristically parasites of voles of the genera *Microtus* and *Chionomys*. However, in addition to *Microtus gregalis* (Pallas), *M. maximowiczii* and *M. oeconomus*, Machul'skii (1958) and Zhaltsanova (1992) reported *P. brevis* or *P. dentata* from *Myodes rufocanus*, *M. rutilus*, *Apodemus peninsulae* and *Cricetulus barabensis* in Buryatia. In the present study, *A.* cf. *dentata* was found from *Microtus fortis* and *Myodes rufocanus*. It is probable that all *A. dentata*-like cestodes in Buryatia represent a single species, with the occurrences in *Myodes*, *Apodemus* and *Cricetulus* being accidental.

Because there are few morphological features useful for the diagnosis of *A. dentata*-like cestodes, sequence data (COI, 28S rRNA) have proved to be necessary tools in the taxonomy of this species complex (Haukisalmi et al. 2009).

Anoplocephaloides cf. *dentata* was significantly more prevalent in Nesteriha (23%) than in the other study sites (0-6%) (Table 1).

Voucher specimen: MSB Endo 152 from *Microtus fortis* (Nesteriha).

***Paranoplocephala* cf. *omphalodes* (Hermann, 1783)**

It has been recently shown that *P. omphalodes sensu stricto* is primarily a parasite of *Microtus agrestis* (L.) and *M. arvalis* (Pallas) in Europe and probably elsewhere in western Eurasia (Haukisalmi et al. 2004). There is another, rather host-specific species in *M. oeconomus* (i.e. *Paranoplocephala jarrelli* Haukisalmi, Henttonen & Hardman, 2006) that occurs in the root/tundra vole throughout its Holarctic range. The *P. omphalodes*-like taxon occurring in the eastern Beringian endemic *Microtus miurus* Osgood is also specifically distinct (i.e. *Paranoplocephala batzlii* Haukisalmi, Henttonen & Hardman, 2006; see Haukisalmi et al. 2006).

The present molecular phylogenetic analysis shows unequivocally that the *P. omphalodes*-like cestodes in Buryatia do not represent the true *P. omphalodes* (Fig. 1).

The Buryatian specimens form a monophyletic group that is sister to the divergent North Alaskan subclade of *P. jarrelli*. The topology and high statistical support of the tree suggests that these two clades are both independent species, forming a sister group for the true, Holarctic *P. jarrelli*.

In the present material, the Buryatian *P.* cf. *omphalodes* occurred exclusively in *Microtus fortis* and *M. oeconomus*. *Paranoplocephala omphalodes* has earlier been reported from *M. maximowiczii*, *M. oeconomus*, *Myodes rufocanus* and *Apodemus peninsulae* in Buryatia and adjacent regions (Machul'skii 1958; Zhaltsanova 1992). The earlier Buryatian records of *P. omphalodes* from *Myodes rufocanus* probably represent another, recently described species (i.e. *Paranoplocephala buryatiensis* Haukisalmi, Hardman, Hardman, Laakkonen, Niemimaa & Henttonen, 2006; see below).

Paranoplocephala cf. *omphalodes* from Buryatia may be primarily associated with the Asian *Microtus* species, i.e. *M. fortis* and *M. maximowiczii*, because it is not known from *M. oeconomus* outside Buryatia. *Paranoplocephala* cf. *omphalodes* will be later described as a new species.

Paranoplocephala cf. *omphalodes* was present in seven of the 12 study sites, highest prevalences being 20-23% (Table 1).

Voucher specimen: MSB Endo 153 from *M. oeconomus* (Nizhnaya Ivolga).

Paranoplocephala blanchardi **(Moniez, 1891)**

Paranoplocephala blanchardi (Moniez, 1891) *sensu* Tenora et al. (1985b) is primarily a parasite of *Microtus* spp. in Europe (Haukisalmi et al. 1994; Tenora et al. 1985b) and western Siberia, extending at least to the Novosibirsk region in the east (Chechulin 1998). The conspecificity of two Buryatian specimens of *P. blanchardi* (from *Microtus fortis*) with the European specimens is confirmed by the present molecular phylogenetic analysis (Fig. 2). The Buryatian records thus represent the easternmost finding of this species. Despite considerable sampling effort, *P. blanchardi* has not been found in north-eastern Siberia (Magadan region, Chukotka; unpublished BCP records).

P. blanchardi was found at a single study site (prevalence 17%) (Table 1).

Voucher specimen: MSB 154 from *M. fortis* (Maloje Kolesova).

Paranoplocephala feodorovi **(Gulyaev & Chechulin, 1996)**

Paranoplocephala feodorovi was originally described as *Parandrya feodorovi* Gulyaev & Chechulin, 1996 from *Arvicola terrestris* (L.) (primary host), *Microtus agrestis* and *M. maximowiczii* from the Novosibirsk region in the south of West Siberia (type locality) and Zabaikalsk in Buryatia (Gulyaev and Chechulin 1996; see Chechulin 1998 for further records in the latter region). Only a single specimen from *Microtus fortis* conforming to the description of *P. feodorovi* was encountered during the present study, which supports the secondary role of *Microtus* spp. in the epidemiology of this cestode.

Morphologically, *P. feodorovi* is closely related to *P. blanchardi*, the main difference being the antiporal extent of the testes (extending across the antiporal ventral longitudinal osmoregulatory canal in *P. blanchardi*, but not in *P. feodorovi*). However, *P. feodorovi* is not genetically related to *P. blanchardi*. In the COI phylogram, *P. feodorovi* was associated with *P. oeconomi*, appearing as one of the basal lineages within *Paranoplocephala* (Fig. 2). The phylogenetic position of *P. feodorovi* supports the hypothesis that *Parandrya* Gulyaev & Chechulin, 1996 is a synonym of *Paranoplocephala s.l.*, as suggested by Haukisalmi and Henttonen (2000) and Haukisalmi and Wickström (2005).

Voucher specimen: MSB Endo 155 from *M. fortis* (Maloje Kolesova).

Paranoplocephala buryatiensis **Haukisalmi, Hardman, Hardman, Laakkonen, Niemimaa & Henttonen, 2006**

P. buryatiensis, described from Buryatian material, is primarily a parasite of *Myodes rufocanus* (Haukisalmi et al. 2007a), although it was found occasionally in *Microtus fortis* in the present material. Its known range spans from Buryatia to north-eastern Siberia. However, it does not occur in the westernmost populations of *Myodes rufocanus* in northern Fennoscandia (Haukisalmi et al. 2007a).

P. buryatiensis is morphologically and genetically closely related to *P. longivaginata* Chechulin & Gulyaev, 1998 from *Myodes rutilus* (below); they form a strongly supported clade in the mtDNA phylogenies (Fig. 2 and Haukisalmi et al. 2007a). Haukisalmi et al. (2007a) provided evidence for phylogenetic codivergence of *P. buryatiensis* and *P. longivaginata* with their primary hosts.

P. buryatiensis occurred in *Myodes rufocanus* at four of the eight study sites, the prevalence in Pasolskaya (43%) being higher than in the other sites (0-10%). It also occurred in *Microtus fortis* at two study sites, where it also parasitized the primary host *Myodes rufocanus*.

Type specimen: USNPC 97137 from *Myodes rufocanus* (Pasolskaya); paratype specimen: USNPC 97138 from *M. rufocanus* (Pasolskaya); voucher specimen: USNPC 97139 from *Microtus fortis* (Kamensk).

Paranoplocephala longivaginata **Chechulin & Gulyaev, 1998**

P. longivaginata was described from *Myodes rutilus* and, secondarily, from *Sciurus vulgaris* L., in Buryatia and the neighbouring Amurskaya Oblast (Chechulin and Gulyaev 1998). In addition to Buryatia and adjacent regions, it has been found from *Myodes rutilus* in north-eastern Siberia (Magadan region; Haukisalmi et al. 2007a). However, *P. longivaginata* does not occur in *M. rutilus* in north-western North America (unpublished BCP data).

P. longivaginata occurred at five of the seven study sites, but always at a low prevalence.

Voucher specimen: MSB Endo 156 from *Myodes rutilus* (Verhnaya Berezovka).

Catenotaeniidae

Catenotaenia **sp. 1**

The specimens from *Cricetulus barabensis* resemble *Catenotaenia dendritica* (Goeze, 1782), *C. laguri* Smith, 1954, *C. linsdalei* McIntosh, 1941, *C. reggiae* Rausch, 1951 and *C. ris* Yamaguti, 1942 in having numerous uterine branches (39-43 in the present specimens). However, these species have either significantly more numerous (*C. den-*

dritica, *C. reggiae*, *C. ris*) or less numerous (*C. laguri*, *C. linsdalei*) testes than the present specimens (ca. 80). Moreover, three of these species are specific parasites of sciurids (*C. dendritica*, *C. reggiae*, *C. ris*), two other have been found only from *Lemmiscus* Thomas (*C. laguri*) and *Thomomys* Wied-Neuwied (*C. linsdalei*), and three of them are known only from North America (*C. reggiae*, *C. laguri*, *C. linsdalei*). We conclude that the present specimens from *C. barabensis* represent an undescribed species of *Catenotaenia* Janicki, 1904.

Zhaltsanova (1992) reported *Catenotaenia cricetorum* Kirshenblat, 1949 from *C. barabensis* from Buryatia, but did not provide any morphological data for the cestode. We assume that the specimens of Zhaltsanova (1992) from *C. barabensis* actually represent the same undescribed species as found by us from Buryatian hamsters.

Voucher specimen: MSB Endo 157 from *C. barabensis* (Ganzurinov).

***Catenotaenia* sp. 2**

The cestodes from *Apodemus peninsulae* had 29-34 uterine branches, which corresponds with *Catenotaenia afghana* Tenora, 1977, *C. californica* Dowell, 1953, *C. neotomae* Babero & Cattan, 1983 and *C. peromysci* Smith, 1954. However, the cestodes found by us have a clearly divided testicular field, a feature which occurs in *C. californica* but not in the three other species mentioned above. Compared with the present material, *C. californica* has markedly wider body (0.75-0.83 mm in the present specimens) and smaller scolex (ca. 0.38 mm in the present specimens). Since *C. californica*, *C. neotomae* and *C. peromysci* are Nearctic parasites of heteromyid and sigmodontid (Neotominae) rodents, it is unlikely that they would occur in a murid rodent in Eurasia. The brief original description of *C. afghana* was based on material from two unrelated host species, *Cricetulus migratorius* (Pallas) and *Alticola* sp. from Afghanistan, and it was not stated which was the type host. Moreover, no type specimen was designated (Tenora 1977). Ganzorig et al. (1999) later redescribed *C. afghana* from *Lasiopodomys brandtii* (Radde) from Mongolia but it is probable that the specimens assigned to *C. afghana* include more than one species. The specimens from Buryatian *A. peninsulae* may therefore represent another undescribed species of *Catenotaenia*.

Voucher specimen: MSB Endo 158 from *A. peninsulae* (Kamensk).

Hymenolepididae

Arostrilepis horrida* (von Linstow, 1901) *s.l.

In the present material, *Arostrilepis horrida*-like cestodes occurred commonly in all *Microtus* and *Myodes* species and accidentally in *C. barabensis* but were absent in *A. peninsulae*. The data of Zhaltsanova (1992) show an equally wide host spectrum for *Arostrilepis horrida*-like cestodes in Buryatia. Three species have been described within the *A. horrida*-complex, i.e. *A. horrida* from an unknown rodent host, *A. beringiensis* Kontrimavichus & Smirnova, 1991 from *Lemmus sibiricus* and *A. microtis* Gulyaev & Chechulin, 1997 from *Microtus* spp. (see Kontrimavichus and Smirnova 1991 and Gulyaev and Chechulin 1997). However, applying molecular methods, the BCP has demonstrated a complex of at least 10 species of *A. horrida*-like cestodes that are poorly differentiated morphologically (Cook et al. 2005, and K. Galbreath and E. P. Hoberg, unpublished). For example, there may be five *Arostrilepis*-species in *Myodes* spp. (species previously assigned to *Clethrionomys*) and two species in *Microtus* spp. in the Holarctic region. The situation is complicated by the fact that it is not known which one (if any) of them is the true *A. horrida*. Therefore, it is not possible to assign the present specimens to a particular species of *Arostrilepis*. However, it is probable that the Buryatian material includes at least one undescribed species, i.e. that/those occurring in *Myodes* spp.

Voucher specimens: MSB Endo 159 from *Microtus fortis* (Kamensk), MSB Endo 160 from *M. oeconomus* (Nizhnaya Ivolga), MSB Endo 161 from *Myodes rufocanus* (Kamensk), MSB Endo 162 from *Myodes rutilus* (Muhorshibir).

***Rodentolepis* sp.**

Rodentolepis sp. from *Cricetulus barabensis* was characterized by 22-24 fraternoid hooks. In this respect it resembles *Rodentolepis fraterna* (Stiles, 1906) (see Genov 1984) and *R. sinensis* (Oldham, 1929) (see Ryzhikov et al. 1978), although the hooks of the present species are somewhat longer (0.020-0.032 mm) than those of *R. fraterna*. In addition, the scolex of the present cestode is significantly larger (0.24-0.26 mm) than that of *R. sinensis*, and its eggs are significantly longer (0.060-0.075 mm) than those of *R. fraterna*. It is probable that *Rodentolepis* sp. from Buryatia represents an undescribed, host-specific species of *C. barabensis*. The high variation in hook length suggests that the material may include more than one species.

Zhaltsanova (1992) reported *R. straminea* (Goeze, 1782) from *C. barabensis* and *Myodes rufocanus* from Buryatia, but that identification is dubious, because many forms, including *R. fraterna* and *R. nana* (Siebold, 1852), have been synonymized with *R. straminea* in the Soviet/Russian literature (see Ryzhikov et al. 1978).

Voucher specimen: MSB Endo 163 from *C. barabensis* (Sharaldai).

Diversity and distribution

The present study shows that there are at least 11 species of cestodes in the Buryatian rodents (assuming 2 species in the *A. horrida*-complex), of which at least five species are previously unreported from the region. The anoplocephalid cestode fauna of Buryatian arvicoline rodents (voles and lemmings) includes a minimum of seven species

(Table 2). The species diversity of the corresponding fauna is equally low in North-East Siberia (six species), whereas the European fauna consists of at least 17 species. Additionally, almost half (eight species) of European anoplocephalid species are endemic

Table 2. Host and geographic distribution of anoplocephalid cestodes of voles and lemmings in Europe, Buryatia and North-East Siberia. The host species are: *Myopus schisticolor (sch)*, *Ondatra zibethicus (zib)*, *Arvicola amphibius (amb)*, *Chionomys nivalis (niv)*, *Microtus agrestis (agr)*, *M. arvalis (arv)*, *M. cabrerae (cab), M. fortis (for)*, *M. guentheri (gue)*, *M. oeconomus (oec)*, *M. subterraneus (sub)*, *Myodes glareolus (gla)*, *My. rufocanus (rufo)* and *My. rutilus (ruti)*. The Arctic lemmings of the genera *Lemmus* and *Dicrostonyx* have been excluded, because they are absent in Buryatia. The primary host species in each region (when evident) have been in indicated in bold.

	Europe	Buryatia	North-East Siberia	General distibution	Sources
Anoplocephaloides dentata	***niv***, *arv*	-	-	Europe	1, 2, 3
A. cf. *dentata*	***oec***	***for***; *rufo*	***oec***	Holarctic	1, 2, 3
A. cf. *dentata* 2	*agr, oec*	-	-	Europe	1, 2, 3
A. cf. *dentata* 3	***arv***	-	-	Europe	1, 2, 3
Anoplocephaloides mascomai	***cab***	-	-	Europe	4
Microcephaloides sp. 1	*agr, oec*	-	-	Europe	2
Microcephaloides sp. 2	***gue***		-	Europe	2
Microcephaloides sp. 3	-	-	***oec***	Holarctic?	2
M. tenoramuraiae	*niv, sub*	-	**-**	Europe	5
Paranoplocephala aquatica	***amb***, *zib*	-	-	Europe	6
P. blanchardi	***agr***, ***arv***, *oec; gla*	***for***	-	Palearctic	7, 8
P. buryatiensis	-	***rufo***; *for*	***rufo***	Palearctic	8, 9
P. feodorovi	-	***amb***; *for*	-	Palearctic	8, 10
P. gubanovi	**-**	***sch***	-	Palearctic	20
P. gracilis	***agr***, *arv, oec; gla, rufo, ruti*	-	-	Palearctic	7, 8, 11
P. janickii	***arv***	-	-	Palearctic	7
P. jarrelli	***oec***	-	***oec***	Holarctic	8, 12, 13
P. kalelai	***rufo***, *gla*	-	-	Palearctic	14 , 15
P. longivaginata	-	***ruti***	***ruti***	Palearctic	8, 9, 16
P. oeconomi	***oec***	-	-	Palearctic	17
P. omphalodes	***arv***, ***agr***; *gla*	-	-	Palearctic	12, 14
P. cf. *omphalodes*	-	*for, oec*	-	Palearctic	8
P. primordialis (s.l.)	-	-	*ruti; oec*	Holarctic	18
P. yoccozi	***niv***	-	-	Palearctic	19

1, Wickström et al. 2005. 2, Haukisalmi et al. 2008. 3, L.M. Hardman et al., unpublished. 4, Murai et al. 1980. 5, Genov and Georgiev 1988. 6, Genov et al. 1996. 7, Tenora et al. 1985b. 8, present study. 9, Haukisalmi et al. 2007a. 10, Gulyaev and Chechulin 1996. 11, Tenora and Murai 1980. 12, Haukisalmi et al. 2004. 13, Haukisalmi et al. 2006. 14, Tenora et al. 1985a. 15, Haukisalmi et al. 2007b. 16, Chechulin and Gulyaev 1998. 17, Gubányi and Murai 2002. 18, V. Haukisalmi and R. L. Rausch, unpublished. 19, Haukisalmi and Henttonen 2005. 20, Gulyaev and Krivopalov 2003.

to this region. Anoplocephalid cestodes of Buryatian rodents consist predominantly of Palaearctic species; only two of them may be endemic to Buryatia or Central Eurasia. Endemism is equally low in North-East Siberia. It should be noted that one of the most specious anoplocephalid lineages of arvicoline rodents, *Microcephaloides* spp. (earlier known as *Anoplocephaloides variabilis*-like cestodes), appears to be absent in Buryatia, although it occurs widely in Europe and North America, and sporadically in North-East Siberia (Haukisalmi et al. 2008).

The high species diversity and endemism in Europe is partly due to the high taxonomic diversity of voles in that region; of the 14 vole and lemming species considered in the present comparison, seven occur exclusively in Europe or western Eurasia. If we restrict the comparison to the vole species with a wide Palaearctic or Holarctic distribution (*Microtus oeconomus*, *Myodes rufocanus* and *M. rutilus*), Europe (eight spp.) still shows somewhat higher species diversity than Buryatia (four species) and North-East Siberia (six spp.). The differences in species diversity may also reflect the more extensive research and use of molecular methods for the European fauna. However, high European species diversity has also been indicated for anoplocephalid cestodes of lagomorphs (Spasskii 1951), suggesting that this phenomenon may have a more general biogeographical and/or historical explanation. The existing phylogenetic data indicate a possible European origin for *Microcephaloides* Haukisalmi, Hardman, Hardman, Rausch & Henttonen, 2008 (see Haukisalmi et al. 2008) and *Paranoplocephala s. str.* (see Haukisalmi et al. 2004), suggesting that Europe may have acted as a centre of origin for several independent anoplocephalid lineages. However, the phylogenetic relationships among various anoplocephalid lineages are still unresolved, which impedes more comprehensive analyses on the historical biogeography of anoplocephalid cestodes of arvicoline rodents.

The faunistic connections of Buryatia seem to be slightly closer to North-East Siberia than to Europe; Buryatian anoplocephalids shared three and two species with these regions, respectively. Moreover, an unexpected connection is seen between Buryatia and eastern Beringia; namely, the sister clade/species of the Buryatian *P.* cf. *omphalodes* occurs in the northernmost Alaska, but probably not elsewhere in North America. Neither clade has been found in extensive studies in the North-East Siberia (BCP), suggesting that the present distribution represents a relict of an earlier continuous distribution. On the continental level, the Buryatian taiga corridor has probably not played a significant role as a migration pathway among anoplocephalid cestodes of rodents; only one species with a continent-wide distribution (*A.* cf. *dentata*) occurred in Buryatia. Moreover, *A.* cf. *dentata* also occurs also in North-Central Siberia (Tunguska river region; Haukisalmi et al. 2009) and may not necessarily have utilized the Buryatian corridor.

The present and earlier studies (Haukisalmi et al. 2008, Haukisalmi et al. 2004, Hu et al. 2005) show that molecular markers, such COI sequences, are necessary tools in the taxonomy of anoplocephalid cestodes, which lack a rostellum and hooks and which can be devoid of reliable distinguishing features. It can be estimated that 50-60% of species diversity of anoplocephalid cestodes of voles and lemmings in the

Holarctic region would have remained undetected if the taxonomy had been based on morphological features only (Table 2 and unpublished records of the BCP and present authors). No molecular systematic studies exist for catenotaeniids but because they also lack anchoring devices, additional, cryptic species diversity is expected to occur also within this family.

The present results demonstrate high variation among study sites in cestodes of Buryatian rodents, with the exception of the ubiquitous *A. horrida*-complex (Table 1). Haukisalmi and Henttonen (1999) showed that patchiness is a predictable feature of certain helminths of rodents and that such patches may be remarkably persistent. The BCP studies also reveal fine-scaled spatial variation in many anoplocephalid cestodes of voles and lemmings in Alaska and adjacent regions (Haukisalmi et al. 2009, Haukisalmi et al. 2004, Wickström et al. 2003). Patchiness has an obvious implication for assessment of the biodiversity cestodes: species and genetic diversity may be much underestimated in samples that are not spatially comprehensive. In addition, helminths may be very specialized in a certain cohort(s) and/or sex of the host, related to seasonally changing heterogeneity of rodent populations (Haukisalmi et al. 1995), which should also be considered in the estimation of parasite diversity.

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RESEARCH ARTICLE

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Roncus elbulli (Arachnida, Pseudoscorpiones), a new species from Cap de Creus Nature Park (Catalonia, Spain), with a key to the Spanish species of the genus *Roncus*

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Abstract

Roncus elbulli **sp. n.** is described from Cap de Creus Nature Park (Catalonia, Spain). The new species is morphologically close to *Roncus cadinensis* Zaragoza, 2007 (Barcelona province), but differs by being smaller in size and having a more robust chela with a different microsetae pattern. The new species seems to be restricted to coastal semiarid slopes with garrigue vegetation. A key to the Spanish species of the genus *Roncus* is provided.

Keywords

Pseudoscorpiones, Neobisiidae, *Roncus*, identification key, new species, Catalonia, Spain

Introduction

Three species of the genus *Roncus* L. Koch, 1873 have recently been described from Catalonia: *Roncus judsoni* Henderickx & Zaragoza, 2005 (eastern Pyrenees, province of Gerona), *Roncus cadinensis* Zaragoza, 2007 (Cadí-Moixeró Natural Park, province of Barcelona) and *Roncus montsenyensis* Zaragoza & Šťáhlavský (2008) (Montseny Natural Park, province of Barcelona). Here we describe an additional new species of this genus from Cabo de Creus Natural Park, province of Gerona, Catalonia, Spain. This new discovery supports Zaragoza and Šťáhlavský's (2008) suggestion that more endemic species of *Roncus* remain undiscovered or misidentified in Northeast Spain, as well as in Southeast and Balearic islands (first author, pers. obs.). This study also reveals that the *Roncus* of Catalonia colonize diverse types of habitats and that this is partly responsible for their endemicity.

Material and methods

The specimens used for morphological study were dissected and examined as temporary glycerine mounts in cavity slides. After examination, the specimens were individually preserved in 70% ethanol inside glass vials, with the dissected appendages in glass microvials inside each vial. Microscopical examination was carried out with a Zeiss Axiolab light microscope, which was also used to take measurements of the appendages and make the drawings. SEM photographs were taken with a HITACHI S-3000N microscope. The measurements were based on Chamberlin's (1931) reference points; the length of the chela and its palm include the pedicel; all measurements are in millimetres. The ratios given are the length/width index of an article, when two articles are compared the ratio is the length/length index. The terminology follows Chamberlin (1931), including trichobothriotaxy, with modifications to the nomenclature of the segments of the pedipalps and legs (Harvey 1992). The terminology of faces of the appendages and the chelal spot-sensilla follows Judson (2007); the term "rallum" is adopted from Judson (2007) for the cheliceral flagellum. The formula of the setal rows of the carapace follows Gabbutt and Vachon (1967).

Abbreviations:

alt.	altitude.
av.	average measurements.
DEUA	Departamento de Ecología, Universidad de Alicante.
HHC	Hans Henderickx, personal collection.
MCNB	Museu de Ciències Naturals, Barcelona.
MHNG	Muséum d'Histoire naturelle de la Ville de Genève.
MNCNM	Museo Nacional de Ciencias Naturales, Madrid.
MNHNP	Muséum national d'Histoire naturelle, Paris.
NHMW	Naturhistorisches Museum Wien.
PT	pseudotactile seta (similar to tactile seta, but shorter).
TS	tactile setae.

Description

Roncus elbulli Zaragoza & Henderickx, sp. n.

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(Figs 1-14, 16-18)

Type material. Male holotype: Spain, Catalonia, Gerona province, Cap de Creus Natural Park, Roses, Cala Montjoi, coordinates 42° 15' 29.75" N, 3° 13' 23.79" W, altitude 100m, under stones, 15 November 2005, leg. H. Henderickx (deposited in DEUA). Paratypes: (all from same location as the holotype or from neighbouring bay slopes "calas"; all collected by H. Henderickx): Cala Canadell, 42° 15' 11.99" N, 3° 14' 33.17" W, alt. 100 m, 2 males, 3 females, 29 October 2002 (1 male 1 female deposited in HHC, 1 male in MHNG, 1 female in DEUA, 1 female in MCNB); Cala Montjoi, 42° 15' 29.75" N, 3° 13' 23.79" W, alt. 100 m, 5 males, 15 November 2005 (1 male deposited in HHC, 1 male in MCNB, 1 male in MNCNM, 1 male in MNHNP, 1 male in DEUA); Cala Rostella, 42° 14' 42.42" N, 3° 13' 23.97" W, alt. 100 m, 2 males, 27 October 2003 (1 male deposited in DEUA, 1 male in NHMW); Cala Murtra, 42° 14' 32.92" N, 3° 13' 16.52" W, alt. 100m, 1 female, 31 October 2002 (deposited in MCNB); 1 male, 1 female, 29 November 2002 (male deposited in MNCNM, female in MHNG); 1 male, 1 female, 2 December 2002 (male deposited in NHMW, female in MNHNP); 1 female, 27 December 2003 (deposited in DEUA).

Diagnosis. Epigean *Roncus* with typical roncoid facies, robust palps, small in size. Carapace longer than broad, av.: 1.20×; epistome moderately prominent; chaetotaxy: 4-8-6-6: 24. Anterior process of coxa I with tooth shape, medial process without denticles. Palp femur granulated at the paraxial face but without tubercles, one tubercle at middle of antiaxial face; longer than either chelal finger or carapace; males 3.19-3.53×(0.56-0.67/0.17-0.20), females 3.20-3.48×(0.66-0.78/0.20-0.24). Patella smooth. Chela, males 2.99-3.16×(0.94-1.14/0.30-0.38), females 2.83-3.08×(1.11-1.34/0.38-0.47). Chelal finger longer than the hand. Chelal fixed finger with 60 (av.) teeth, movable finger 56 (av.). Without microsetae proximal to the trichobothrium *eb*. One or two, even without microsetae below trichobothria *eb* and *esb*.

Etymology. The species epithet, *elbulli,* is a noun in apposition and refers to the world-famous *Restaurante El Bulli*, which is located at the *locus typicus*, Cala Montjoi.

Description. The data correspond to the male holotype, followed by paratype males and females data in parentheses. Measurements and ratios in Table 1.

Opisthosomal pleura and legs yellowish, tergites slightly sclerotized. Carapace, chelicerae and pedipalps reddish.

Carapace (Fig. 3) longer than broad, widest at the middle. One pair of reduced eyes with flattened lenses 0.050 (0.050-0.065) mm long, situated 0.055 (0.058-0.086) mm from anterior margin. Epistome moderately prominent (Fig. 4), isosceles triangle-shaped, longest side opposite to apex (or equilateral), apex slightly rounded (or pointed), 0.016 (0.013-0.035) mm long and 0.025 (0.015-0.035) mm wide. Chaetotaxy: 24 (24-26) setae, formula: 4:6:8:6 (4:5-6:8-10:6). Glandular pores present, 3 (0-4) on

Table 1. *Roncus elbulli* sp. n.: measurements and ratios

***Roncus elbulli* sp. n.**	**♂ holotype**	**11 ♂ paratypes**	**7 ♀ paratypes**
Body	1.72	1.40-2.12	1.45-2.88
Carapace	1.21× (0.58/0.48)	1.13-1.25× (0.56-0.69/0.47-0.55)	1.15-1.27× (0.65-0.76/0.54-0.66)
Chelicera			
Hand	0.36/0.18	0.32-0.39/0.17-0.20	0.39-0.47/0.21-0.23
Finger	0.25	0.23-0.34	0.27-0.34
Palp			
Trochanter	1.98× (0.35/0.18)	2.00-2.28× (0.34-0.42/0.16-0.20)	1.95-2.13× (0.39-0.48/0.19-0.23)
Femur	3.19× (0.59/0.19)	3.19-3.53× (0.56-0.67/0.17-0.20)	3.20-3.48× (0.66-0.78/0.20-0.24)
Patella	2.09× (0.48/0.23)	2.10-2.27× (0.46-0.55/0.20-0.25)	2.07-2.30× (0.53-0.65/0.25-0.30)
Pedicel	0.16	0.16-0.19	0.17-0.21
Club	1.39× (0.32/0.23)	1.38-1.51× (0.30-0.37/0.20-0.25)	1.35-1.54× (0.36-0.44/0.25-0.30)
Club/pedicel	2.00×	1.87-2.06×	1.86-2.12×
Hand	1.46× (0.48/0.33)	1.36-1.52× (0.44-0.56/0.29-0.38)	1.42-1.53× (0.56-0.66/0.38-0.47)
Pedicel	0.09	0.07-0.10	0.09-0.11
Finger	0.56	0.51-0.63	0.57-0.70
Chela	3.01× (0.99/0.33)	2.99-3.16× (0.94-1.14/0.30-0.38)	2.83-3.08× (1.11-1.34/0.38-0.47)
Chela/carapace	1.71×	1.65-1.85×	1.71-1.81×
Femur/carapace	1.02×	0.96-1.06×	1.00-1.07×
Femur/finger	1.07×	1.02-1.11×	1.07-1.16×
Femur/patella	1.24×	1.18-1.29×	1.17-1.25×
Patella/hand	1.00×	0.94-1.02×	0.94-0.99×
Finger/hand	1.16×	1.07-1.19×	1.00-1.11×
Leg I			
Femur	3.00× (0.32/0.11)	2.92-3.27× (0.29-0.36/0.10-0.13)	2.96-3.20× (0.34-0.42/0.12-0.13)
Patella	2.66× (0.23/0.09)	2.48-2.80× (0.21-0.25/0.08-0.10)	2.31-2.68× (0.23-0.28/0.10-0.11)
Tibia	4.23× (0.28/0.07)	4.23-4.71× (0.28-0.33/0.06-0.08)	4.07-4.68× (0.31-0.37/0.07-0.08)

***Roncus elbulli* sp. n.**	**♂ holotype**	**11 ♂ paratypes**	**7 ♀ paratypes**
Basitarsus	2.57× (0.13/0.05)	2.60-2.95× (0.13-0.16/0.05-0.06)	2.55-2.77× (0.14-0.16/0.05-0.06)
Telotarsus	4.97× (0.23/0.05)	4.64-5.47× (0.21-0.26/0.04-0.05)	4.59-5.28× (0.23-0.29/0.05)
Femur/patella	1.36×	1.35-1.53×	1.36-1.58×
Telo-/basitarsus	1.76×	1.53-1.69×	1.51-1.78×
Leg IV			
Femur+patella	2.74× (0.55/0.20)	2.67-3.00× (0.51-0.61/0.18-0.22)	2.74-3.20× (0.59-0.69/0.20-0.24)
Tibia	5.17× (0.50/0.10)	5.18-5.46× (0.48-0.57/0.09-0.11)	5.01-5.50× (0.53-0.63/0.11-0.12)
Basitarsus	2.46× (0.17/0.07)	2.43-2.58× (0.16-0.20/0.07-0.08)	2.31-2.55× (0.20-0.21/0.08)
Telotarsus	4.63× (0.29/0.06)	4.58-4.88× (0.28-0.32/0.06-0.07)	4.40-4.79× (0.30-0.35/0.07-0.08)
Telo-/basitarsus	1.66×	1.59-1.79×	1.66-1.73×

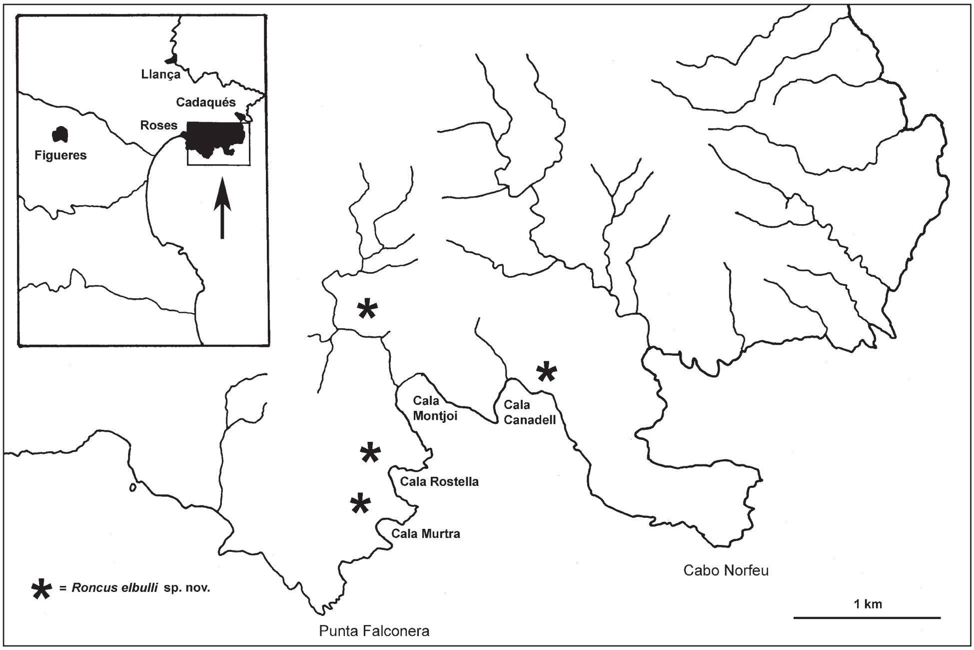


Figure 1. Map showing the bay slopes "calas" where *Roncus elbulli* sp. n. is found.

Figure 2. Habitus of *Roncus elbulli* sp. n. (Cap de Creus, October 2002).

each side between anterior and ocular zones. One microlyrifissure close to each eye and one on each side of the posterior zone.

Coxal area. Manducatory process with 4 (3-4) setae; palpal coxa with 8 (7-9) setae, pedal coxa I with 8 (6-8) setae, II: 6-7 (6-7), III: 5 (4-6), IV: 7-9 (7-9). Anterior process of coxa I (Fig. 5) with simple tooth shape, apically pointed (seldom culminating in two denticles), 0.023 (0.015-0.030) mm long and 0.015 (0.015-0.023) mm broad; medial process straight, not prominent, without denticles.

Tergal chaetotaxy I–X: 6:10:11:11:11:11:11:11:11(4 PT):9(4 TS) (5-8:9-11:10-11:11:11:11-12:11-12:11-12:11:9-10). Segment XI with 10 setae, 6 of which are tactile setae. Anal cone with 2 dorsal and 2 ventral setae. Male genital area with 14 (11-19) setae on sternite II; sternite III with 14 (13-19) setae, 5 (5-9) of them along posterior margin of genital opening; genital opening with 2+2 internal setae. Female genital opening with 6-9 microsetae on sternite II and 11 on sternite III. Chaetotaxy of sternites IV–X: 8:13:14:14:13:14:14(2 PT) (8-10:11-15:12-14:12-14:12-14:12-13:9-11-14). Three microsetae on each stigmata of sternites III and IV.

Chelicera (Figs 6-7) with 6 setae on hand (one male with 7 on both chelicera) and one seta on movable finger, 0.66× (0.64-0.71) from base. Without granulation at base of movable finger. Spinneret is a flattened hyaline tubercle (slightly lower in males than in females) with 4 silk ducts. Fixed finger with 4 (4-9) apical protuberances and 12 (9-

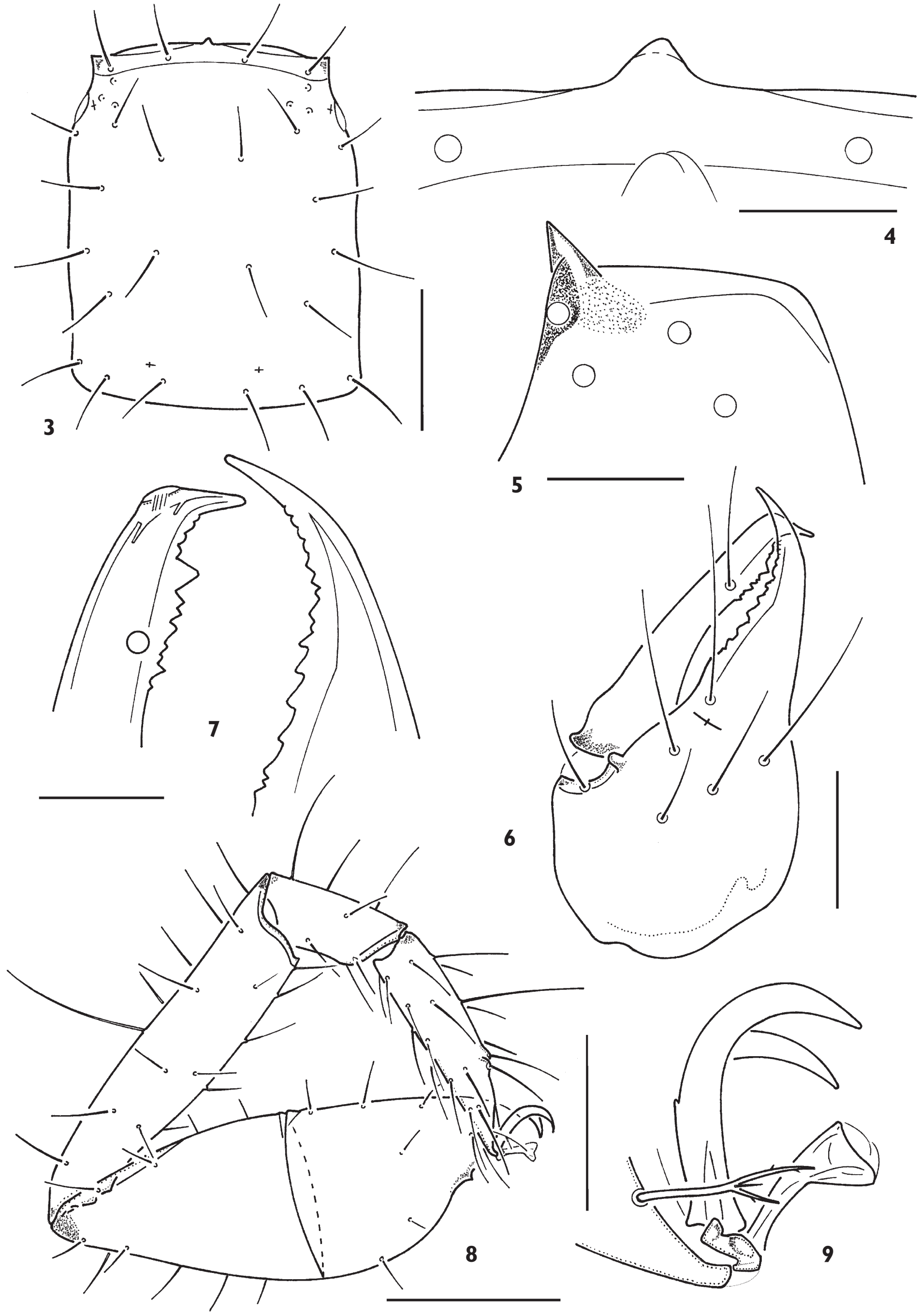
14) medium and small size teeth; movable finger with 3 (1-5) apical protuberances and 9 (8-11) teeth, 1 (1-2) of large size. Rallum with 8 (7-9) denticulate blades, length of proximal blade about one third that of others; serrula exterior with 26 (25-28) blades, serrula interior with 22 (22-25) blades.

Palps (Figs 10-12, 16-18), trochanter with one robust tubercle and two small protuberances on antiaxial face; with tiny dorsal denticulation in distal half; paraxial face of femur completely granulated but without tubercles, one tubercle at middle of antiaxial face, one glandular pore mediodistally, measurements (av.): 3.37×(0.62/0.18), females 3.28×(0.71-0.22). Patella smooth, one (one or two) micropores at base of pedicel, some lyrifissures as shown in Fig. 10. Chela (Figs 11, 12, 16-18) (av.): males 3.06×(1.05/0.34), females 2.96×(1.22/0.41); two male specimens from Cala Montjoi and both males from Cala Rostella have a chelal ratio >3.10× and show a shorter chelal length of <1.00 mm. Paraxial face of hand granulated at base of fixed finger, one pore at antiaxial face close to finger base; two (one or two) micropores at base of dorsal face of pedicel; ratio length chelal finger/hand, av.: males 1.16×, females 1.06×. Fixed finger with 60 (57-69) teeth up to level of trichobothrium *ib*; *nodus ramosus* at level of 5th (4-6th) distal tooth; distance between trichobothria *ib* and *ist* 1.76 (1.46-2.27) times longer than that between *ist* and *it*; two (0-2) microsetae below trichobothria *eb* and *esb* (Figs 13, 14, 17), sometimes one microsetae is also found clearly distal of *eb*, but it is slightly longer and is not considered to belong to this group; one lyrifissure at level of trichobothria *eb*, *ib* and *et*, one on the paraxial face of the hand close to finger base. One sensillum near the tip of both fingers. Movable finger with 54 (51-59) teeth, ending at level of trichobothrium *b* (or just distal); distance between trichobothria s*b* and *st* 1.04 (0.86-1.06) longer than distance *b–sb*; one sensillum (*p*1) close to dental margin, above or slightly distal of trichobothrium *sb*, another sensillum (*p*2) distal of *sb* (more or less close to trichobothrium, but always distal); two ventral glandular pores distal and proximal to *sb*; one lyrifissure basal of trichobothrium *b*, one between *b* and *sb* and one slightly basal, level with or even distal of *sb*; one female paratype from Cala Canadell shows a teratological absence of trichobothrium *b*.

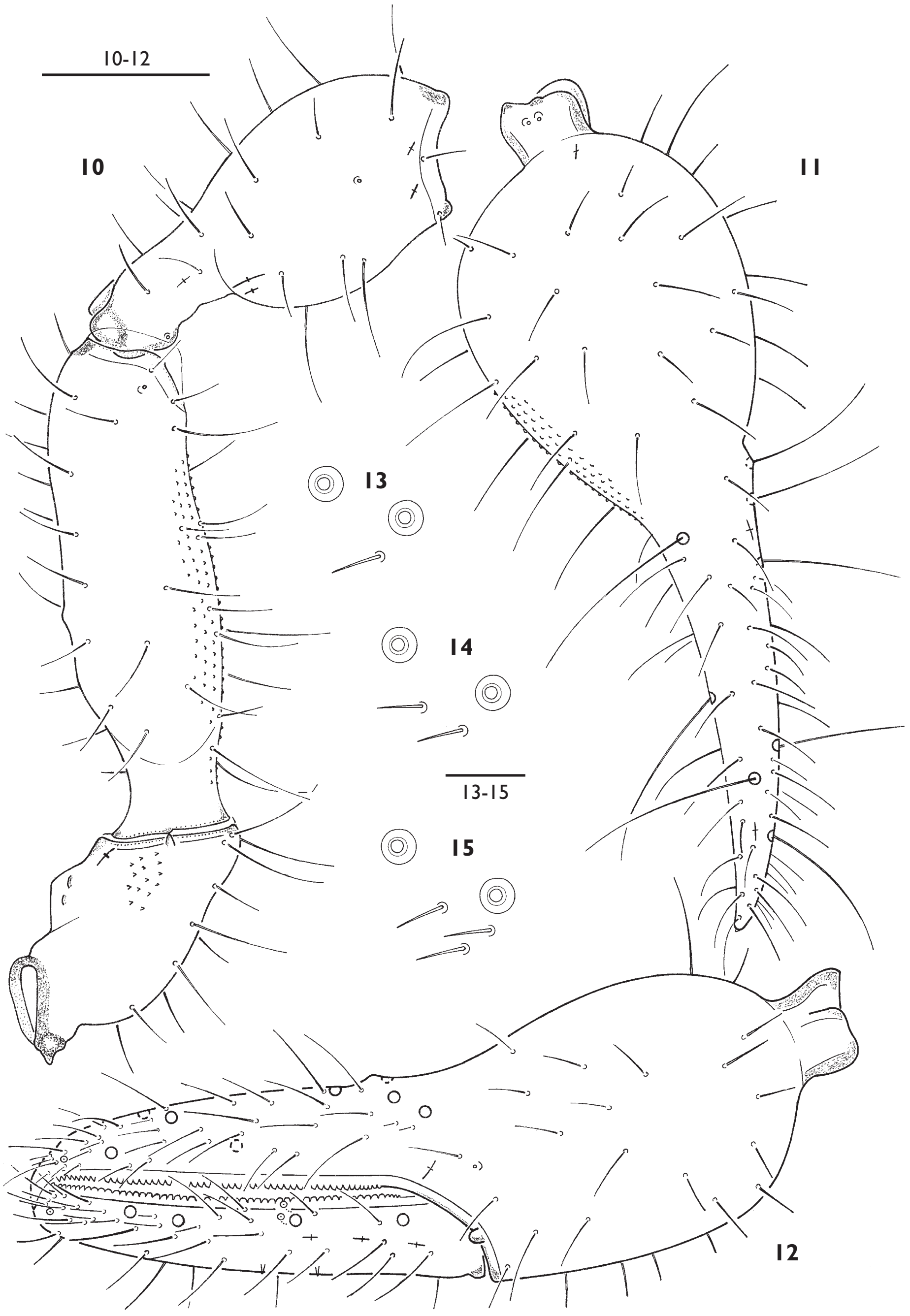
Claws of legs I and IV (Fig. 9) with a tiny tooth at middle of dorsal side. Leg IV (Fig. 8) tibia TS ratio >0.50, typical for *Roncus* (Zaragoza 2008): 0.53 (0.51-0.66), basitarsus TS ratio 0.19 (0.14-0.21), telotarsus TS ratio: 0.36 (0.32-0.39); subterminal setae (Fig. 9) 0.048 (0.048-0.068) mm long, with three rami, the longest [L=0.023 (0.021-0.033)] and the next longest [L=0.013 (0.013-0.020)] with scarce spinules, the shortest [L=0.004 (0.05-0.008, apically broken in many specimens)] smooth.

Distribution. The new species has been located on four slopes of the bay "calas", between Cabo Norfeu and Punta Falconera, Rosas, Cap de Creus Natural Park. Starting at the Restaurant 'El Bulli' (Cala Montjoi), a small steep path climbs up the slope to an altitude of 100 m, where the new *Roncus* species was found. Although several other locations on the Cap de Creus peninsula were sampled, the species was only found on the southern slopes.

Biology. The new species lives under stones in the garrigue, a semiarid environment that is exposed to the sun. This habitat is new for the genus in Spain: *Roncus* species in this country are usually found in humid forests or in caves, although some



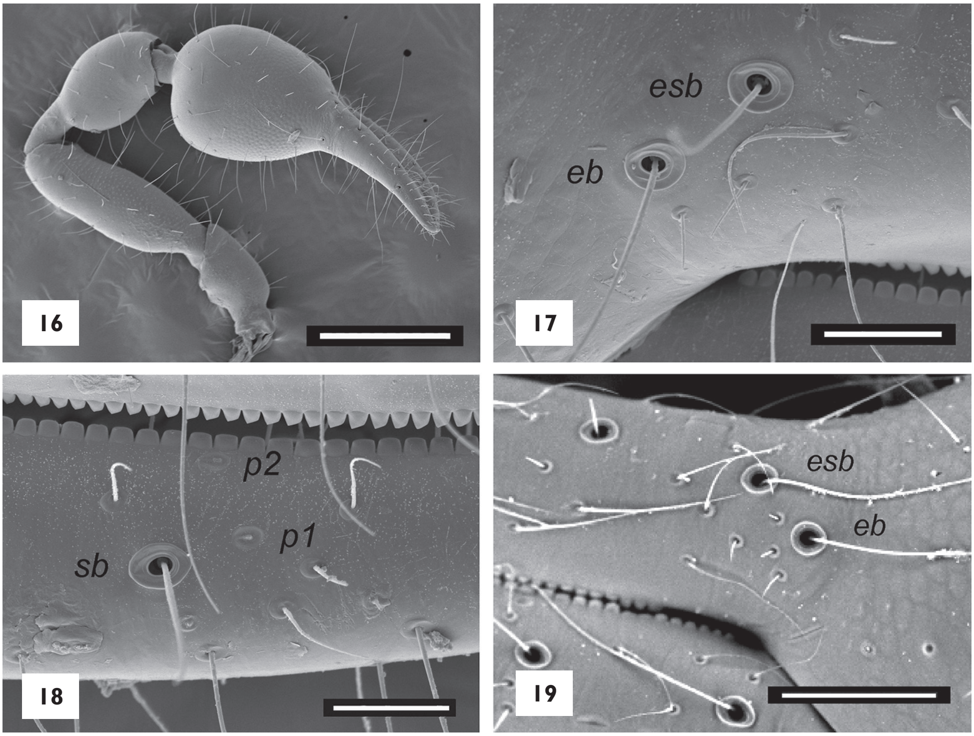
Figures 3-9. *Roncus elbulli* sp. n., male holotype. 3. carapace; 4. anterior margin of carapace, showing epistome; 5. anterior and medial processes of coxa I; 6. left chelicera; 7. fingers of left chelicera, partial view; 8. right leg IV, lateral view; 9. distal end of tarsus and apotele of left leg IV, lateral view. Scale bars (mm): 0.05 (Figs 4, 5, 7, 9), 0.10 (Fig. 6), 0.20 (Figs 3, 8).



Figures 10-15. *Roncus elbulli* sp. n., male holotype (except where otherwise noted): 10. left palp, without chela, dorsal view; 11. left chela, dorsal view; 12. left chela, lateral view; 13. male paratype, chelal microsetae pattern below trichobothria *eb*/*esb*. 14. chelal microsetae pattern below trichobothria *eb*/*esb*. Scale bars (mm): 0.05 (Figs 13-14), 0.20 (Figs 10-12). 15. *Roncus cadinensis* Zaragoza, 2007, male holotype: chelal microsetae pattern below trichobothria *eb*/*esb*. Scale bar (mm): 0.05.

other Mediterranean species had been reported from the garrigue and xeric habitats (e.g. Gardini 1981, 1991). The new species seems to have found a seasonal niche: all specimens were found during the short humid period in the middle of the winter. The Cap de Creus peninsula bears several endemic invertebrates and another probably endemic pseudoscorpion, *Allochernes deceuninckorum* Henderickx & Vets 2003, has been described from the southern slopes (Henderickx and Vets 2003).

Remarks. Following Mahnert's (1977) key and recent papers of Henderickx and Zaragoza (2005), Zaragoza *et al.* (2007) and Zaragoza and Šťáhlavský (2008), amongst the *Roncus* species from Spain with a roncoid form, the new species belongs to the group with a robust palpal femur (ratio <4.00×). It most closely resembles *Roncus cadinensis* Zaragoza, 2007, recently described from Catalonia. In general, these two species are morphologically very close, but some distinctive characteristics are found: the average palpal chela ratio is 3.06 (1.05/0.34) in males of the new species, but 3.34 (1.17/0.35) in *R. cadinensis*; the paraxial face of the chelal hand is more convex in the new species; the average palpal femur length is 0.62 in males of *R. elbulli* sp. n., versus about 0.69 in *R. cadinensis*; carapaceal epistome more prominent (av.: 0.020 mm long)



Figures 16-19. *Roncus elbulli* sp. n., female paratype, Cala Canadell. SEM photographs: 16. left palp, dorsal view; 17. chelal microsetae pattern below trichobothria *eb*/*esb*; 18. fingers of the chela, antiaxial face, partial view, showing trichobothrium *sb* and sensilla *p*1 and *p*2 on movable finger. *Roncus cadinensis* Zaragoza, 2007, male paratype. SEM photograph: 19. chelal microsetae pattern below trichobothria *eb*/*esb*. Scale bars (mm): 0.05 (Figs 17, 18), 0.10 (Fig. 19), 0.50 (Fig. 16).

and pointed in the new species, as opposed to short (av.: 0.014 mm long) and rounded in *R. cadinensis*. On average, the distance *ib-ist* is 1.86× distance *ist–it*, and the distance *sb–st* is 0.98× distance *b–sb* in the new species, whereas in *R. cadinensis* the distance *ib-ist* is 1.56× distance *ist–it*, and the distance *sb–st* is 1.13× distance *b–sb.* The chelal microsetae pattern, as defined by Zaragoza and Šťáhlavský (2008) for the microsetae below trichobothria *eb* and *esb*, is reduced in *R. elbulli* sp. n.: some specimens bear only one or two microsetae (Figs 13, 14, 17), two specimens lack microsetae on one chela and one male lacks them on both chelae; *R. cadinensis* usually bears three or four microsetae in the same area (Figs 15, 19) (only one female of *R. cadinensis* with two microsetae between *eb-esb* and one level with *esb*, the latter being considered as part of a group of three microsetae).

There is also an important difference in the habitat preferences of the two species: *R. cadinensis* occurs at 950-1400 m altitude in gallery forest and pine forest (*Pinus sylvestris*) biotopes, whereas *R. elbulli* sp. n. occurs at 100 m altitude in the garrigue relatively close to the coast.

Roncus pugnax (Navás, 1918) was previously the only Spanish species with a chelal ratio of about 3.00 (Beier 1963). This species shows wide variation in morphometry (Beier 1939) and it might represent a "complex" of different species. However, all specimens assigned to *R. pugnax* have long chelal appendages (femur >0.90 mm, chela >1.70), much longer than those of *R. elbulli* sp. n.

Concerning the western Mediterranean species of the genus, *R. elbulli* sp. n. differs from the French epigean species included in Gardini's keys (1982, 1991). *Roncus binaghii* Gardini, 1991 (mainland France and Italy) coincides in having short palps, but the length/breadth ratios are higher than in the new Spanish species (e.g. male chela 3.25 and hand 1.66 on average in *R. binaghii*). *R. binaghii* also differs in having the femur the same length as the finger and denticles on the medial process of coxa I. According to the keys of Gardini and Rizzerio (1985, 1986) and Gardini (1991, 1992, 1993) for the numerous mainland Italian species, *R. elbulli* sp. n. groups with the species with 6 setae on the carapaceal posterior row, medial process of coxa I without denticles, palpal patella smooth, palpal femur without tubercles on paraxial face and short chelal appendages. These characteristics again lead to *R. binaghii*, which has been discussed above.

Among the epigean species from Sardinia, *R. elbulli* sp. n. resembles *Roncus abditus* (J.C. Chamberlin, 1930) and *Roncus caralitanus* Gardini, 1981, both species with short palpal segments and a chela ratio of about 3.00× (Gardini 1981; Gardini and Rizzerio 1985, 1987). *R. caralitanus* and *R. duboscqi* differ from *R. elbulli* sp. n. in having the carapace as long as broad (*R. elbulli* sp. n. av.: 1.20×), a higher chelal hand ratio in males (>1.60×, versus <1.50×, av.: 1.47×), the chelal finger equal in length to the hand in the males (longer than hand in *R. elbulli* sp. n.), and fewer teeth on the chelal fingers (<50, as opposed to 57-69 on fixed finger and 51-59 on movable finger in *R. elbulli* sp. n.).

Key to the Spanish species of the genus *Roncus*

Note: *Roncus caballeroi* Lagar, 1974, is not included because the original description is insufficient and does not give measurements.

1 Species with roncoid facies, epigean or troglophile, eyes present with more or less flattened lenses, palps robust **2**

– Species with parablothroid facies, troglobitic, eyes reduced to spots or absent, palps slender **10**

2 Palpal femur 2.89-3.54 times longer than broad **3**

– Palpal femur 3.80-4.80 times longer than broad **7**

3 Chela with microsetae proximal to trichobothrium *eb* .... ***Roncus lubricus* L. Koch, 1873**
(epigean; NW Europe; presence in Spain doubtful, due to misidentification).

– Chela without microsetae proximal to trichobothrium *eb* **4**

4 Palpal chela about 1.80 mm long, femur about 1.00 mm long .... ***Roncus pugnax* (Navás, 1918)**
(epigean; provinces of Barcelona, Castellón, Gerona, Tarragona, Valencia, Zaragoza and Balearic islands)

– Palpal chela 1.10-1.40 mm long, femur 0.56-0.82 mm long **5**

5 Carapace as long as broad, epistome prominent and pointed .... ***Roncus caralitanus* Gardini, 1981**
(epigean; Sardinia, Sicily; doubtful presence in Balearic islands).

– Carapace longer than broad (about 1.20×), epistome low or moderately prominent **6**

6 Chela about 3.00 times longer than broad and femur about 0.60 mm long in males, chela with 0-2 microsetae below trichobothria *eb-esb* .... ***Roncus elbulli* sp. n.**
(epigean; province of Gerona)

– Chela about 3.35 longer than broad and femur about 0.70 mm long in males, chela with 3-4 microsetae below trichobothria *eb-esb* .... ***Roncus cadinensis* Zaragoza, 2007**
(epigean; province of Barcelona)

7 Palpal femur longer than 1.00 mm (1.07-1.55), patella and hand about 1.00 mm long .... ***Roncus neotropicus* Redikorzev, 1937**
(epigean and troglophilic; Balearic islands)

– Palpal femur 1.00 mm long or shorter, patella and hand about 0.80 mm long or less **8**

8 Chelal microsetae pattern with increased number of microsetae (8-10) below *eb-esb* .... ***Roncus judsoni* Henderickx & Zaragoza, 2005**
(troglophilic; province of Gerona)

– Chela with 2-5 microsetae below *eb-esb* **9**

9 Palpal femur at most 4.00 times longer than broad in males (0.72-0.73 mm long); chela 1.17-1.28 mm long; chela with 4-5 microsetae below *eb-esb* .... ***Roncus montsenyensis*** **Zaragoza & Šťáhlavský, 2008**
(epigean; province of Gerona)

– Palpal femur 4.24-4.30 times longer than broad in males (0.84-0.98 mm long); chela 1.47-1.69 mm long; chela with 2-4 microsetae below *eb-esb* .... ***Roncus duboscqi*** **Vachon, 1937**
(epigean; France; doubtful records from Spanish provinces: Barcelona, Gerona)

10 Larger number of setae on carapace (about 50) .... ***Roncus setosus*** **Zaragoza, 1982** (troglobitic; province of Alicante)

– Lower number of setae on carapace (maximum 25) **11**

11 Small species, palpal femur 1.00 mm long or less **12**

– Large species, palpal femur 1.18-1.83 mm long **13**

12 Palpal femur 4.65 times longer than broad and longer than chelal finger .... ***Roncus bellesi*** **Lagar, 1972**
(troglobitic; province of Lérida)

– Palpal femur 5.20 times longer than broad and as long as chelal finger .... ***Roncus juvencus*** **Beier, 1939**
(troglobitic; province of Tarragona)

13 Epistome low, chelal femur 6.20-6.50 times longer than broad (1.72-1.83 mm long), chela with pedicel 5.40 times longer than broad .... ***Roncus lagari*** **Beier, 1971**
(troglobitic; province of Tarragona)

– Epistome prominent, chelal femur 4.09-5.40 times longer than broad (1.18-1.59 mm long), chela with pedicel 3.41-5.10 times longer than broad...... **14**

14 Palpal trochanter without tubercle .... ***Roncus hibericus*** **Beier, 1939**
(troglobitic; province of Barcelona)

– Palpal trochanter with more or less prominent tubercle............................ **15**

15 Palpal femur clearly shorter than the chelal finger, femur 5.10-5.40 times longer than broad (1.29-1.54 mm long), finger 1.40-1.60 mm long .... ***Roncus vidali*** **Lagar, 1972** (troglobitic; Balearic islands)

– Palpal femur as long or longer than the chelal finger **16**

16 Palps moderately slender: palpal femur longer than the finger and 4.09-4.49 longer than broad (1.26-1.33 mm long); patella 2.52-2.62 times longer than broad (0.99-1.15 mm long), chelal hand 1.55-1.59 times longer than broad (0.90-1.06 mm long) .... ***Roncus boneti boneti*** **Beier, 1931**
(troglobitic; province of Alicante)

– Palps slender: palpal femur same length as finger and 4.83-5.25 times longer than broad (1.42-1.48 mm long), patella 2.96-3.14 times longer than broad (1.18-1.23 mm long), chelal hand 1.87-2.01 times longer than broad (1.15 mm long).................................... ***Roncus boneti tarbenae*** **Mahnert, 1977**
(troglobitic; province of Alicante)

Discussion

Gabbutt and Vachon (1967) pointed out difficulties in the taxonomy of the genus *Roncus*, due to the inadequate help that morphometry provides in discriminating between species. Gardini (1981, 1983) emphasized this problem and the need for finding distinctive new characteristics. Recently, Henderickx and Zaragoza (2005) and Zaragoza and Šťáhlavský (2008) expressed similar opinions and the latter showed that karyological analysis can be an invaluable aid in confirming the discrimination of species.

The chelal microsetae pattern has been shown to be of great help for distinguishing closely related species, accompanied by other characteristics. Gardini (e.g. 1981, 1983) emphasized the presence or absence of microsetae proximal to the trichobothrium *eb* and Gardini and Rizzerio (1985, 1986) used this characteristic as the first distinction point for their keys. Henderickx and Zaragoza (2005), Zaragoza *et al.* (2007) and Zaragoza and Šťáhlavský (2008) also showed the utility of the number of microsetae lying below trichobothria *eb* and *esb*. The latter characteristic has been used above to compare *R. elbulli* sp. n. with allied species from Catalonia. At least for this region, this characteristic presents a constant range for each of the species recently discovered; in *R. elbulli* sp. n. all the 19 specimens studied show a single pattern. Zaragoza (2008) found that different chelal microsetae areas can be distinguished in other neobisiid genus (*Roncocreagris* Mahnert, 1974) and expressed the opinion that these might act as "sensory fields".

Endemicity is common in most of the epigean *Roncus* species (Gardini, 1981); some apparently widespread species, e.g. *R. lubricus* (Gardini 1983), have since been shown to have more restricted distribution areas after new morphological characteristics have been considered. The Sardinian species *R. abditus* and *R. caralitanus* are very probably endemic (Gardini 2000; Zaragoza *et al.* 2007; Zaragoza and Šťáhlavský 2008), despite records in literature (Harvey 2008) from mainland France and Italy, Corsica and Sicily (*R. abditus*) and Balearic islands (misidentified, first author, pers. obs.) and Sicily (*R. caralitanus*). *R. pugnax* has been recorded as widespread in some eastern Spanish regions (Aragón, Balearic islands, Catalonia and Valencia; Zaragoza 2007), but Beier (1939) found that some specimens from Catalonia show variation in palpal parameters and it is likely that they belong to different, undescribed species (first author, pers. obs.). In recent years three species have been described from Catalonia: *R. judsoni*, *R. cadinensis* and *R. montsenyensis*, the latter two probably belonging to a single phyletic lineage, as confirmed by karyological analysis (Zaragoza and Šťáhlavský 2008). *R. elbulli* sp. n. seems to belong to the same lineage, although karyological data are not yet available for this species. The ability of the species to adapt to and colonize diverse types of habitats seems the main cause of endemicity in this genus.

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We are indebted to Dr Giulio Gardini (Università degli Studi di Genova) and Dr Volker Mahnert (MHNG) for their thoughtful comments and suggestions to improve this paper. We are grateful to Dr Mark Judson (MNHNP) for his revision of the contents and English of the manuscript prior to submission. Thanks are due to Dr Eduardo Seva (Departamento de Ecología, Universidad de Alicante) for SEM facilities, and to Mr Andrés Amorós (Servicio Técnico de Investigación, Universidad de Alicante) for his help in taking SEM photographs.

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RESEARCH ARTICLE

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A new species of *Coenosia* Meigen (Diptera, Muscidae) from Kunashir Island

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Abstract

A new species, *Coenosia polina*, is described from Kunashir – the southernmost island of the Kuril archipelago. It is related to *Coenosia xanthopleura* Shinonaga, 2003, described from Honshu Island, Japan.

Keywords

new species*, Coenosia polina*, Muscidae, Diptera, Kunashir Island, Kuril Islands

Introduction

Among the Diptera material collected with the aid of yellow-tray traps in Kunashir Island by Igor Melnik, I found two species of *Coenosia* Meigen: 1 male of *C. mollicula japonica* Hennig, 1961 and 3 males and 1 female of an almost entirely yellowish *Coenosia*, which is related to *Coenosia xanthopleura* Shinonaga, 2003, described from Honshu Island, but clearly belongs to a new species.

Material

Holotype: male – Russia, Kunashir Island, Grozovoe env., Ivanovsky Cape, 43°50'22.7"N 145°24'39.9"E, leg.I.Melnik 8-15.VIII 2008.
Paratypes: 2 males and 1 female with same labels.
Holotype and paratypes are in the Zoological Museum of Moscow State University.

Description

Coenosia polina Vikhrev, sp. n.

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Male. Length: body about 3.25mm; wing about 3.5mm. An entirely yellow species with only central part of scutum grey dusted.

Head. Eyes bare. Interocular space about 1/3 of head-width. Ground-colour brownish-yellow. Fronto-orbital plate, parafacial, gena and face densely white dusted, occiput light-grey dusted. Frontal vitta not dusted, yellow-brown in lower 2/3 and brownish-black in upper 1/3. Frontal vitta about 2.5-3 times as wide as each fronto-orbital plate. Parafacial narrow, slightly wider than diameter of anterior ocellus. Gena 1.5 times as wide as postpedicel. Frontal triangle whitish, weakly expressed, extending to level of upper frontal seta or slightly more. 3 pairs of strong inclinate frontal setae, median pair distinctly weaker (one male has a fourth pair of hair-like median frontal setae), and 1 pair of reclinate orbital setae. Antenna yellow, inserted slightly above mid-level of eye. Postpedicel short, 2 times as long as wide, its tip rounded. Arista basally whitish and thickened, the longest aristal hairs almost half as long as width of postpedicel. Palpus whitish-yellow. Prementum of proboscis yellow, glossy.

Thorax. Entirely yellow, only central part of dorsum of scutum grey dusted and anterior part of anepimeron with a small grey dusted subtriangular spot (Fig 1.). Dusted area on scutum restricted within the lines between presutural and intraalar setae; post-

Figure 1. *Coenosia polina* sp. n. – paratype; ds – grey dusted spot on anepimeron.

pronotal lobe yellow, undusted. Two brown vittae running through dorsocentral rows. Scutellum grey dusted, yellow in apical 1/3.

Ground-setulae very sparse, short. Acrostichal setulae weak, in 1-2 irregular rows in anterior and posterior 1/3 of scutum, absent in median 1/3. Dorsocentrals 1+3, presutural strong; 1-2 weak intraalars, only 1 proepisternal seta. Katepisternals 1:1:1. Scutellum with strong basal and apical setae, disc almost bare, with 1-2 short setulae.

Legs. All coxae, femora, tibiae and tarsi yellowish-white, only apical tarsomeres of all legs blackish. Tarsomeres not enlarged. Fore tibia with a weak submedian posterior seta. Mid femur with 3-4 anterior setae in basal 2/3 and 4 stronger posteroventral in basal 2/3; 0 anterior and 2 posterior preapical setae. Mid tibia with 1 short submedian posterodorsal. Hind femur with rows of 5-6 anteroventral and 5-6 stronger anterodorsal setae and 3 long and thin posteroventrals. Hind tibia with anterodorsal slightly above middle, anteroventral in apical 1/3, preapical dorsal in apical 1/4, in apical 1/3 with 4 long and thin posteroventral setae.

Wing. Clear. Veins yellow. Costal spine not distinct. Costa continuing to vein M1+2, though very thin in last section. Cross-vein r-m placed at level or slightly beyond the point where vein R1 enters costa. Calypters and halteres white. Lower calypter only slightly projecting beyond upper calypter.

Abdomen. Entirely yellow in ground-colour. Tergites 3 to 5 each with a pair of strong lateral discals, tergite 5 also with pair of medial marginal setae. Tergites 4 and 5 each with pair of blackish-brown spots, tergite 3 with the same, but the spots only weakly distinct.

Male terminalia as shown in Fig.2. Cercal plate small, apically bifurcate, with weak sclerotization.

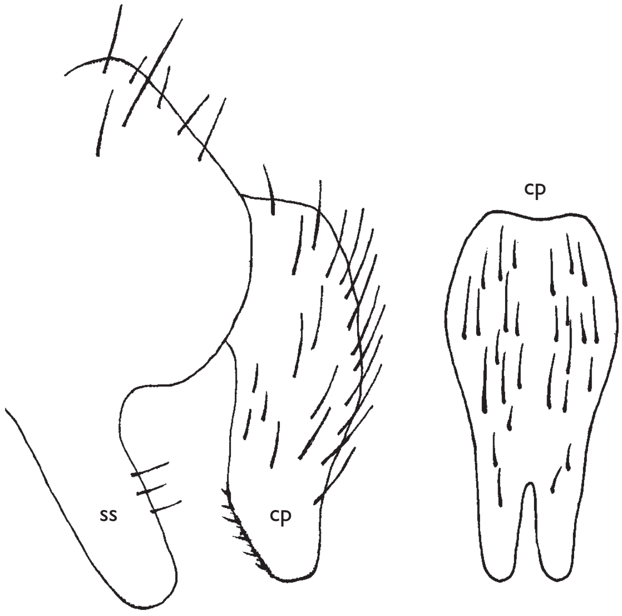

Figure 2. Male terminalia and cercal plate. ss – surstylus, cp – cercal plate.

Female. Length: body about 3.8mm, wing about 4.1mm. Similar to male. Leg colour more dirty yellowish, so that the blackish colour of apical tarsomeres of all legs is less conspicuous than in male. All tibial setae stronger than in male. Mid tibia with strong anterodorsal. Hind tibia without long and thin posteroventral setae in apical 1/3.

Diagnosis. The new species can be easily separated from almost all Palaearctic *Coenosia* by the yellow pleura. The only exception is *C. xanthopleura* Shinonaga, described from Honshu Island, Japan.

The following key couplets will separate *C. polina* from other *Coenosia* so far recorded from Japan and Kunashir Island:

1 Thorax with yellow pleura and postpronotal lobe..**2**
– Thorax with dark pleura .... **all other species of *Coenosia***
2 Scutum densely grey dusted, pleura yellow with grey dusted spot on anepimeron, pedicel and palpi yellow, apical tarsomeres of all legs blackish (less distinct in ♀), male hind tibia with 4 long and thin posteroventrals in apical 1/3.. ***C. polina* sp. n.**
– Scutum without dense dust, pleura entirely yellow, pedicel and palpi black, legs entirely yellow, male hind tibia without posteroventrals .... ***C. xanthopleura* Shinonaga**

Habitat. All specimens were collected in yellow-tray traps which were placed at the edge of a deciduous (mostly oak) forest at almost sea level (25 m).

Etymology. The new species is named after my daughter Polina.

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I am grateful to Igor Melnik for collecting material and to Konstantin Tomkovich for mounting it. I thank Dr. Adrian C. Pont (GB), Dr. Satoshi Shinonaga (Japan) and Dr. Wan-Qi Xue (China) for providing current information on the genus *Coenosia.*

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RESEARCH ARTICLE

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A description of four new species of fleas (Insecta, Siphonaptera) from Angola, Ethiopia, Papua New Guinea, and Peru

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Abstract

Four new species of fleas are described: *Aphropsylla truncata* **sp. n.** (Ethiopia), *Ectinorus hirsutus* **sp. n.** (Peru), *Rhinolophopsylla traubi* **sp. n.** (Angola), and *Thaumapsylla wilsoni* **sp. n.** (Papua New Guinea). Our understanding of the genus *Aphropsylla* is deficient, therefore a discussion of host/parasite relationships and new records from Uganda are provided. A key is provided for the genus *Aphropsylla*, while representatives of the other three genera are associated with existing keys to facilitate their identification. The presence of lucodiscs on *Aphropsylla* and other genera is briefly discussed. The occurrence of lucodiscs among representatives of the order Siphonaptera deserves further investigation.

Keywords

Lucodisc, fleas, Siphonaptera, new species, Angola, Ethiopia, Papua New Guinea, Peru, Uganda

Introduction

During ongoing studies of the late Robert Traub collection of fleas (maintained in the Carnegie Museum of Natural History), series containing undescribed species of *Aphropsylla* Jordan, 1932, *Ectinorus* Jordan, 1942, *Rhinolophopsylla* Oudemans, 1909, and *Thaumapsylla* Rothschild, 1907were discovered. These new taxa are herein described and additional new host and locality records are reported for the genus *Aphropsylla*.

Materials and methods

Dissections of flea genitalia and mounting techniques were completed in accordance with procedures outlined in Hastriter (2004), and Hastriter and Whiting (2003), respectively. Methods of measuring fleas and preparing digital images follow those outlined in Hastriter and Eckerlin (2003). Line drawings were prepared with the aid of a Ken-A-Vision microprojector. Mammal nomenclature follow those of Wilson and Reeder (2005) and morphological terms are adapted from those of Rothschild and Traub (1971). Unless otherwise specified, numbers used within descriptions apply to only one side of laterally flattened microscope slide mounted specimens.

Description of four new species

Siphonaptera

Pulicidae

Aphropsylla Jordan, 1932

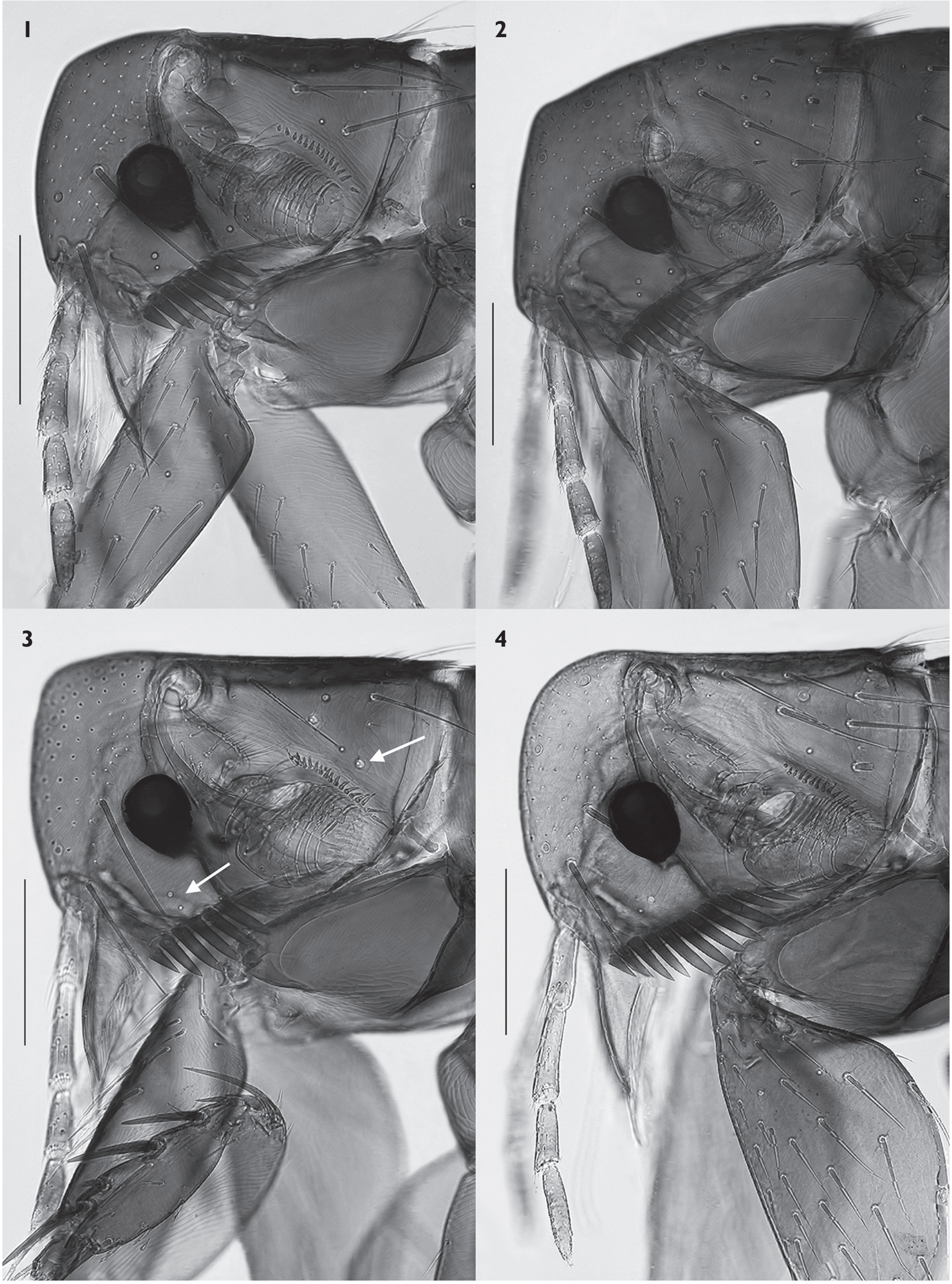
(Figs. 1-18)

Type species. *Aphropsylla conversus* Jordan. Novitates Zoologicae, 1932:292-293.

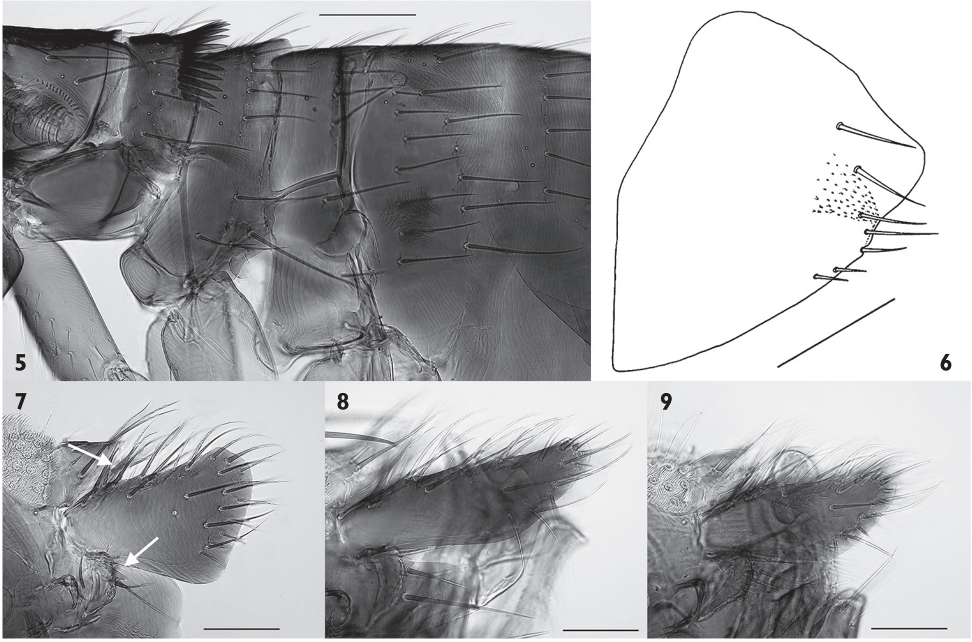
Aphropsylla species were originally placed in the genus *Ctenocephalus* Kolenati (now *Ctenocephalides* Stiles and Collins) until Jordan (1932) noted the generic distinction in the two genera by the position of the genal comb relative to the oral angle of the frons. Only three species of *Aphropsylla* occur in a limited region of east Africa (Ethiopia, Kenya, and Uganda).

Key to species of *Aphropsylla*

1 Males **2**
– Females (unknown for *A. wollastoni*) **4**
2 Apex of P1 rounded, not truncate. Length of P1 greater than 2.5 times its widest dimension (Figs. 8, 9) **3**
– Apex of P1 greatly expanded and truncate. Length of P1 less than 1.5 times its widest dimension (Fig. 7) .... ***A. truncata*, sp. n.**
3 Genal comb usually with six or seven ctenidia (Fig. 3) .... ***A. conversa* (Jordan & Rothschild, 1913)**
– Genal comb with 10 or 11 ctenidia (Fig. 4) .... ***A. wollastoni* (Rothschild, 1908)**
4 First genal tooth (cephalad) nearly as long as adjacent tooth. Ventral anal lobe rounded at apex and setae restricted to apical third. Tergum eight with



Figures 1-4. 1-2. *Aphropsylla truncata* n. sp. 1. Head, holotype ♂. 2. Head, paratype ♀. 3. *Aprhopsylla conversa*, head, holotype ♂. 4. *Aphropsylla wollastoni*, head, lectotype ♂. Scale = 200 µm



Figures 5-9. 5-7. *Aprhopsylla truncata* n. sp. 5. Thorax and abdomen, paratype ♂ (B-74177). 6. Sternum eight, paratype ♂ (B-74129). 7. Process of ninth tergite (P1), paratype ♂ (B-74177), lower arrow = P2, upper arrow = P3. 8. *Aphropsylla conversa*, process of ninth tergite (P1), holotype ♂. 9. *Aphropsylla wollastoni*, process of ninth tergite (P1), lectotype ♂. Scale 5-6 = 200 µm, 7-9 = 100 µm

distinct sinus subtended by group of setae (Fig. 11). Second segment of labial palpus longer than proximal segment.. ....*A. conversa* **(Jordan & Rothschild, 1913)**

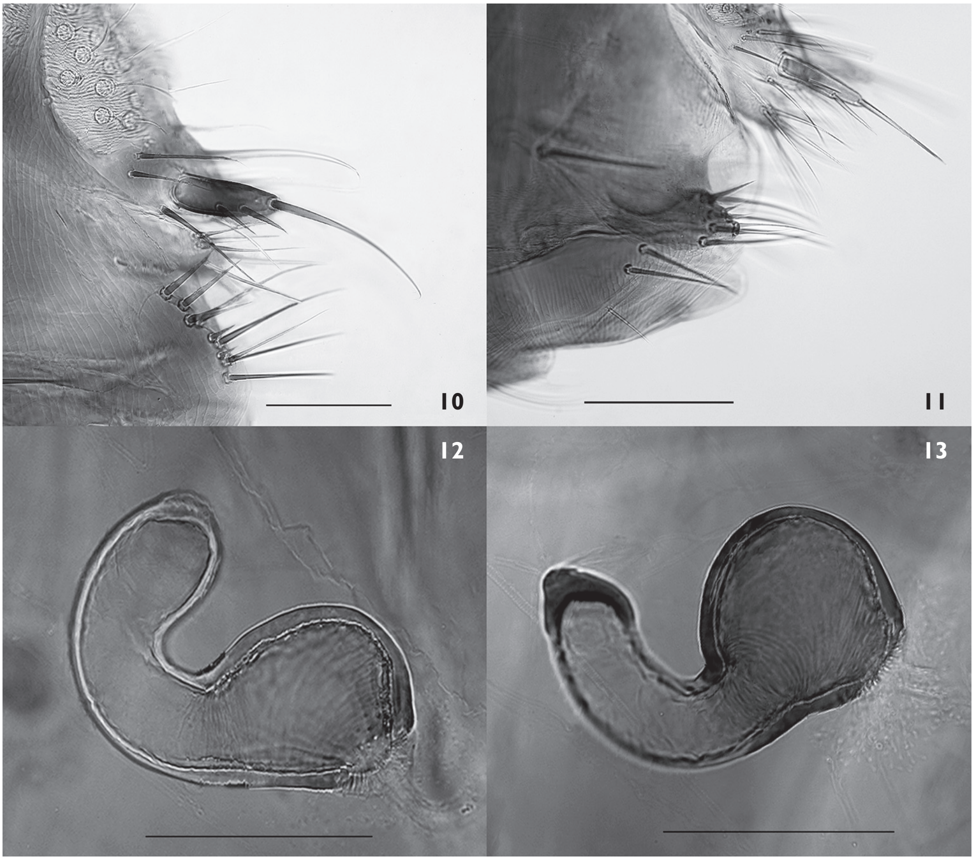
– First genal tooth < 1/2 the length of adjacent tooth. Ventral anal lobe oblique at apex and setae covering apical half. Tergum eight without sinus, but rounded with sinuate margin (Fig. 10). Second segment of labial palpus equal in length to proximal segment ....***A. truncata,* sp. n.**

Aphropsylla conversa (Jordan & Rothschild, 1913)

(Figs. 3, 8, 11, 13, 17)

Ctenocephalus conversus Jordan & Rothschild. 1913. Novitates Zoologicae, 20:231-232.
Aphropsylla conversus Jordan. 1932:292-293; Hopkins. 1947:152.
Aphropsylla conversa Hopkins & Rothschild. 1953:133; Cheetham. 1988:35; Beaucournu. 2004:190.

Material Examined. Holotype ♂, **Kenya:** Mutaragwa, Aberdare Range, [~0°08'S, 36°07'E], ex. *Lophuromys testudo* = *Lophiomys imhausi* Milne-Edwards, 15 III 1910,



Figures 10-13. 10-11. Eighth tergite and anal stylet. 10. *Aphropsylla truncata* n. sp., allotype ♀. 11. *Aphropsylla conversa*, “neallotype” = allotype? ♀. 12-13. Spermatheca. 12. *Aphropsylla truncata* n. sp., paratype ♀. 13. *Aphropsylla conversa*, “neallotype” = allotype? ♀. Scale 10, 12-13 = 100 µm, 11 = 200 µm

Robin Kemp (BMNH); “neallotype” ♀, same data as holotype except ex. *Dendrohyrax crawshayi* = *Dendrohyrax arboreus* (A. Smith), 17 III 1910 (BMNH); paratype ♂, same data as holotype except *Genetta stuhlmanni* Mataschie = *Genetta maculata* (Gray), 23 III 1910, Robin Kemp (BMNH); 5 ♂, 4♀, **Uganda:** Bumagabula, foot of Butandiga [~1°10’N, 34°22’E], west side of Mt. Elgon, 2135 m elev., ex. “on man (acc.)”, 22 II 1961, A.W.R. McCrae (BMNH).

New Records. *Uganda:* nr Bumagabula, foot of Butandiga [~1°10’N, 34°22’E], west side of Mt. Elgon, 2135 m elev., ex. “on man (acc.)”, 20 II 1961, A.W.R. McCrae (British Museum Reg. No. 1961-684), 5 ♂, 4♀ (BMNH).

Remarks. When Jordan and Rothschild described this species, they erroneously labeled one female (same data as holotype) as a “neallotype”. It is presumed they ment “allotype” and not “neallotype” or neoallotype. Host preferences for this species of *Aphropsylla* are virtually unknown since only a single specimen had been collected from each of the three known host species (other than man). *Genetta maculata*, a small agile

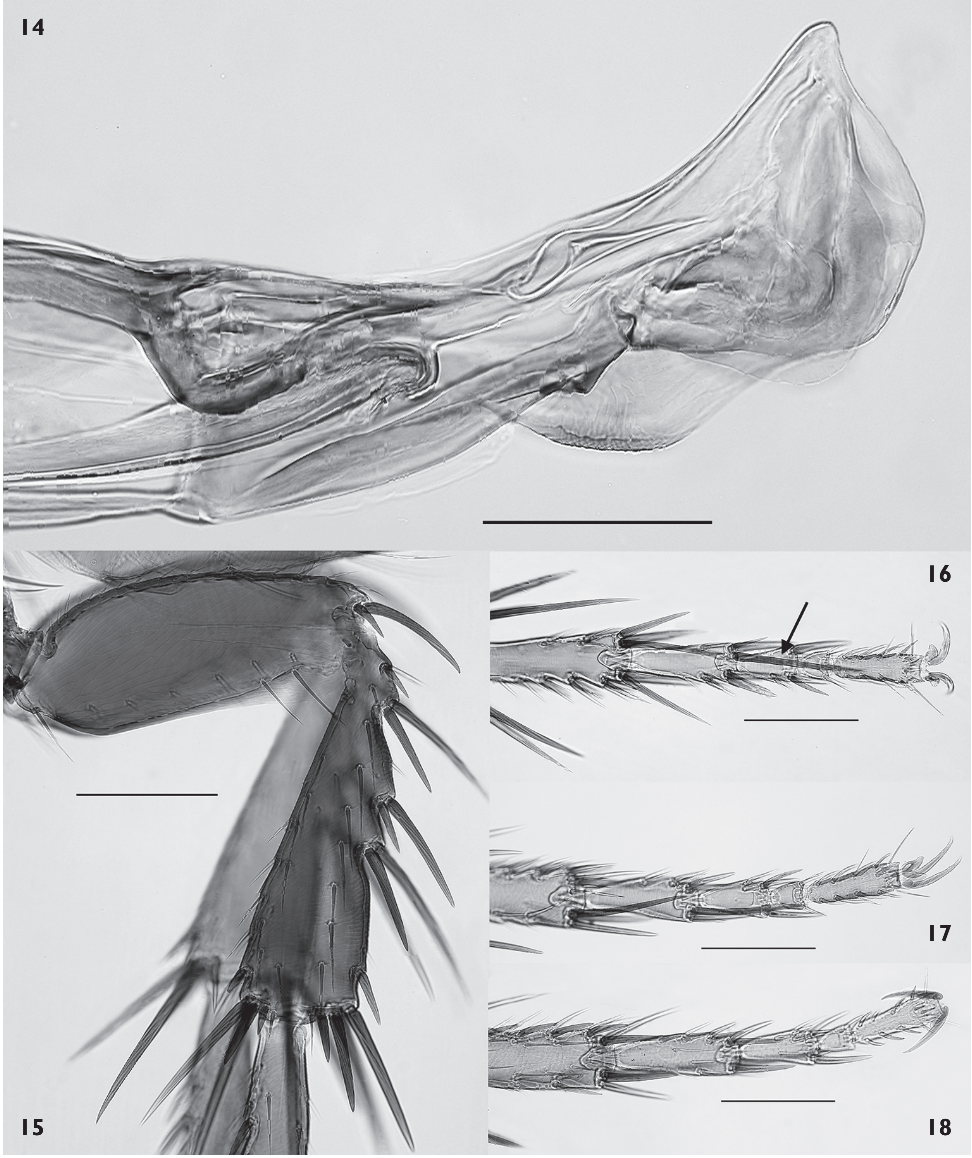


Figure 14-18. 14-16. *Aphropsylla truncata* n. sp. 14. Aedeagus, paratype ♂ (B-74177). 15. Hind femur and tibia, allotype ♀. 16. Hind tarsi, holotype ♂. 17. *Aphropsylla conversa*, hind tarsi, holotype ♂. 18. *Aphropsylla wollastoni*, hind tarsi, lectotype ♂. Scale 14 = 100 µm, 15-18 = 200 µm

and scansorial carnivore, is certainly an accidental host, likely infested with one specimen correlated with the host's carnivorous habits. *Lophiomys imhausi* and *D. arboreus* are both herbivores. Although the latter is arboreal, the single specimen recorded from it is also likely accidental. The label data for the nine specimens reported here, all indicate that the host was "on man" and it is presumed that the collector (or labeler) assumed man was an "acc. = ?accidental" host. Unfortunately, the circumstances are not known surrounding the collection of no less than nine specimens from a human. There was surely some intimate contact with a bird or mammal nest by the "human host". The fact that a sizable series of the new species described below was collected from bird nests (and not from a mammal per se) might suggest that the genus has close evolutionary affinities to avian hosts.

Aphropsylla truncata Hastriter, sp. n.

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(Figs.1, 5-7, 10, 12, 14-16)

Type Material. Holotype, ♂; allotype ♀, and11 ♂, 10♀ paratypes, **Ethiopia:** Bale Province, Bale Mts., Bale National Park, Dinshu (sic) Dinsho [~6°46'N, 39°40'E], 3018 m elev., ex. "bird nest, nest four feet from ground", 22 II 1973, R. Traub and J. Ash (12 slides B-74177: 12 ♂, 9♀, 2 slides B-74176: 2♀); 8 ♂ , 8♀ paratypes, same data as holotype except ex. "mossy bird nest in tree", 19 II 1973 (8 slides B-74129); 1 ♂, 1♀ paratypes same data as holotype except ex. "mouse nest on bird nest in bush", 20 II 1973 (1 slide B-74150); 1♀ paratype, same data as holotype except ex. "*Dendromus* [Smith, 1829] nest, nest ~5 feet from ground", 21 II 1973 (slide B-74173); and 1♀ paratype, same data as holotype except ex. "*Dendromus* nest atop bird nest on bush, nest ~5 feet from ground", 21 II 1973 (slide B-74174). Primary types and all paratypes except for 6 paratypes (3 slides B-74177) in the author's collection are deposited in the Carnegie Museum of Natural History, Pittsburgh, PA.

Diagnosis. Male easily distinguished from *A. conversa* and *A. wollastoni* by the short truncate shape of P1 (length <1.5 greatest width vs. length >2.5 x greatest width), the presence of a spiculated intersegmental membrane between the lobes of S-VIII, and one seta of fourth hind tarsal segment extended beyond base of distotarsomere 3. Female sex of *A. wollastoni* unknown. Female sex of *A. truncata* separable from *A. conversa* by 1) ventral anal lobe broader, ventrally oblique at apex, and adorned with setae on distal half, 2) anal stylet 3 x as long as greatest width vs. >4 x as long as width in *A. conversa,* 3) T-VIII without deep marginal sinus as *A. convera*, 4) first genal tooth <half length of adjacent tooth, nearly as long as adjacent tooth in *A. conversa*, 5) 7-8 genal teeth vs. 8-9 in *A. conversa*, and 6) one seta of fourth hind tarsal segment extending beyond base of distotarsomere 3.

Description. Head (cf. Figs. 1-4). Anterior frons vertical, abrupt obtuse angle caudad to antennal groove (female more angular). Numerous minute coniform pegs on anterior preantennal area. Two large ocular setae; patches of four minute setae below and 10 setae above dorsal ocular seta. Gena with 6-7 sharp darkly pigmented ctenidia (female = 7-8). Small lightly pigmented sharp spine ventrad to apex of genal lobe. Three placoids evenly distributed along margin of frons, single placoid near occipital groove (female same except with two placoids along dorsal occipital area and single placoid laterally). Lucodiscs (appear pearly as tiny shiny air bubbles) occur 1) two between eye and genal ctenidia, 2) one anterior to genal spine, 3) one dorsad of clavus, 4) two laterally on each thoracic segment and each abdominal T-I-VII and S- II-VIII (female without lucodisc on S-VIII). Eye large, oval, darkly pigmented. Antennal segments stubby and broad. Scape with numerous slender setae; pedicel with marginal long setae extending to 3/4 length of clavus. Ventral clavus of male with first seven segments fused (all fused in female). Genal lobe produced upward to enclose most of antenna within fossa. Postantennal area with three rows (1, 1, and 4) setae (female = 1, 3, and 6). Occipital groove with dense cluster of minute setae within darkly pigmented groove. Penultimate segment of labial palpus shortest; second segment longest. Maxillary lobe stout, acutely pointed; lobes of five segments, extended 1/2-3/4 length of fore coxa. **Thorax** (Fig. 5). Each segment with erect dorsal mane; pronounced on pronotum. Pronotum with single row five setae with intercalaries. Pronotal ctenidia of 12-13 in male (female = 15-16). Base of pronotal ctenidia with peduncle and pit-like incrassations. Meso- and metanota each with row of five marginal setae with intercalaries; mesonotum with dorsal anterior patch of ~30 minute scattered setae, metanotum with anterior row of two setae. Prosternosome stout; without lateral depression; first link plate bar-like without prosternosomal notch. Second link plate robust, spiracle small. Mesepimeron with single dorsal seta; three ventral setae. Mesepisternum without setae; mesosternum quadrate, extended down. Pleural rod bifurcate dorsally. Mesothoracic spiracle mesal and borne in cup-like stalk. Lateral metanotal area and metepisternum fused, with partial sulcus only; single seta in each area. Metasternum quadrate and jutting downward. Pleural ridge and furca fused and stout; pleural arch unusually thick and massive. Metepimeron with two vertical rows (6-7 anterior, 7-8 posterior); spiracle round and dorsad to dorsal most setae. **Legs** (Figs. 15, 16). Procoxa with 28-30 lateral setae (excluding marginals). Lateral sulcus of mesocoxa interrupted. Metacoxa with mesal group of 18-20 short spiniform setae. Profemur with five small lateral setae; one small mesal seta. Femoral-tibial guard setae two on all segments; lateral shortest or thinner of two. Margin of fore, mid and hind tibiae with 5, 6, 6 dorsal notches, respectively. Number of setae in respective dorsal notches: fore tibia (beginning with proximal notch) (1, 2, 2, 2, 2), mid tibia (1, 2, 2, 2, 2, 3), hind tibia (2, 2, 2, 2, 1, 4). Lateral setae of meso- and metatibia, respectively (5, 13). Apical seta of hind tarsomere II extended well onto distotarsomere. Distotarsomeres each with 4 pairs lateral plantar bristles, 2 spiniform preapical plantar bristles; in addition to usual preapical lateral hairs. Numerous fine setae on plantar surfaces of distotarsomeres. **Unmodified Abdominal Segments** (Fig. 5). T-I with three rows of setae; T-II-VII each with single row of setae with intercalaries. Lowest setae level with round spiracles. Four minute setae on keel of S-II. One lateral seta on S-III-VII (female with one seta on S-II-VI and two on S-VII). Three antesensilial bristles; mesal and lateral vestigial. Sensilium with 14 sensilial pits. **Modified Abdominal Segments, Male** (Figs. 6, 7). Tergum VIII reduced; without setae. Tergum IX with P1 narrow at base, expanded and truncate at apex. P2 ventrolateral to P1, lobate with 6-7 caudally directed setae of which one is long. Cylindrical trichoid sensilium with two apical setae. Sternum VIII with seven lateral setae; dorsal lobe subtended by shallow sinus.

Distal arm of S-IX broader at base than apex; apex hooked caudad. Caudal margin fringed with numerous fine setae, lacking apodemal rod. Spiculated intersegmental membrane connecting mesal area of S-VIII. **Aedeagus** (Fig. 14). Aedeagal apodeme long and narrow. Penis rods exceed apex of aedeagal apodeme. Ventral lateral lobe expanded ventrad. Median dorsal lobe hood-like at dorsoapical margin. Sclerotized inner tube with dorsal spine on basal third; confined within phallosome. Crochet large and bilobed; ensheathed within lateral lobe. **Modified Abdominal Segments, Female** (Figs. 10, 12). Tergum VIII with four lateral setae and two marginal setae on broad lobe; several short spiniform mesal setae. Sternum VIII angled apically; with longitudinal striations, no setae. Dorsal anal lobe triangular; anal stylet robust with two lateral short setae and long apical seta. Ventral anal lobe broad with ventrally oblique apex; setae numerous on apical half. *Fibula vaginalis* sclerotized. Cribriform area of spermatheca at ventroapical aspect of bulga. Bulga spherical. Bulga and hilla subequal in length; no demarcation between them.

Length (slide mounted specimens): Holotype 2.4mm, male average: 2.4mm (n = 13; range: 2330-2641 µm); allotype 2.3mm, female average: 2.4mm (n = 14; range: 1986-2806 µm).

Etymology. The species name "*truncata*" is derived from *truncus* (L.) or "cut off", which is descriptive of the male eighth tergite (P1) unique to this species of *Aphropsylla*.

Remarks. All specimens were collected in an arboreal situation from a nest. Nests were either individual bird nests, or a *Dendromus* nest associated with a bird nest. It is significant that 39 specimens from three different collections were collected from a bird nest unassociated with a mammal nest, while only two collections yielding only 3 specimens were collected from *Dendromus* nests associated with the same type of "mossy" bird nests. It would appear that this species is biologically associated with a bird and that the mammal is an accidental host species. It is unfortunate that the bird species is unknown; however, judging from the nest materials, height of nests, elevation, and endemic locality of Dinsho, likely candidates might be the Black Headed Sisken (*Serinus nigriceps* Ruppell) or other local species of the genus *Serinus* Koch. These bird species should be investigated as possible avian host species.

The genus *Aphropsylla* (Archaeopsyllini Oudemans) has several unique features shared by few other genera. A dense array of fine setae lining the recess of the occipital groove is present in males. In other flea taxa, this area is usually devoid of setae, or is limited to sparse or unapparent setae. Another unusual feature is the presence of lucodiscs, a term coined by Traub and Johnson (1952) and first identified in the distant related genus *Stenoponia* Jordan & Rothschild. Within the tribe Archaeopsyllini, lucodiscs also occur in the genera *Archaeopsylla* Dampf and *Ctenocephalides* Stiles & Collins. The author was unable to examine the other two rare genera in this tribe (*Centetipsylla* Jordan and *Nesolagobius* Jordan & Rothschild) to determine the presence of lucodiscs. All three genera in the tribe Hystrichopsyllini Tiraboschi (*Atyphloceras* Jordan & Rothschild, *Hystrichopsylla* Taschenberg, and *Typhloceras* Wagner) also have lucodiscs. It should be noted that lucodiscs are distinct morphological entities present in defined patterns, which are species specific. They may have significance in identification criteria and phylogenetic relationships. Lucodiscs are not the subject of this paper; however, their prevalence among the order Siphonaptera deserves further investigation beyond this discussion.

Aphropsylla wollastoni Rothschild

(Figs. 4, 9, 18)

Ctenocephalus wollastoni Rothschild. 1908. Entomologist's Monthly Magazine, 44:76-79.
Aphropsylla wollastoni Jordan. 1932:292-293; Hopkins. 1947:152; Hopkins and Rothschild. 1953:133; Cheetham. 1988: 102; Beaucournu. 2004:190.

Material Examined. Lectotype and paralectotype ♂♂, **Uganda:** Mubuku Valley [~0°21'N, 30°02'E], E. side of Rwenzori [Range], 1830 m elev., ex. "a mouse", 10 III 1906, A.F.R. Wollaston (BMNH).

Remarks. Rothschild (1908) described *A. wollastoni* from three males from the Rwenzori, Uganda. The female is not described and additional records, other than the type series, have never been reported. The host of this flea remains to be determined. Future collections might well be directed from bird nests of finches (family Fringillidae) at or near the type locality.

Ischnopsyllidae

Ischnopsyllinae

Rhinolophopsylla traubi Hastriter, sp. n.

urn:lsid:zoobank.org:act:CAF9F887-9E01-41F0-A261-7C74640BD48A
(Fig. 19-25)

Type Material. Holotype, ♂ and 4♂, 5♀paratypes, **Angola:** Huila Province, Fān and Huila [15°13'59.988"S, 13°31'0.0114"E], ex. *Rhinolophus eloquens* K. Andersen, 4 XII 1954, Gerd Heinrich (6 slides B-46465, B-46468, B-46469); allotype ♀ and 3♂, 3♀ paratypes, same data as holotype except XI-XII 1954 (4 slides B-46466); and 1♂ paratype, same data as holotype except ex. *Miniopterus* sp. (slide B-46472). Holotype, allotype and all paratypes deposited in the Carnegie Museum of Natural History, Pittsburgh, PA (CMNH) except for three paratypes (2 slides, B-46465, B-46472) in the author's collection.

Diagnosis. Males and females differ from *R. ashworthi* (Waterston) by the absence of combs on the metanotum and first two abdominal segments. Most closely allied to the *R. unipectinata* ssp. complex but can be distinguished from those in the male by details of the aedeagus (lacking expanded median dorsal lobe), S-VIII, and the marginal position of the acetabulum with telomere extended beyond posterior margin

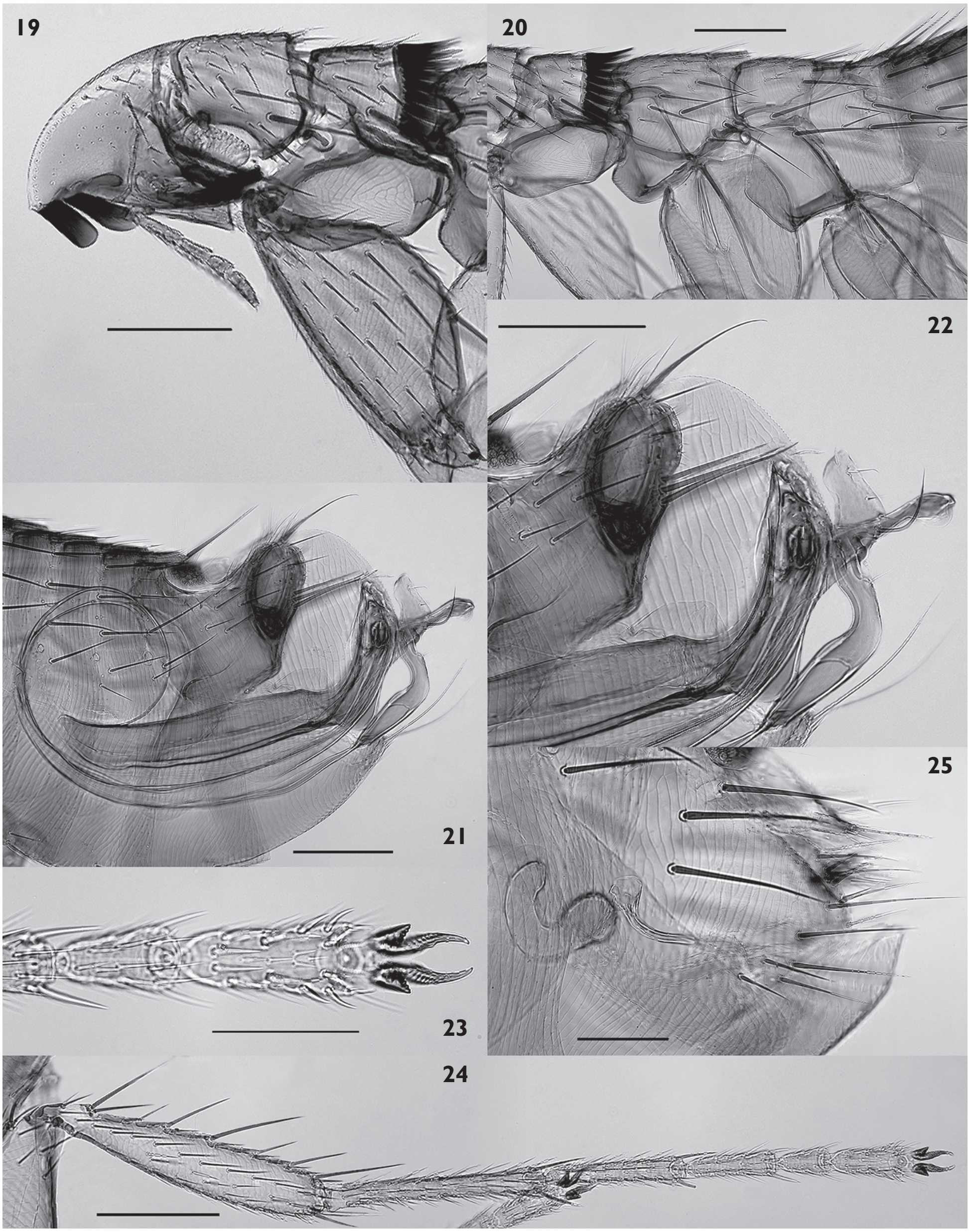

Figure 19-25. *Rhinolophopsylla traubi* n. sp. 19. Head and pronotum, paratype ♀ (B-46466). 20. Thorax, holotype ♂. 21. Abdomen and terminal segments, holotype ♂. 22. Eight and ninth tergites, aedeagus, and ninth sternite, holotype ♂. 23. Distotarsome 3, paratype ♂ (B-46466). 24. Hind tibia and tarsi, paratype ♂ (B-46466). 25. Spermatheca, bursa copulatrix, and terminal segments, paratype ♀ (B-46466). Scale 19-22 and 24 = 200 µm, 23 and 25 = 100 µm

of caudal portion of basimere. Females of all species are similar, but *R. traubi* females may be separated from *R. ectopa* (Jordan) and *R. capensis* Jordan & Rothschild by the presence of a group of 4-5 setae anterior to the usual marginal group of setae on T-VIII and from *R. unipectinata* ssp. by group of 3-4 spiniform setae at upper posterior mesal margin of T-VIII. Both males and females key out as *R. capensis* in key of Hopkins and Rothschild (1956:347).

Description. Head (Fig. 19). Preoral genal spines spatulate, darkly pigmented; posterior spine expanded towards apex. Pale band along smooth margin of frons with one slender seta at oral angle, 14 minute setae separating pale band from preantennal area, and seven slender setae continuing dorsad. Preantennal area adorned with numerous minute scattered setae; ten to twelve setae along ventral margin of antennal fossa, large ocular setae anterior to vestigial, ventrally notched eye, extended beyond genal process. Gena heavily sclerotized, dark at apex; latter sinuate and truncate. Apical half of scape with 7-8 scattered thin setae. Pedicel with 4-5 slender setae extended one third length of clavus. Clavus extended to no further than apex of gena. Three long setulae along dorsal margin of antennal fossa. Postantennal area with numerous scattered setae. Maxilla truncate; labial palpus with six segments. Well developed preoral tuber present. **Thorax** (Figs. 19, 20). Pronotal ctenidia of 20 spines; three rows of setae (1-3, 4, 5). Prosternosome expanded dorsad; large notch with first link plate. Meso- and metanota with numerous setae; main row on metanotum exceptionally long. Metanotum with two marginal spinelets. Mesepisternum with two setae; mesepimeron with two dorsal and three ventral setae. Pleural rod slender; upper portion entirely spread cephalad. Mesosternum heavily sclerotized on ventral half. Lateral metanotal area with one large seta. Metepisternum with one equally large seta. Pleural ridge without pleural arch. Metepimeron with two vertical rows, each with two setae, all below round spiracle. **Legs** (Fig. 24). Fore coxa with 30 lateral setae excluding marginal setae. Meso- and metacoxae with setae along anterior margins. Large seta at apex of metacoxa set in extra large alveolus; apicocaudal notch shallow. Profemur with 6-7 lateral setae; meso- and metafemora each with 4-5 lateral apical setae. Coarse oblique, parallel reticulations on lateral aspect of femora; mesal surface reticulated sculpturing perpendicular to femora. Femorotibial joints with two guard setae each; lateral smaller of pairs. Sparse false comb on dorsal margin protibia and mesotibia; metatibia slender with single long seta in poorly defined dorsotibial notches, most with small basal seta. First and second mesotarsal segments subequal in length. First metatarsal segment long, but less than segments 2-4 combined. Five lateral plantar bristles; first pair shifted onto plantar surface between second pair. Two preapical plantar bristles; two preapical plantar hairs. Dorsal surface of distotarsomere III with longitudinal row of five fine setae; two apical fine setae resembling preapical lateral hairs. **Unmodified Abdominal Segments, Male** (Fig. 21). Apical spinelets on T-I-III (3, 1, 1). Tergites heavily sclerotized dorsally. Five to six setae in each row; lowest seta at or just below level of round spiracles. Tergum VIII dorsoapically expanded; enveloping T-IX with 7-8 lateral setae dorsally. Apical margin T-VIII minutely serrate. Sternites II-IV with single seta; S-V-VII each with two setae. Small setae lateral and mesal to long antesensilial bristle. Sensilial plate expanded caudally; 20 pits in sensilium. Female similar to male except dorsal margins of tergites less sclerotized; single spinelet on T-4. Female S-II-III with single seta, S-IV-VI with three setae. **Modified Abdominal Segments, Male** (Figs. 21, 22). Basomere caudally rounded; acetabular bristles three [two on one side in holotype, three on other side (three the norm)]; acetabulum nearly marginal with telomere extending well beyond caudal margin of basimere. Basimere with long apical seta; two lateral setae. Manubrium with hook-like sclerotization in middle of plate. Sternum VIII with teat-like apex adorned with two long setae, 3-4 smaller basal setae. Proximal arm of S-IX lacking; distal arm with quadrate apical lobe adorned with four small marginal setae, one long curved seta. Apodemal rod long, extending well beyond apex of penis plate. **Aedeagus** (Fig. 22). Aedeagal apodeme with parallel margins. Penis rods forming 3/4 revolution. Ventral lateral lobes divided by shallow sinus. Median dorsal lobe inconspicuous and rounded apically. Crochet dominant feature of aedeagus; hyaline proximal lobe reduced. Paxillus long, peg-like, associated with subtending sinus of apical lobe of distal arm S-IX. Sclerotized inner tube with thumb-like sclerotization on dorsal aspect. **Modified Abdominal Segments, Female** (Fig. 25). Caudal margin T-VIII sinuate; with three long dorsal setae, group of four slender setae anterior to marginal setae. Marginal setae include 4-5 long setae; group of 3-4 mesal spiniform setae. Sternum VII with row of five lateral setae; small broad dorsal lobe subtended by shallow sinus extended to ventral margin. Sternum VIII boat-shaped, without setae; ventral margin moderately sclerotized. Dorsal anal lobe with setae on dorsoapical half; anal stylet twice length of maximum width with long apical seta, two basal setae. Ventral anal lobe acutely pointed; setae on ventroapical half. Bulga spherical; hilla twice length of bulga; subapical entrance of duct of spermatheca. Bursa copulatrix sclerotized to perula; perula with distal sclerotization.

Length (slide mounted specimens): Holotype 2.1mm, male average: 2.2mm (n = 9; range: 1885-2371 µm); allotype 2.4mm, female average: 2.3mm (n = 9; range: 2130-2558 µm).

Etymology. To Robert Traub, this flea is named *Rhinolophopsylla traubi* in his honor and his memory. Even after his death, Robert Traub's genius in work on ectoparasites (especially fleas and mites) continues to inspire those who marvel at his keen insights on zoogeography and evolution of these groups.

Thaumapsyllinae

Thaumapsylla wilsoni Hastriter, sp. n.

urn:lsid:zoobank.org:act:12DCADE9-21EA-4692-9F1D-1464C7838E88
(Figs. 26-31)

Type Material. Holotype, ♂ and 2♂ paratypes, **Papua New Guinea:** [Golf Province], Kukuba caves [lowlands], ex. *Dobsonia moluccensis* (Quoy and Gaimaard), 1 IX 1972, R.L. Vanderwal (3 slides B-87002); 4♂ paratypes, Javavare caves, 73 km NE Port

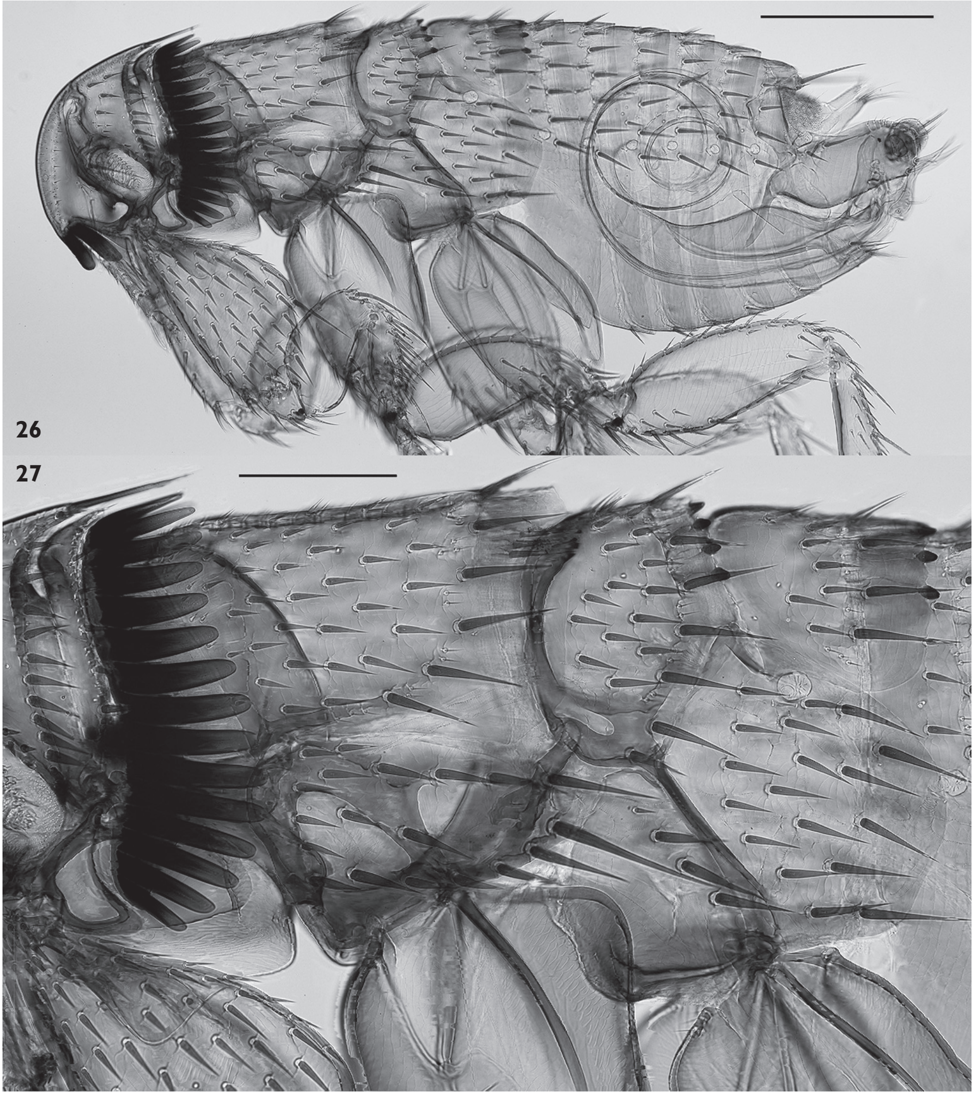

Figure 26-27. *Thaumapsylla wilsoni* n. sp., holotype ♂. 26. Whole body overview. 27. Pronotal ctenidia and thorax. Scale 200 µm

Morsby, 610 m elev., ex. *D. moluccensis*, 23 VIII 1966, 31 X 1968, 3 XI 1968, N. Wilson (slides B-84147, B-84148, B-84149). Holotype and 5 paratypes deposited in CMNH and one paratype (B-84148) in the author's collection.

Diagnosis. Female sex is unknown. Males clearly distinguished from *T. dina* Jordan, 1937 by the possession of only two preoral genal spines. Further separable from males of *T. longiforceps* Traub and *T. breviceps* Rothschild by the shape of the crochet, distal arm of S-IX, and aedeagus. Further details include a greatly expanded prosternosome with ventrad quadrate lobes, a broad marginal band lacking trans-

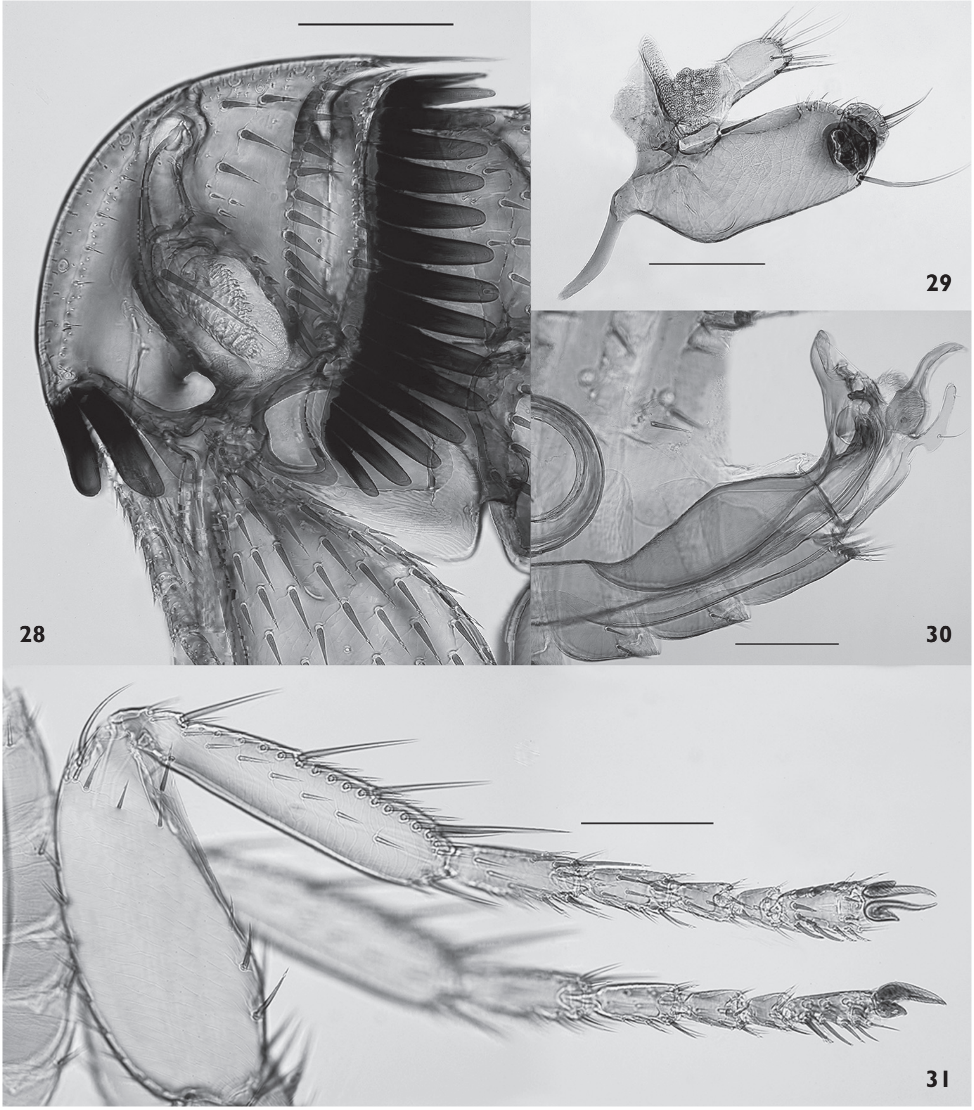

Figure 28-31. *Thaumapsylla wilsoni* n. sp. 28. Head and pronotum, holotype ♂. 29. Ninth tergite, paratype ♂ (B-84148). 30. Aedeagus, distal arm of ninth sternite, and eighth sternite, paratype male (B84148). 31. Hind legs, paratype ♂ (B-87002). Scale = 200 µm

verse striae, and lack of a distinct false comb on upper third of metatibia. Both choices in the second couplet of the key in Hopkins and Rothschild (1956:190) become problematic.

Description. Head (Figs. 26, 28). Frons and occiput gently arched separated by antennal groove almost contiguous with dorsal antennal fossa. Thin incrassation with sparse canaliculi along entire margin. Six fine setae (with 4-5 minute setae interspersed between them) parallel to margin of frons; with zone of minute coniform receptors between frons and these setae. Three minute setae parallel with ventor of antennal fossa anterior to vestigial lightly pigmented eye. Very large ocular bristle at margin of antennal fossa extending over clavus. Genal lobe sinuate at apex; two preoral darkly pigmented spatulate genal ctenidia present; anterior slightly shorter than posterior. Two placoids along margin of frons, two along margin of occiput, and one ventral to the latter two. Four short spiniform setae at dorsal margin of antennal fossa. Two rows of large spiniform setae (1, 3), group of three smaller setae ventrad, and many fine setae anterior to those in postantennal area. Thirteen large spiniform setae at posterior margin of head; dorsomedial posterior margin of head with single long seta borne on projection extended over pronotum. Maxilla sharp at apex. Labial palpus six segments extending to 2/3 of forecoxa; segments 3-5 one third length of other segments. Antennal fossa partially covered by genal lobe. Scape with 3 apical setae; pedicel with one or two minute setae; clavus with single stubby seta on each dorsal flabellate segment. Antenna confined to antennal fossa. **Thorax** (Figs. 26-28). Pronotum ctenidia of 16-17 spatulate spines per side; spines shorter dorsally than ventrally. Ctenidia extended onto prosternosome and arching forward. Single row of six minute setae at base of pronotal ctenidia; all dorsal to robust first link plate. Prosternosome with two lobes forming an unusual quadrate ventral extension. The nature of all setae of meso- and metathorax and abdomen are spiniform and darkly pigmented. Many setae on mesothorax and mesopleuron. Noteworthy is horizontal row on ventral mesopleuron that resembles false comb. Mesopleural rod massive and bifurcate. Second link plate conspicuous. Metanotum adorned with marginal row of seven long spiniform setae; anterior group of 13-14 shorter spiniform setae. Metanotal margin with four short, blunt, black spinelets. Lateral metanotal area without setae; heavily sclerotized margins. One small and three large spiniform setae on metepisternum; meso- and metasternites reduced to heavy sclerotizations. Pleural ridge slender; pleural arch absent. Furca thread-like. Metepimeron with group of 18 spiniform setae; round spiracular fossa larger than those of abdomen. **Legs** (Fig. 31). Fore coxa robust, expanded on caudal margin with noticeably large seta; numerous lateral spiniform setae. Setae on meso- and metacoxa limited to the apical third. Two robust setae at each femoral-tibial joint; lateral smaller of two. To large setae dorsal to each femoral pit. Five dorsal notches on dorsal margin of each tibia; false combs on each. False comb of metatibia less conspicuous on dorsal third of metatibia. Fifth tarsal segments with five lateral plantar bristles; first pair shifted onto plantar surface between second pair. Two preapical spiniform plantar bristles; two thin preapical plantar hairs; three setae on pulvillus. **Unmodified Abdominal Segments** (Fig. 26). Tergum I with three marginal spinelets; main row of 4 setae and anterior group of 7-8 setae. Tergites II-VI with seven setae in main row; T-II-IV with anterior rows of 4, 3, 2 setae, respectively. Four setae on T-VII. One large antesensilial bristle, lateral small and mesal reduced to minute seta; all borne on tubercle. One seta below lever of round spiracles on all terga. Setae on S-II-VII (1, 1, 2, 1, 2, 2). Sensilium with 16 pits. Pencil-like paired proctigers arise from base of sensilial plate; each bearing terminal tuft of long setae. **Modified Abdominal Segments**. Tergum VIII with two lateral setae; ventroapical margin extends to upper margin of S-VIII. Sternum VIII with truncate lobe; lower portion bearing row of four marginal setae and one minute seta anterior to main row. Length of basimere twice width, with dorsal fringe of fine setae and two long acetabular bristles. Telomere spherical with two large apical setae. Manubrium knife-like and directed downward. Dorsal arm of S-IX with single long seta on ventral lobe (Fig.30). Proximal arm of S-IX short; fused with ventral portion of aedeagal apodeme. Apodemal rod long, forming one complete revolution. **Aedeagus** (Fig. 30). Aedeagal apodeme expanded dorsad and sharp at apex; apical appendage nearly as long as apodeme. Penis rods forming coil of two revolutions. Median dorsal lobe narrow, extended well beyond sclerotized inner tube. Sclerotized inner tube short with thick dorsal spur. Crescent sclerite thickened at anterior. Crochet long, extended to sharp pointed apex; paxillus interlocked with sinus of distal arm of S-IX.

Length (slide mounted specimens): Holotype 2.6mm, male average: 2.6mm (n = 7; range: 2489-2665 µm).

Etymology. The species is named *Thaumapsylla wilsoni* in honor of my colleague Nixon Wilson, Professor Emeritus, University of Northern Iowa, Cedar Falls, Iowa for not only collecting this new species, but also in recognition of his untiring efforts collecting ectoparasites over many years and for his contributions to our understanding of the order Siphonaptera.

Rhopalopsyllidae

Ectinorus Jordan, 1942

A comprehensive listing of the 38 known species of the South American genus *Ectinorus* was presented in Hastriter and Sage (in press). This new species represents the 39th species in the genus *Ectinorus*.

Ectinorus hirsutus Hastriter, sp. n.

urn:lsid:zoobank.org:act:504801F4-E773-4B8B-99B5-A1387A59A991
(Figs. 32-40)

Type Material. Holotype, ♂; **Peru:** Yauli Province, Junin Department, 15.3 km N La Oroyo [~11°23'51"S, 75°53'10"W], 3963 m elev., ex. *Neotomys* sp., 15 VI 1964, T.B. Seifert (slide B-71617); allotype, ♀ (same data as holotype, slide B-71617); 2♂ paratypes (same data as holotype except leg. N.E Coon, slide B-71590 and D.L. Knowlton, slide B-71601); 2♂ paratypes (same data as holotype, except *Akodon* sp., 16 VI 1964, leg. D.R. Seidel, 2 slides B-71635, 1 is a dissection); and 2♂ paratypes (same data as holotype, except *Akodon* sp., 14, 16 VI 1964, leg. N.E. Coon, slide B-71580, and F.J. Meyer, slide B71629). Holotype, allotype, and 4 paratypes were deposited in CMNH and two paratypes (slides B-71635 and B-71580) were retained in the author's collection.

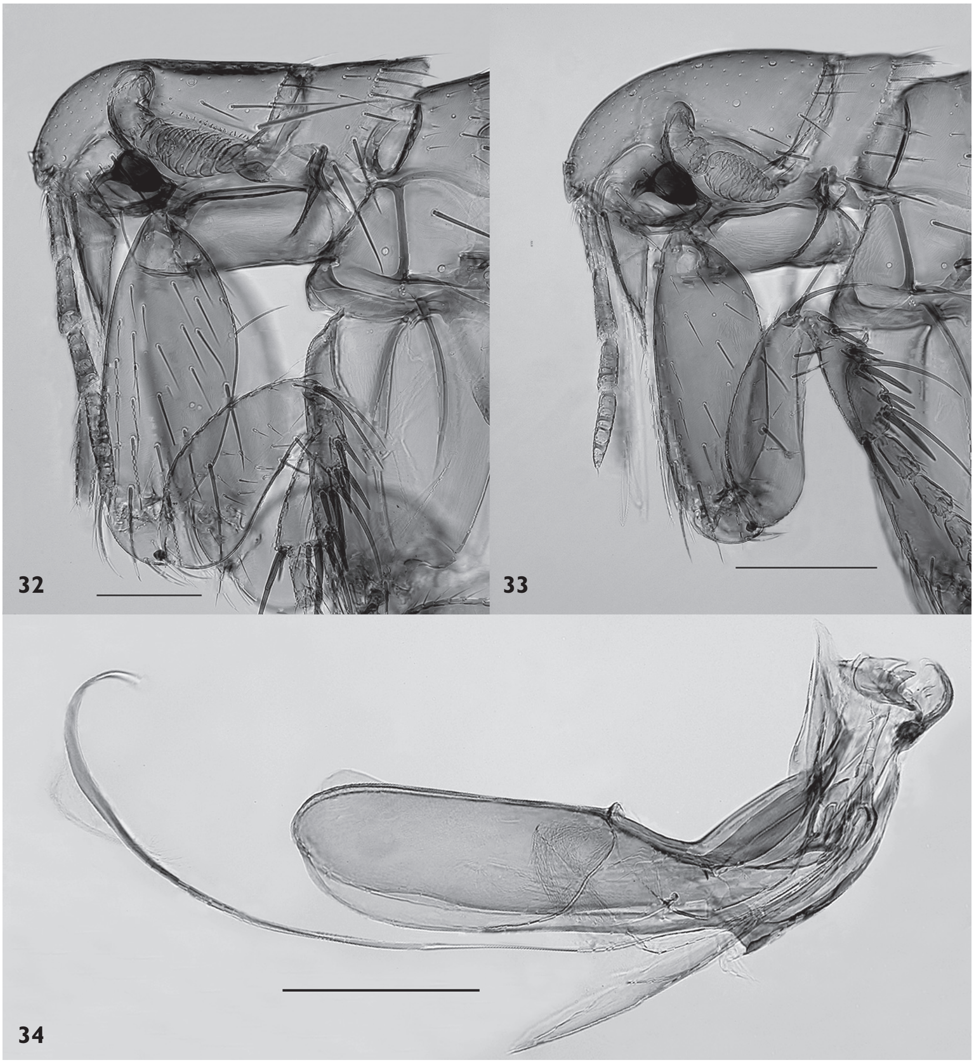

Figure 32-34. *Ectinorus hirsutus* n. sp. 32. Head and pronotum, holotype ♂. 33. Head and pronotum, allotype ♀. 34. Aedeagus, holotype ♂. Scale = 200 µm

Diagnosis. Males distinguished from all members of the subgenus *Ectinorus* that possess a *processus basimeris ventralis* by a combination of the following characters: 1) apical spinelets present on T-I, 2) the *processus basimeris ventralis* is apical and not ventrally affixed to margin of basimere, 3) the crochet is spoon-shaped, and 4) S-VIII possesses an accessory lobe bearing setae that extends beyond ventral apex of caudal margin of S-VIII. Most closely resembles *E. ineptus* Johnson and *E. uncinatus* Beaucournu & Gallardo in these characters, although easily distinguished by the details of T-IX, S-VIII, and aedeagus. Among the 18 taxa belonging to the subgenus (*Ectinorus*), the female sex has been definitively described for only twelve species (*E. alejoi* Hastrit-

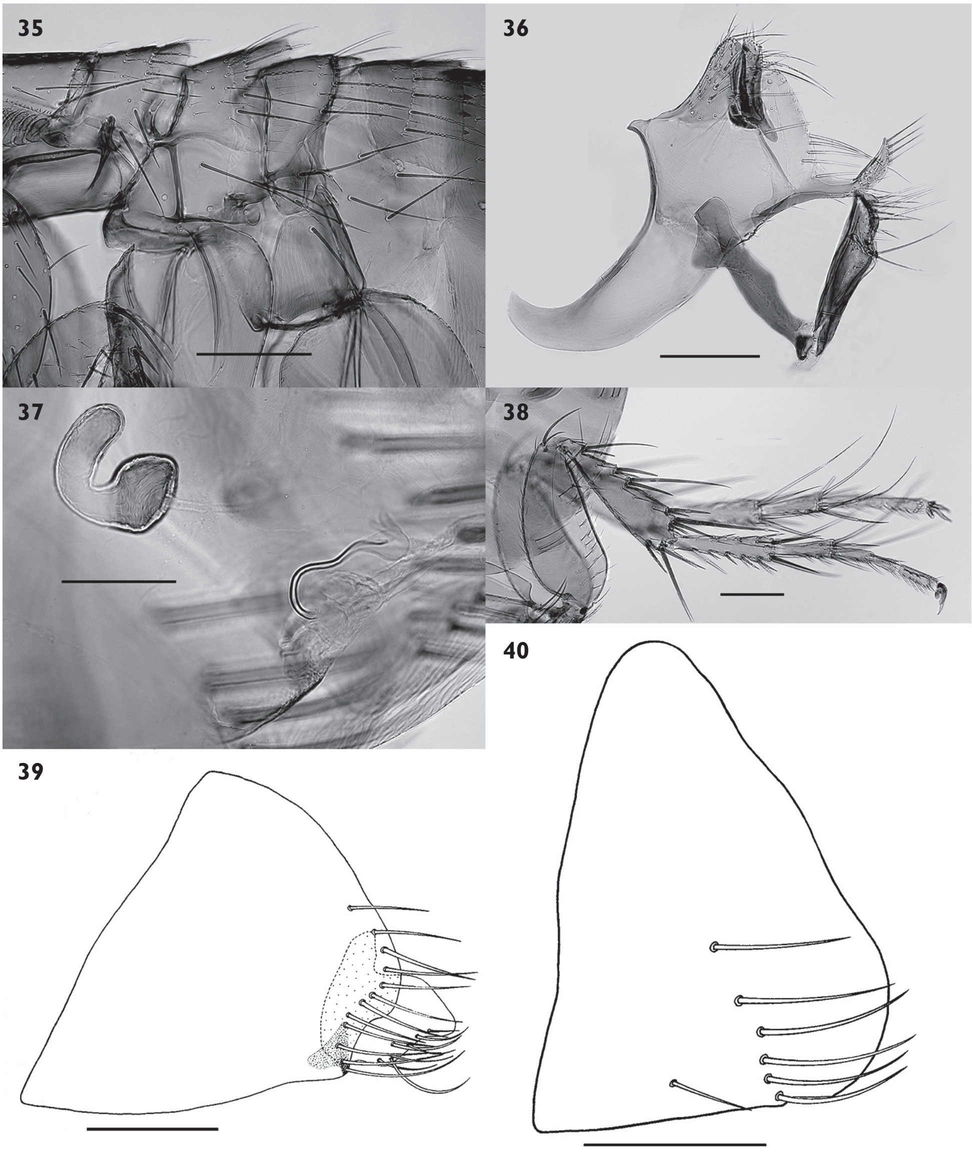

Figure 35-40. *Ectinorus hirsutus* n. sp. 35. Thorax, holotype ♂. 36. Ninth tergite and ninth sternite, paratype ♂ (B-71635). 37. Spermatheca and bursa copulatrix, allotype ♀. 38. Hind legs, holotype ♂. 39. Eighth sternite, holotype ♂. 40. Seventh sternite, allotype ♀. Scale 35-36 and 39-40 = 200 µm, 37 = 100 µm

er, *E. chilensis* Lewis, *E. cocyti* (Rothschild), *E. disjugis* Jordan, *E. gallardoi* Hastriter, *E. hecate* Johnson, *E. levipes* (Jordan & Rothschild), *E. martini* Lewis, *E. mondacai* Hastriter, *E. polymerus* Jordan, *E. trionyx* Jordan, and *E. morenoi* Hastriter). Female differs from those of *E. hecate*, *E. levipes*, *E. mondacai*, and *E. morenoi* in that the hilla is not distinctly restricted at the junction of the bulga and from *E. polymerus* and *E. trionyx* whose bulgae are obviously longer than wide. Distinguished from the remaining five species (*E. alejoi*, *E. chilensis*, *E. cocyti*, *E. disjugis*, and *E. gallardoi*) by a combination of all the following characters: 1) hilla is much longer than length of bulga, 2) seven segments in the labial palpus (including basal palp bearing segment), 3) six setae in main row on S-VII, 4) a group of fine setae on lateral aspects of both S-II and S-III, and 5) four setae per side on S-IV-VI. Extralimital species whose female sexes are unknown include *E. lareschiae*, *E. mimacydis*, and *E. splendidus*. This new species is very closely related to *E. ineptus* Johnson, *E. uncinatus* Beaucournu and Gallardo, and *E. curvatus* Beaucournus and Gallardo. These are all geographically confined to northern Chile and the southern half of Peru. Although males are easily distinguished, the females prove to be an enigmatic complex for which identifications remain uncertain. The possession of seven segments in the labial palpus of *E. hirsutus* differs from those females tentatively assigned by Beaucournu and Gallardo (1991) to the respective "*ineptus* complex" of species (*E. ineptus*, *E. curvatus*, and *E. uncinatus*), although the number of segments in the labial palpus of this single female (allotype) may prove anomalous and not distinctive for this new species. *Ectinorus ineptus* and *E. uncinatus* display only minor differences in the male sex and *E. uncinatus* may prove to be a junior synonym of *E. ineptus*. Further material is required to assess the validity of these two species.

Description. Head (Figs. 32, 33). Frontal tubercle squared at apex; thick sclerotization behind tubercle. Fine seta dorsad and contiguous with tubercle. Two placoids along margin of frons; one placoid caudad to scape and one more posterior near occipital groove. Preanntennal area with numerous minute coniform peg-like receptors. Single seta along antennal fossa anterior to moderately pigmented eye. Ocular row with three long setae; two shorter setae (female with four). Genal process bluntly acute; with marginal row of 4-6 setae caudad and ventrad to eye, two short setae at apex of gena. Lateral and anterior tentorial arms fused and connecting eye with margin of gena. Postantennal area with three rows of setae (1, 1, 6). Dorsal margin of antennal fossa with row of 22 minute spiniform setulae (female with 5-6). Seven setae confined to apical margin of scape; barely extended to apex of pedicel. Pedicel without setae; apical segments of clavus extended onto prosternosome. Maxilla acutely sharp at apex. Labial palpus of seven segments; extends to apex of fore coxa. **Thorax** (Figs. 32, 33, 35). Pronotum with main row and incomplete anterior row of setae. First link plate affixed to shallow notch on prosternosome (link plate vestigial in female). Mesonotum with 14 pseudosetae (female with 12); two complete rows of setae with scattered anterior setae. Mesepisternum with one seta; mesepimeron with four setae. Metanotum with main row and anterior row of setae; caudal margin hyaline. Lateral metanotal area with one short and two long setae. Metepisternum with single long seta; pleural arch present. Metepimeron with two vertical rows, two setae each; spiracle mushroom shaped (asymmetrical). **Legs** (Fig. 38). Procoxa with 25-27 lateral setae (including marginals) (female with 18-20). Lateral sulcus of mesocoxa vestigial at apex. Anterior margin of meso- and metacoxa with setae on anterior margin. Profemur with 14-15 small lateral (female with 7-8); 3-4 small mesal seta (female with 2). Femoral-tibial guard setae two on all segments; equal size on fore femur, lateral smaller of two on meso- and metafemora. Margin of fore, mid and hind tibiae with 6, 7, 7 dorsal notches, respectively. Number of setae in respective dorsal notches: fore tibia (beginning with proximal notch) (2, 2, 2, 3, 2 3) (female with 1, 2, 2, 3, 2, 3), mid tibia (1, 2, 1, 2, 3, 2, 3), hind tibia (2, 2, 1, 2, 3, 2, 4). Lateral setae of meso- and metatibia, respectively (5, 6). Two long slender setae on hind tarsi I extended to apex of tarsus II; one seta extended to apex tarsus III. Hind tarsus III with three long slender setae extended well onto distotarsomere. Distotarsomeres each with four pair lateral plantar bristles, two spiniform preapical plantar bristles; in addition to preapical lateral hairs. Numerous fine setae on plantar surfaces of all distotarsomeres. Female lacking long slender setae. **Unmodified Abdominal Segments**. Tergum I with six marginal spinelets (female with 4); two rows setae (5, 6) (female with 4, 5). Tergites II-VII with 7-8 setae in main row; ventral most of each row at level with small round spiracles (female with 1-2 setae below level of spiracles). Sternum II with single ventral seta and two small lateral setae (female with 4-5 lateral setae); S-III with single small lateral seta (female with 3-4 lateral setae), S-III-VII with three ventral setae (female with S-III-VI with 3, 3, 4, and 4 ventral setae). **Modified Abdominal Segments, Male** (Figs. 36, 39). Single antesensilial bristles on projection. Sensilium with 18 sensilial pits. Tergum VIII vestigial. Tergum IX massive relative to abdomen; manubrium hooked upward at apex. Caudal margin fringed with many long setae; *processus basimeris ventralis* arising from apical margin into large lobe bearing caudal fringe of stout setae. Telomere parallel sided, oblique at apex. Acetabulum set well back from caudal margin of basimere. Sternum VIII with caudal lobe subtended by ventral sinus; adorned along margin with 11-12 long setae. At apex of S-VIII, subventral lobe adorned with multiple curved setae. Proximal arm of S-IX with expanded apex attached to inner aspect of junction of basimere and manubrium. Distal arm of S-IX with lobe on caudal margin bearing 2-3 long setae; numerous fine lateral setae, and 6-7 long setae along apicocaudal margin. Apex of S-IX with caudally directed tooth-like appendage. **Aedeagus** (Fig. 34). Median dorsal lobe acutely pointed at apex. Apico-median sclerite with caudal sinus and ventro-apical hook. Crochet spoon-shaped; heavily sclerotized at ventral margin. Sclerotized inner tube widening towards apex with oblique line ending with small ventral spur (appears as artifact, but is present on all specimens examined); slight swelling at base. Anterior portion of crescent sclerite thickened. Girdle ventrally expanded; truncate at ventral apex. Penis rod single, extending to apex of aedeagal apodeme (penis rod extended well beyond aedeagal apodeme in illustration because it was pulled out during dissection). Aedeagal apodeme broad; round at apex. Small proximal spur present. **Modified Abdominal Segments, Female** (Fig. 37, 40). Tergum VIII especially long on dorsal margin; five small dorsal setae, 5-8 long lateral setae. Caudal lobe with 11-12 long marginal setae; 5-8 small sharp setae at mesal surface near margin. Spiracle VIII vermiform. Sensilial plate with 18 sensilial pits per side. Sternum VII with row of six long setae; caudal margin with round ventral lobe subtended by small sinus. Sternum VIII bluntly rounded; longitudinal sculpturing present. Dorsal anal lobe with scattered setae; anal stylet twice as long as width. Anal stylet placed at ventral margin; dorsal anal lobe bearing one long apical seta; two short setae ventrad to base of long seta. Ventral anal lobe with scattered setae on apical half; ventral margin sclerotized. Spermatheca with hilla longer than bulga. Bulga obliquely flattened at subventral margin of cribriform area. Bursa copulatrix sclerotized, arching caudad; perula slightly globular without sclerotization. *Fibula vaginalis* long, sclerotized, and distinct.

Length (slide mounted specimens): Holotype 1.9mm, male average: 1.7mm (n = 6; range: 1534-1970 µm); allotype 2.3mm

Etymology. The ninth tergite and the eighth and ninth sternites of the male are adorned with rows of long setae producing an appearance of “hairy” or “shaggy”, thus *hirsutus* (L.)

Remarks. *Neotomys* appears to be the preferred host of *E. hirsutus*. Only *Neotomys* was recorded on the slides and on the “B” number records of Robert Traub. Voucher specimens could not be traced to validate the field identifications; however, the type locality of *E. hirsutus* is sympatric with that of *Neotomys ebriosus* Thomas, the only species in the genus. Occurring together with this new species on *N. ebriosus* were the two specimens (male and female) of *Sphinctopsylla inca* (Rothschild) and a single female *Tetrapsyllus bleptus* (Jordan & Rothschild) identified by Robert Traub.

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RESEARCH ARTICLE

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Synopsis of warty leaf beetle genera of the World (Coleoptera, Chrysomelidae, Cryptocephalinae, Chlamisini)

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Abstract

The 11 world genera of Chlamisini Gressitt are reviewed, diagnosed, and illustrated. A key for their identification is provided. A replacement name is proposed, *Kakita* Chamorro-Lacayo & Konstantinov, **nom. n.**, for *Ceratochlamys* Bokermann, 1961, a junior homonym of *Ceratochlamys* Habe, 1946 (Mollusca). *Chlamisus rousei* Medvedev, 1993 is designated as a junior synonym of *Chlamisus straminea* Suffrian, 1866, **syn. n.**

Keywords

Chrysomelidae, Chlamisini, Cryptocephalinae, leaf beetles, key, genera, world, new name

Introduction

Chlamisini Gressitt constitute a relatively small tribe in the leaf beetle subfamily Cryptocephalinae Gyllenhal with approximately 500 species currently classified in 11 genera (Blackwelder 1946; Monrós 1952; Seeno and Wilcox 1982). The distribution of species in the tribe is largely circumtropical. The majority of species and 10 of the 11 genera occur in the Neotropical Region, particularly in the Amazon Basin (Table 1). The only genus not represented in the Neotropical region, *Hymetes* Lacordaire, 1848, is known to occur only in the Oriental region. Of the 10 genera found in the Neotropics, four are endemic. The largest genus, *Chlamisus* Rafinesque, has been reported from all biogeographic regions and it is the only chlamisine genus to be found in the Palearctic and Australasian regions.

Adult chlamisines are distinguished readily from other leaf beetles by their tuberculate or warty dorsal body surface (resembling caterpillar droppings), by their legs fitting into depressions, and by the presence of antennal grooves adjacent to the prosternal process into which the short serrate antennae fit. Hence, these beetles have the ability to tightly withdraw all appendages to form a compact cylinder and successfully mimic small flower buds, caterpillar droppings, or other forms of debris or excrement. Most are dark colored, but some are metallic or light with dark velvety spots.

Chlamisini, as well as other Cryptocephalines, have an interesting and unique life history. Each egg is individually covered by the mother, with a mixture of her own feces and rectal secretions to form a scatoshell, before releasing it into the environment (LeSage 1982, 1984; Erber 1988; Brown and Funk 2005). The individual plates that make up the scatoshell (egg-case) are thought to be unique to each species (Erber 1988). After eclosion, the larva retains this scatoshell. With each subsequent instar, the growing larva builds onto its inherited scatoshell with its own pliable feces (Brown and Funk 2005; Chaboo, Brown and Funk 2008; LeSage 1982, 1984). Finally, pupation takes place within their cases. These cases may not only afford larvae mechanical protection, but they may help to disguise them from predators by effectively resembling auxiliary plant buds.

The classification of Chlamisini remains largely unchanged from that proposed by Lacordaire (1848) more than 150 years ago, which has been properly criticized as being inadequate (Karren 1972). *Chlamisus* Rafinesque 1815 (=*Chlamys* Knoch,

Table 1. List of World Chlamisini genera and their distributional ranges. NA = Nearctic; NT = Neotropical; AT = Afrotropical; WP = West Palearctic; EP = East Palearctic; OR = Oriental; AU = Australasian (Monrós 1952; Karren 1966, 1972; Reid 1991).

Genus	Author	Year	NA	NT	AT	WP	EP	OR	AU
Chlamisus	Rafinesque	1815	X	X	X	X	X	X	X
Diplacaspis	Jacobson	1924	X	X					
Exema	Lacordaire	1848	X	X				X	
Neochlamisus	Karren	1972	X	X					
Pseudochlamys	Lacordaire	1848	X	X					
Melittochlamys	Monrós	1948		X					
Aulacochlamys	Monrós	1952		X	X			X	
Fulcidax	Voet	1806		X					
Hymetes	Lacordaire	1848						X	
Kakita	Chamorro-L. & Konstantinov	2009		X					
Carcinobaena	Lacordaire	1848		X					

1801, nec Bolten, 1798) is the type genus of the tribe Chlamisini Gressitt, 1946, which is based on the valid name of the original nominal type genus (i.e., *Chlamys*). Nonetheless, the invalid name Fulcidacinae, based on the genus *Fulcidax* Voet, 1806, has been used previously (Jacobson 1924; Navajas 1944a,b; Chûjô 1940, 1942; Braga et al. 1999). To date, *Chlamisus* includes the majority of species in the tribe and has become a catch-all genus in need of a comprehensive taxonomic revision (Karren 1972; Monrós 1952; Reid 1991). Lacordaire (1848) proposed14 species groups in *Chlamisus*.

The second oldest name in the tribe is *Fulcidax*, a senior synonym of *Poropleura* Lacordaire, 1848. In addition to *Poropleura*, five additional genera were proposed by Lacordaire (1848): *Carcinobaena* Lacordaire, *Diaspis* Lacordaire (= *Diplacaspis* Jacobson, 1924), *Exema* Lacordaire, *Hymetes* Lacordaire, and *Pseudochlamys* Lacordaire. Monrós (1948, 1952) established 2 genera, *Melittochlamys* Monrós for the first 7 species included by Lacordaire (1848) in species group 1 of *Chlamisus*, and *Aulacochlamys* Monrós for several species in *Exema*. Bokermann (1961) proposed the genus *Ceratochlamys* Bokermann for an unusual species from Brazil; however, this name is a junior homonym of *Ceratochlamys* Habe, 1946 in Mollusca and a replacement name is here proposed. The most recent addition to the tribe, *Neochlamisus* Karren, was described almost 4 decades ago. The genus was established as a result of a comprehensive revision of North American Chlamisinae north of Mexico, and it consists of a number of species formerly included in *Chlamisus* and *Diplacaspis* (Karren 1972). Major chlamisine revisions have been regional, e.g., Monrós (1952) and Karren (1966, 1972) for Argentina and North America north of Mexico, respectively. These treatments comprise the most recent taxonomic activity in the tribe.

Motivation for this study came from the realization that identification tools for chlamisine genera, mainly for the Neotropical fauna, are outdated, incomplete, or difficult to use, particularly when dealing with very similar taxa (i.e., *Chlamisus*, *Diplacaspis*, *Neochlamisus*, *Pseudochlamys*, *Fulcidax*, and *Exema*). As with most Neotropical Chrysomelidae, identification at all taxonomic levels below tribal, presents a major challenge, and generic differentiation of chlamisines is no exception. Yet, no single key offers the tools to confidently segregate species into genera. Therefore, the objectives of this study were to provide comprehensive, accurate, and lucid identification tools to world chlamisine genera and to identify potential areas of research. This was achieved by studying the type species of each genus (when available) and several congeners, and by comparing traditional and novel characters across all taxa. The product consisted of a dichotomous key to all world genera, as well as analogous taxonomic diagnoses and high resolution images/illustrations for each genus.

Even though we follow the classification proposed by Lacordaire (1848) and our study is based on original generic concepts, we echo the sentiment expressed by Karren (1972) and Reid (1991) that there is a need for a complete reassessment of generic boundaries within Chlamisini, particularly *Chlamisus*, to reflect natural groups. This study is the first step towards a comprehensive revision of Chlamisini, which will center largely around taxa from the Neotropical Region. Characters identified in this study will provide a basis from which to address generic concepts in the future. Complete disarticulation of key taxa from each genus and morphological comparison among the genera was beyond the scope of this study.

Materials and methods

Our treatment of all chlamisine genera is based on examination of the type species of each genus, when available. Additional representatives of each genus were examined (see material examined section under each generic treatment). All material examined is housed in the entomology collection of the National Museum of Natural History, Smithsonian Institution (NMNH). This institution holds the Monrós collection as well as many chlamisines identified by Karren and Bokermann. Under each genus a list of the material examined is provided; it includes exact label data for each specimen [all labels are listed as they appear from top to bottom on the pin and each label starts with a lower case letter separated by a forward dash (/)]. Genera are listed in alphabetical order. In addition to observations made of available specimens, the dichotomous key takes into account characters used by Monrós (1952), Karren (1972), and Riley et al. (2002). Terminology for morphological structures follows Karren (1972), Chamorro-Lacayo and Konstantinov (2004), and Chamorro-Lacayo et al. (2006).

Diagnoses of World Chlamisini genera

Aulacochlamys Monrós

(Figs. 1 A, B; 2 A, B; 3 A; 4, A; 5 A)

Aulacochlamys Monrós, 1952: 657. Type species: *Exema costicollis* Lacordaire, 1848, by original designation. Seeno and Wilcox, 1982: 43 (catalog).

Diagnosis. Length 2.00-2.80 mm, width 1.18-1.72 mm. General body shape cylindrical. Antenna serrate beyond 5th antennomere; 3rd, 4th, and 5th antennomeres slightly widened, but not dilated distally. Pronotum medially elevated, with six distinct, small, sharp, longitudinal carinae, which converge medially near posterior margin. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with or without notch (Fig. 1A). Prosternum gradually narrowing posteriorly, broadening before apex. Mesoscutellum very short, transverse. Anterior margin of metasternum concave. Metascutellum concealed by elytra. Elytral suture completely serrate, although serration weak near scutellum. Elytral tubercules well developed. Tibiae slightly curved, cylindrical. Fore- and midtibial apices without claw. Tarsal claw appendiculate.

Distribution. Pantropical, except Australia (Monrós, 1952).

Remarks. *Aulacochlamys* resembles *Chlamisus* Rafinesque in overall body shape, size and color; however, the six longitudinal carinae on the pronotum immediately dis-

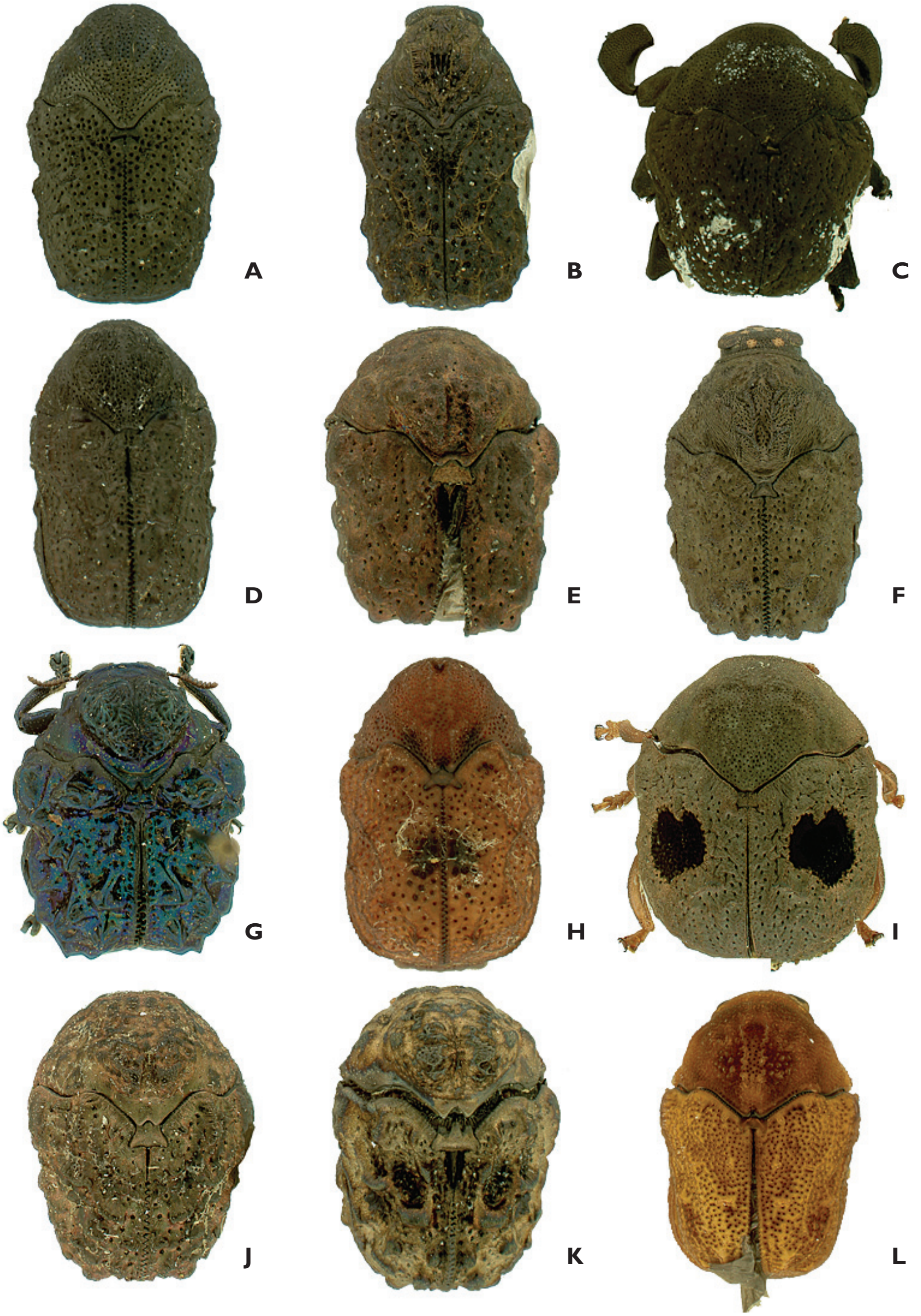

Figure 1. Chlamisini, dorsal view. **A**, *Aulacochlamys distincta* (Achard). **B**, *A. costicollis* (Lacordaire. **C**, *Carcinobaena pilula* (Klug). **D**, *Chlamisus foveolatus* (Knoch). **E**, *Diplacaspis prosternalis* (Schaeffer). **F**, *Exema elliptica* Karren. **G**, *Fulcidax coelestina* (Lacordaire). **H**, *Hymetes javana* Lacordaire. **I**, *Melittochlamys specula* (Klug). **J**, *Neochlamisus insularis* (Schaeffer). **K**, *N. velutinus* Karren. **L**, *Pseudochlamys megalostomoides* Lacordaire ♀.

tinguish it from *Chlamisus*. The absence of spines on the fore- and midtibiae also differentiates most studied species of *Aulacochlamys* from *Chlamisus*; however, this character may be sexually dimorphic in *Chlamisus* (Karren 1972).

A total of 32 species were included in this genus by Monrós (1952); 3 Afrotropical, 21 Neotropical, and 8 Oriental.

Material examined.

Aulacochlamys costicollis (Lacordaire):

1) a. [Brazil] Corumba, Matt. Grosso/ b. F. Monrós Collection, 1959/ c. *Aulacochlamys costicollis* (Lac.) F. Monrós det. 1950. 2) a. Bolivia, Nor. Ungas, Co-

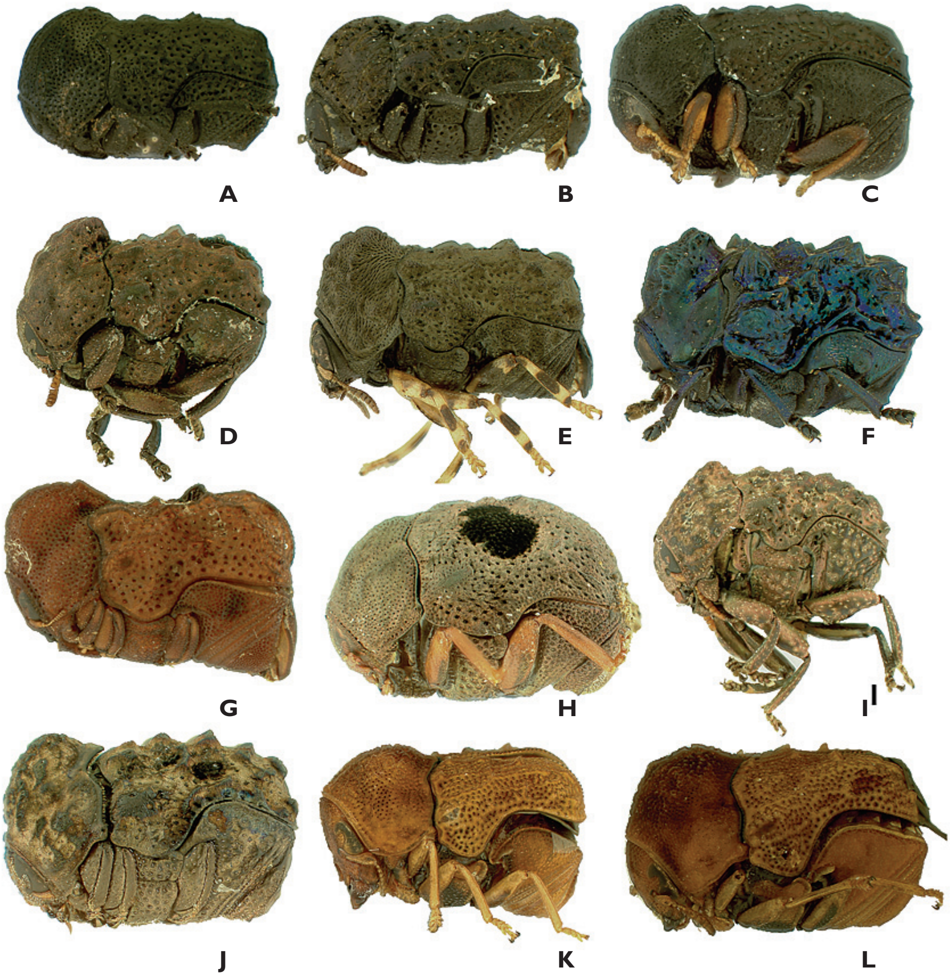

Figure 2. Chlamisini, lateral view. **A**, *Aulacochlamys distincta* (Achard). **B**, *A. costicollis* (Lacordaire). **C**, *Chlamisus foveolatus* (Knoch). **D**, *Diplacaspis prosternalis* (Schaeffer). **E**, *Exema elliptica* Karren. **F**, *Fulcidax coelestina* (Lacordaire). **G**, *Hymetes javana* Lacordaire. **H**, *Melittochlamys specula* (Klug). **I**, *Neochlamisus insularis* (Schaeffer). **J**, *N. velutinus* Karren. **K**, *Pseudochlamys megalostomoides* Lacordaire ♂. **L**, *P. megalostomoides* ♀.

roico. II.952, coll. F. Monrós/ b. F. Monrós Collection, 1959. 3) a. Argent., Misiones, S. Sauier, P. Londero, Monrós, IX.947/ b. F. Monrós Collection, 1959.

Aulacochlamys distincta (Achard):

1) a. Panason, Philippines/ b. F. Monrós Collection, 1959. 2) a. Manila, Philippines/ b. F. Monrós Collection, 1959/ c. *Aulacochlamys distincta* Achard.

Aulacochlamys malayanus (Baly):

1) a. Sumatra, Benculen, IV. 1891, E. Modigliani/ b. F. Monrós Collection, 1959/ c. *Exema malayana* Baly/ d. *Aulacochlamys malayanus* Baly, F. Monrós det. 1955.

Aulacochlamys pygidialis Monrós:

1) a. Peru, Firgo, Moria, Kuschel, XII. 1946/ b. paratipos/ c. F. Monrós Collection, 1959/ d. *Aulacochlamys pygidialis* Monrós.

Aulacochlamys radiatus Monrós:

1) a. [Argentina] R.A. Misiones, A. Ogloblin leg./ b. paratipos/ c. F. Monrós Collection, 1959/ d. *Aulacochlamys radiatus* Monrós.

***Carcinobaena* Lacordaire**

(Figs. 1 C; 3 B; 4 B; 5 B)

Carcinobaena Lacordaire, 1848: 647. Type species: *Chlamys pilula* Klug 1824, by monotypy; Clavareau, 1913: 210 (catalog); Blackwelder, 1946: 647 (catalog); Monrós, 1952: 515 (detailed morphological study); Seeno and Wilcox, 1982: 43 (catalog).

Diagnosis. Length 4.54-5.36 mm, width 3.63-4.27 mm. General body shape subglobular. Antenna serrate beyond 6th antennomere, 3rd, 4th, and 5th antennomeres slightly widened, but not dilated distally. Pronotum without median elevation, relatively smooth and continuous with rest of body, without well developed median longitudinal sulci. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with notch. Prosternum broadly narrowing posteriorly, at apex not much narrower than anterior section of prosternum. Narrowest part of prosternal process at about ½ length of entire prosternum. Mesoscutellum transverse, rectangular. Metascutellum concealed by elytra. Sutural serration of elytra poorly developed with individual serra wide, short, and rounded**.** Elytral tubercules not well developed. Femora and tibiae flattened; tarsi reduced, retractile, able to fit into groove along apex of tibia. Protibial apex with short medially facing spine. Midtibial apices without spine. Tarsal claw simple.

Distribution. The only species, *Carcinobaena pilula* (Klug), occurs in French Guiana and northern Brazil (Monrós, 1952).

Remarks. This genus resembles *Melittochlamys* in overall body shape; however, the modified legs of *Carcinobaena* immediately distinguish it not only from other chlamisines, but from most other genera in Chrysomelidae.

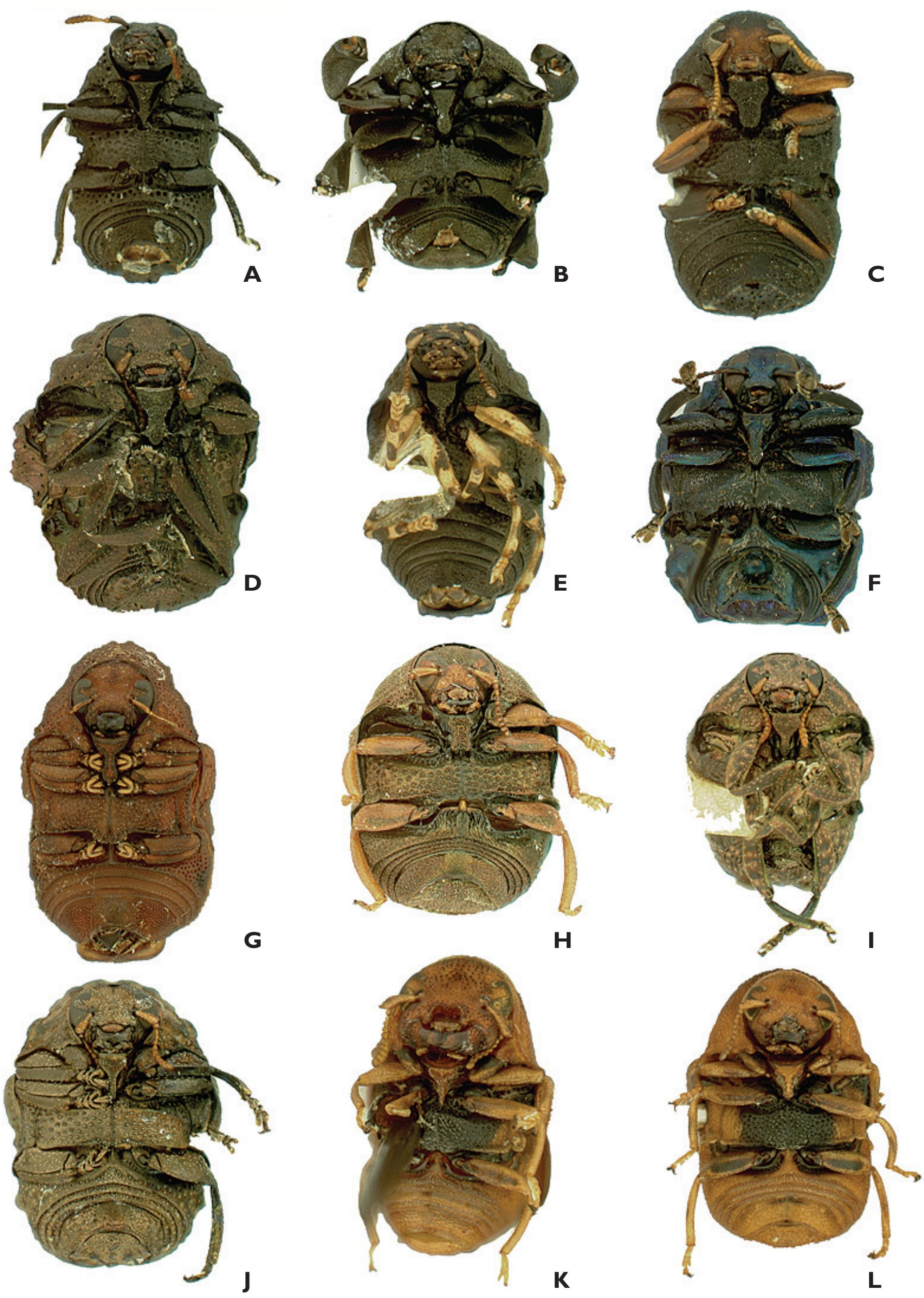

Figure 3. Chlamisini, ventral view. **A**, *Aulacochlamys costicollis* (Lacordaire). **B**, *Carcinobaena pilula* (Klug). **C**, *Chlamisus foveolatus* (Knoch). **D**, *Diplacaspis prosternalis* (Schaeffer). **E**, *Exema elliptica* Karren. **F**, *Fulcidax coelestina* (Lacordaire). **G**, *Hymetes javana* Lacordaire. **H**, *Melittochlamys specula* (Klug). **I**, *Neochlamisus insularis* (Schaeffer). **J**, *N. velutinus* Karren. **K**, *Pseudochlamys megalostomoides* Lacordaire ♂. **L**, *P. megalostomoides* ♀.

Material examined.

Carcinobaena pilula (Klug):

1) a. Brazil, Para, Santarem: Tanerinha, VII.1921, I. Boy/ b. F. Monrós Collection, 1959/ c. *Carcinobaena pilula* (Klug), F. Monrós det. 1949. 2) a. Para, Brazil, de Mathan/ b. F. Monrós Collection, 1959. 3) a. Santarem, Brazil, F. Knab./ b. *Carcinobaena pilula* Klug/ c. *Carcinobaena pilula* (Klug), F. Monrós det. 1949.

Chlamisus Rafinesque

(Figs. 1 D; 2 C; 3 C; 4 C; 5 C; 7 B, D)

Chlamys Knoch, 1801: 122. Type species: *Chlamys foveolata* Knoch, 1801, by subsequent designation of Navajas, 1946: 244 [preoccupied by *Chlamys* Bolten, 1798, Mollusca].

Chlamisus Rafinesque, 1815: 116 (new name for *Chlamys* Knoch).

Diagnosis. Length 3.09-7.72 mm, width 1.90-5.36 mm. General body shape cylindrical. Body usually not metallic in color. Frons in canthus of eye usually without yellow spots (face may be entirely or partly yellow, with yellow area extending into canthus, but elytra do not have velvety spots). Frons glabrous or (rarely) covered with dense hairs. Pronotum and elytra usually glabrous or (rarely) covered with dense short hairs. Antenna serrate beyond 3rd or 4th antennomeres, 2nd antennomere slightly widened, globose, 5th antennomere nearly as large as 6th. Pronotum medially elevated, with various bumps and short carinae. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with well differentiated notch. Prosternum posteriorly narrowed, posteriorly much narrower than anterior margin. Anterior margin of metasternum concave. Mesoscutellum short, transverse. Metascutellum not exposed. Sutural serration of elytra usually incomplete (suture entire immediately following mesoscutellum). Elytral tubercules well developed. Males without spines or spinulae on first ventrite. Tibiae slightly curved, slightly flattened, with sharp dorsal edge. Fore- and midtibial apices with spine. Tarsal claw appendiculate. Male ejaculatory guide (part of internal sac of aedeagus) symmetrical, without sheath. Apex of spermathecal duct as wide as rest of pump.

Distribution. Cosmopolitan (Monrós 1952; Reid 1991).

Remarks. *Chlamisus* is close to *Exema* and *Neochlamisus*. From *Neochlamisus* it can be separated by the following characters: body usually not metallic in color; frons in canthus of eye usually without yellow spots (face may be all or partly yellow, with yellow area extending into canthus, but elytra do not have velvety spots); and male ejaculatory guide symmetrical, without sheath. From *Exema* it can be separated by the following characters: males without spines or spinulae on first ventrite; 5th antennomere nearly as large as 6th; sutural serration of elytra usually incomplete (suture entire immediately following mesoscutellum); and prosternum posteriorly pointed (narrowed), posteriorly much narrower than anterior margin.

No Australasian species were examined for this study, but according to Reid (1991) native Australasian species of *Chlamisus* do not fit into any current definition given for either American (Karren 1972; Monrós 1951) or Oriental (Gressitt and Kimoto, 1961) species. Reid (1991) also recognized several characteristics distinguishing Oriental (South-East Asian) and American species.

Comparison of the paratype of *Chlamisus rousei* Medvedev, 1993 described from Puerto Rico with specimens of *Chlamisus straminea* Suffrian, 1866 from Puerto Rico and Virgin Islands revealed that they are conspecific, therefore we here synonymize these names.

There are approximately 400 species of *Chlamisus* in the world (Monrós 1952; Reid 1991); approximately 100 Neotropical, 45 Palearctic, 18 Nearctic, 22 Oriental, 6 Afrotropical, and 2 Australasian (naturally occurring).

Material examined.

Chlamisus foveolatus (Knoch):

1) a. [USA] Beltsville, MD, VIII. 5/ b. *Chlamisus foveolatus* (Knoch) det. Karren 1971. 2) a. [USA] VI.10.11, Southern Pines, NC, AH Manee/ b. *Chlamisus foveolatus* (Knoch) det. Karren 1971.

Chlamisus maculipes (Chevrolat):

1) a. Mexico, Salle/ b. F. Monrós Collection, 1959/ c. *Chlamisus maculipes* (Chevr.) F. Monrós det. 1949.

Chlamisus obidensis Monrós:

1) a. [Brazil] Teffe (Ega), Amazonas, M. de Mathan, IV.78 et I.79/ b. F. Monrós Collection, 1959.

Chlamisus pilifrons (Lefevre):

1) a. [India] Rhamnaq (Hindustan)/ b. Ex. Musaeo Lefevre, 1894/ c. F. Monrós Collection, 1959/ d. *Chlamisus pilifrons* Lef. F. Monrós det. 1956.

Chlamisus pubiceps Chen:

1) a. Russia, Far East, Ussury region, Kondrat'evka, 28.VII.1992, leg. A. Konstantinov/ b. *Chlamisus pubiceps* Chen, det. A. Konstantinov.

Chlamisus semirufus Chen:

1) a. nr. Foochow, China, 1921-4, CR Kellog.

Chlamisus straminea Suffrian:

1) a. [Puerto Rico] on leaves of *Diascorea*, Ponce PR, 11.VIII.33, R.G. Oakley, SS 4489. 2) a. St. Thomas Vir. Ids., June 5, 1917 (122), Harold Morrison/ b. F. Monrós Collection, 1959/ c. *Chlamisus straminea* Suffr. F. Monrós det. 1954. 3) a. From Puerto Rico/ b. Paratypus, *Chlamisus rousei* L. Medv.

Diplacaspis Jacobson

(Figs. 1 E; 2 D; 3 D; 4 D; 5 D)

Diaspis Lacordaire, 1848: 645; Type species: *Diaspis paradoxa* Lacordaire, 1848, by monotypy; Jacoby, 1881: 74; *Diaspsis* Jacoby, 1889: 155 (misspelling; summary); [preoccupied by *Diaspis* Costa, 1835, Coccidae]

Diplacaspis Jacobson, 1924: 239 (new name for *Diaspis* Lacordaire); Blackwelder, 1946: 647 (catalog); Seeno and Wilcox, 1982: 43 (catalog); Riley et al., 2003: 183 (catalog).

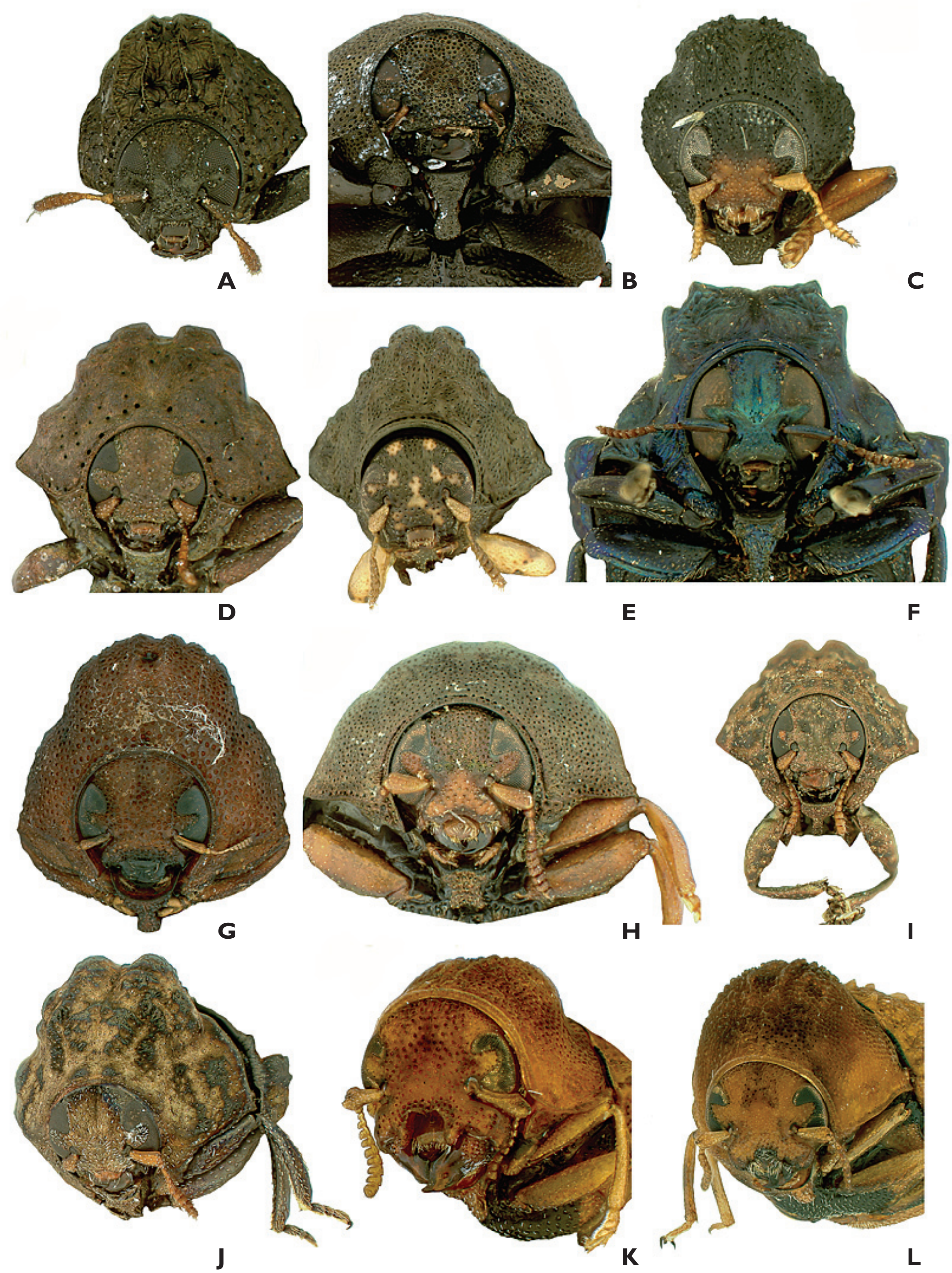

Figure 4. Chlamisini, frontal view. A, *Aulacochlamys costicollis* (Lacordaire). B, *Carcinobaena pilula* (Klug). C, *Chlamisus foveolatus* (Knoch). D, *Diplacaspis prosternalis* (Schaeffer). E, *Exema elliptica* Karren. F, *Fulcidax coelestina* (Lacordaire). G, *Hymetes javana* Lacordaire. H, *Melittochlamys specula* (Klug). I, *Neochlamisus insularis* (Schaeffer). J, *N. velutinus* Karren. K, *Pseudochlamys megalostomoides* Lacordaire ♂. L, *P. megalostomoides* ♀.

Skwarraia van Emden, 1932: 9 (new name for *Diaspis* Lacordaire).

Diagnosis. Length 3.00-3.81 mm, width 2.36-3.18 mm. General body shape subcylindrical, widest near shoulders. Antenna serrate beyond 4th antennomere, 3rd and 4th antennomeres slightly widened, but not dilated distally. Pronotum medially elevated, with two tall projections separated by furrow. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with wide notch. Prosternum gradually narrowing posteriorly, abruptly narrowing before middle, widening between mesocoxae. Anterior margin of metasternum concave. Mesoscutellum short, transverse. Metascutellum broadly exposed. Elytral suture serrate, entire (not serrate) in part that exposes metascutellum. Elytral tubercules well developed. Tibiae slightly curved, flattened, with sharp dorsal edge. Fore- and midtibial apices with spine. Tarsal claw appendiculate.

Distribution. New World (Monrós, 1952).

Remarks. This genus may be distinguished from other Chlamisini by the shape of the prosternum, and an exposed metascutellum in combination with the appendiculate tarsal claw. According to Karren (1972), South American species of *Diplacaspis* may not possess bifid claws or a posteriorly expanded prosternal process between the mesocoxae. However, the only two species available for our study [*D. batesi* (Baly) and *D. prosternalis* (Schaeffer)] share character states consistent with the diagnosis.

A total of 6 species currently are known in this genus (Monrós, 1952).

Material examined.

Diplacaspis batesi (Baly):

1) a. Brazil, Minas Gerais, col. M. Pic/ b. F. Monrós Collection, 1959/ c. *Diplacaspis batesi* (Baly) F. Monrós det. 1950.

Diplacaspis prosternalis (Schaeffer):

1) a. [Mexico] EA Schwarz Collector/ b. Monterrey, Mex. 25.II/ c. *Diplacaspis prosternalis* (Schaeffer) det. Karren 1968. 2) a. Granada, Nicaragua, Coll. Baker/ b. *Diplacaspis prosternalis* (Schaeffer) det. Karren 1968.

Exema Lacordaire

(Figs. 1 F; 2 E; 3 E; 4 E; 5 E)

Exema Lacordaire, 1848: 844; Type species: *Chlamys intricata* Kollar, 1824, by subsequent designation of Jacoby, 1908: 278; Karren, 1966: 1 (revision of North American species north of Mexico).

Diagnosis. Length 2.18-3.45 mm, width 1.36-2.72 mm. General body shape cylindrical, widest near shoulders. Antenna serrate beyond 5th antennomere, 3rd, 4th, and 5th antennomeres slightly widened, but not dilated distally. Pronotum medially elevated, with various bumps and short ridges. Pronotal base opposite mesoscutellum (posterior pronotal lobe) concave, usually without well differentiated notch. Prosternum gradually narrowing posteriorly, at about middle abruptly narrowing to thin parallel sided

Figure 5. Chlamisini, caudal view. **A**, *Aulacochlamys costicollis* (Lacordaire). **B**, *Carcinobaena pilula* (Klug). **C**, *Chlamisus foveolatus* (Knoch). **D**, *Diplacaspis prosternalis* (Schaeffer). **E**, *Exema elliptica* Karren. **F**, *Fulcidax coelestina* (Lacordaire). **G**, *Hymetes javana* Lacordaire. **H**, *Melittochlamys specula* (Klug). **I**, *Neochlamisus insularis* (Schaeffer). **J**, *N. velutinus* Karren. **K**, *Pseudochlamys megalostomoides* Lacordaire ♀.

ridge. Anterior margin of metasternum concave. Mesoscutellum short, transverse. Metascutellum not exposed. Elytral suture serration complete. Elytral tubercules well developed. Males with spines or spinulae on first ventral abdominal segment. Tibiae slightly curved, flattened, with sharp dorsal edge. Fore- and midtibial apices with spine in males, but lacking them in females. Tarsal claw from simple to appendiculate. Ejaculatory guide (part of internal sac of aedeagus) short, tubular, sclerotized.

Distribution. Nearctic, Neotropical, and Oriental Regions (Monrós, 1952; Karren, 1966).

Remarks. This genus may be distinguished from *Chlamisus* by the following characters: males with spines or spinulae on first ventral abdominal segment; 5th antennomere much smaller than 6th; sutural serration of elytra complete (in *Chlamisus* males without spines or spinulae on first ventrite and 5th antennomere nearly as large as 6th; sutural serration of elytra usually incomplete); ejaculatory guide short, single, tubular, and sclerotized (elongate and paired in *Chlamisus*). Lacordaire (1848) established *Exema* for species of *Chlamisus* that have a very abrupt antennal "club", the first serrated antennomere (6th) is much wider than 5th.

Exema was designated a junior synonym of *Chlamisus* by Gressitt and Kimoto (1961) based on their study of Oriental species; however, *Exema* continues to be treated as valid (Karren 1966, 1972; Riley et al. 2003; Seeno and Wilcox 1982).

A total of 26 species are included in *Exema*; 9 Nearctic, 7 Oriental, and 10 Neotropical (Monrós 1952; Karren 1966).

Material examined.

Exema canadensis Pierce:

1) a. [USA] Lakehead Md, 21.VII.06/ b. Ex. Coll. Knab/ c. *Exema canadensis* Pierce det. Karren 1966.

Exema elliptica Karren:

1) a. [USA] Houston, Tex. 25.V.49, T. L. Ward, *Baccaharis halinifolia*/ b. Paratype *Exema elliptica* Karren.

Exema variopicta Monrós:

1) a. [Argentina] R.A. Salta, San Bernardo, 30.I.950, Willink & Monrós/ b. 1181/ c. F. Monrós Collection, 1959/ d. *Exema variopicta* Monrós F. Monrós det. 1954.

***Fulcidax* Voet**

(Figs. 1 G; 2 F; 3 F; 4 F; 5 F)

Fulcidax Voet, 1806: 33; Type species: *Fulcidax azureus* Voet, 1806 = *Clytra monstrosa* Fabricius, 1798, by monotypy; Jacoby, 1881: 90 (Central American species); Monrós, 1952: 641 (overview of genus); Blackwelder, 1946: 650 (catalog); Seeno and Wilcox, 1982: 43 (catalog).

Poropleura Lacordaire, 1848: 863; Type species: *Clytra monstrosa* Fabricius, 1798, by subsequent designation of Navajas, 1946: 245.

Diagnosis. Length 6.50-7.20 mm, width 4.60-5.00 mm. General body shape subquadrate, metallic coloration. Antenna serrate beyond 3 rd antennomere, 2nd and 3rd antennomeres slightly widened, but not dilated distally. Head with the vertex longitudinally impressed. Pronotum with median elevation, surface tuberculate. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with acute notch. Prosternum acutely narrowing posteriorly, prosternal process 2/3 size of entire prosternum. Anterior margin of metasternum concave. Mesoscutellum trapezoidal. Metascutellum not exposed. Sutural serration of elytra well developed beyond middle of suture towards the apex. Elytral tubercules pronounced. First ventrite with lateral tubercles. Tibiae slightly curved, flattened, with sharp dorsal edge. Fore- and midtibial apices with spine. Tarsal claw simple.

Distribution. Central and South America (Monrós 1952).

Remarks. *Fulcidax* can be distinguished from all other chlamisine genera by the longitudinally impressed vertex of the head, simple tarsal claws, large body size, and usually bright metallic coloration.

Currently, 7 species are included in the genus (Monrós 1952).

Material examined.

Fulcidax bacca (Kirby):

1) a. [Brazil] Canlareira, S. Paulo, 8.VII.1929, J. Halik, 1275/ b. *Fulcidax bacca* Kirby/ c. J. Guerrin det. 1942/ d. Brazil, Halik 1966 Collection. 2) a. Brazil/ b. CF Baker collection, 1927/ c. *Fulcidax bacca* (Kirby) F. Monrós det. 1949.

Fulcidax chimaera (Lacordaire):

1) a. [Argentina] Munici[pi]o Rio Verde, Estado Goyaz, Dr. Nick. XI.945/ b. F. Monrós Collection, 1959/ c. *Fulcidax chimaera* (Lac.) F. Monrós det. 1952.

Fulcidax coelestina (Lacordaire):

1) a. Bolivia, Trinidad, X.1917 Lizer. Deletang/ b. F. Monrós Collection, 1959/ c. *Fulcidax coelestina* (Lac.) F. Monrós det. 1948.

Hymetes Lacordaire

(Figs. 1 H; 2 G; 3 G; 4 G; 5 G)

Hymetes Lacordaire, 1848: 861; Type species: *Hymetes javana* Lacordaire, 1848, by monotypy; Baly, 1865: 61 (description)

Diagnosis. Length 6.34-7.10 mm, width 4.27-4.46 mm. General body shape subquadrate. Antenna serrate beyond 5th antennomere, 2nd antennomere globular, 3rd, 4th and 5th antennomere of equal size, subcylindrical, 6th antennomere very short. Pronotum medially elevated, without pronounced tubercules, but with relatively short, acute ridges. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with acute notch. Prosternal process approximately ½ length of entire prosternum, narrow, slightly broadening posteriorly. Anterior margin of metasternum forming an elongate projection. Mesoscutellum trapezoidal. Metascutellum not exposed. Sutural serration of elytra complete. Elytral tubercules weakly developed. Tibiae slightly curved, flattened dorsally, with sharp edge dorsomedially. Fore- and midtibial apices without spine. Tarsal claw appendiculate.

Distribution. Oriental Region (Monrós 1952).

Remarks. This genus can be separated from all other chlamisine genera by the anteriorly elongate metasternum projection (concave in other chlamisines), by the subcylindrical 3rd, 4th and 5th antennomeres, and by the absence of spines on the fore- and midtibiae.

Three species are known from India and Java (Monrós 1952).

Material examined.

Hymetes javana Lacordaire:

1) a. [Indonesia] Java/ b. F. Monrós Collection, 1959. 2) a. [Indonesia] East Borneo, Batan bessi, M. E. Walsh, 1937/ b. F. Monrós Collection, 1959/ c. *Hymetes javana* Lac. F. Monrós det. 1957.

Hymetes indica Chapuis:

1) a. India/ b. F. Monrós Collection, 1959/ c. *Hymetes indica* Chap F. Monrós det. 1957.

Kakita **Chamorro-Lacayo & Konstantinov, new name**

(Fig. 6 A-E)

Ceratochlamys Bokermann, 1961:465, *nec* Habe, 1946: 214 (Mollusca); Type species: *Ceratochlamys monrosi* Bokermann, 1961, by monotypy; Seeno and Wilcox, 1982: 43 (catalog).

Diagnosis. Length 5.20 mm, width 2.70 mm. General body shape oblong. Head with large laminar projection on occipital region, projection longer than entire head. Antenna serrate beyond 5th antennomere, 3rd antennomere elongate, cylindrical, 4th antennomere slightly dilated distally. Pronotum large with paired pyramidal projections directed towards cephalic projection. Prosternal process 2/3 length of entire prosternum, narrow. Mesoscutellum trapezoidal. Sutural serration of elytra incomplete. Elytral tubercules well developed. Tarsal claws appendiculate.

Distribution. The only species, *Kakita monrosi* (Bokermann), is known from Rio de Janeiro, Brazil (Bokerman 1961).

Remarks. Only a single female specimen represents this genus. Whether the laminar projection on the head, which distinguishes this genus from all other chlamisines, is sexually dimorphic is unknown. In leaf beetles, sexually dimorphic characters on the head, such as projections and enlarged mandibles, are usually present only on the male (e.g., *Labidostomis* Germar; *Pseudochlamys* Lacordaire; *Normaltica* Konstantinov) (Konstantinov 2004; Konstantinov and Korotyaev 2004). On the other hand, all female cryptocephalines have a modified 5th ventrite for the purpose of scatoshell coating. It is possible, that this laminar projection on the head is only present on the female

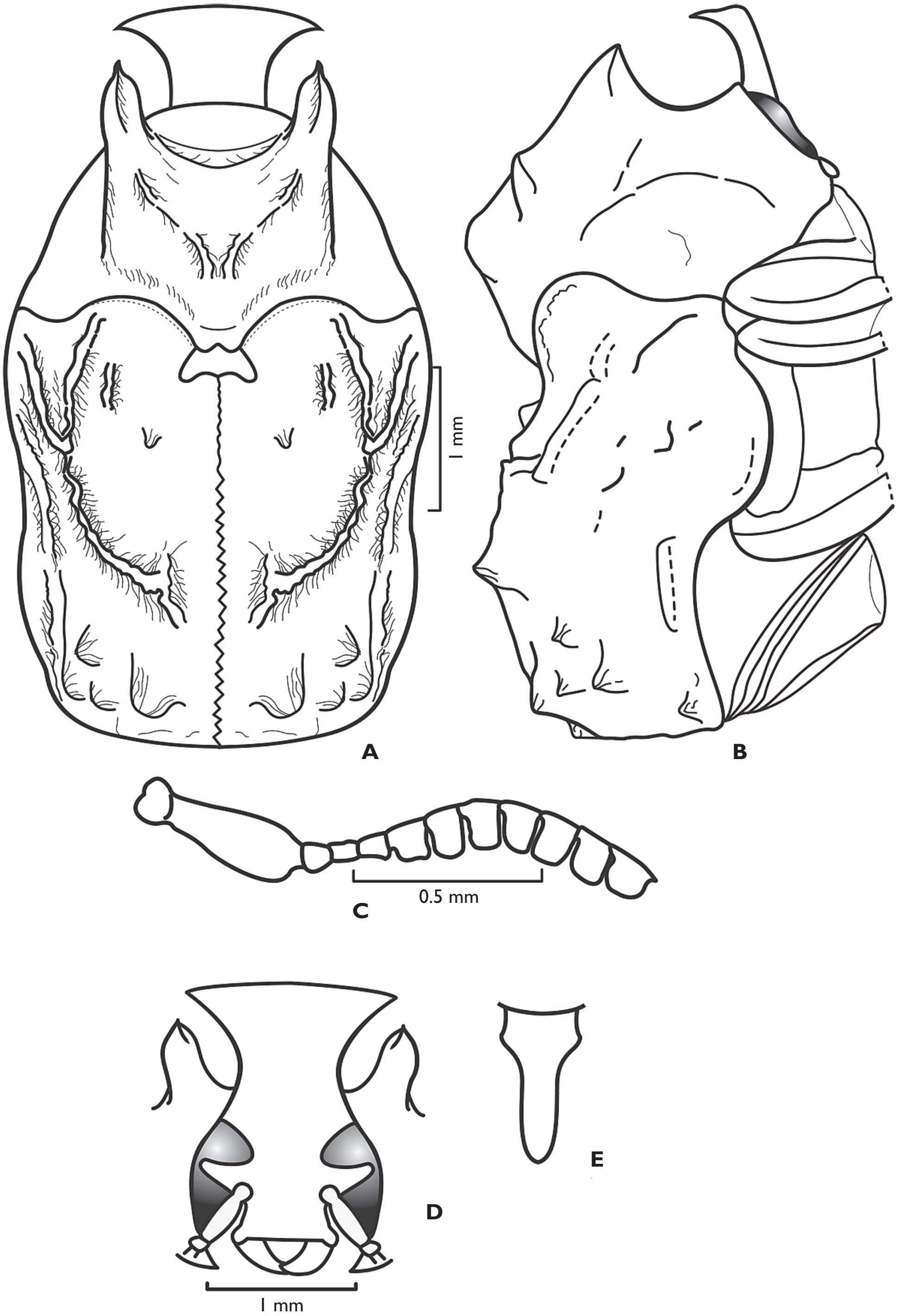

Figure 6. *Kakita monrosi* (Bokermann). **A**, Ventral view. **B**, Lateral view. **C**, Antenna. **D**, Frontal view. **E**, Prosternum.

also for purposes dealing with coating of individual eggs. Females, during the coating process, strike a pose in which the entire weight of their bodies rests on their forelegs and possibly their head. This laminar projection may be helpful in balancing their body. One thing is certain, observation in the field and continued collecting efforts to discover the male are necessary to understand the function of this modification.

The name *Ceratochlamys* Bokermann, 1961 is preoccupied by an available name in Mollusca, *Ceratochlamys* Habe, 1946. A replacement name, *Kakita* Chamorro-Lacayo & Konstantinov is provided and *Ceratochlamys* Bokermann is invalid as a junior homonym.

Etymology. Kakita, modified from its correct spelling "caquita", is a Spanish word for "small feces or excrement". The name alludes to the resemblance these beetles have to small pieces of excrement. The name is feminine.

***Melittochlamys* Monrós**

(Figs. 1 I; 2 H; 3 H; 4 H; 5 H)

Melittochlamys Monrós, 1948: 192; Type species: *Chlamys speculum* Klug, 1824, by original designation; Fiebrig, 1910: 253 (larval description); Monrós, 1949: 617 (description of new species and generic concept broadened); Monrós, 1951: 451 (key and description of new species); Monrós, 1952: 666 (generic overview); Seeno and Wilcox, 1982: 43 (catalog).

Diagnosis. Length 3.60-5.20 mm, width 2.60-4.00 mm. General body shape subglobular. Antenna serrate beyond 3rd antennomere, 3rd antennomere only slightly dilated distally. Pronotum without median elevation, relatively smooth and continuous with rest of body, without well developed median longitudinal sulci. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with or without notch. Prosternum not acutely narrowing posteriorly, prosternal process broad and parallel-sided. Anterior margin of metasternum broadly concave. Mesoscutellum quadrate. Metascutellum not exposed. Sutural serration of elytra completely absent or weakly developed. If sutural elytral serration present, well developed beyond middle of suture towards the apex. Elytral tubercules not well developed, frequently with velvety, discrete spots and microsculpture different from rest of body surface. Tibiae slightly curved, convex dorsally, with sharp edge dorsomedially. Fore- and midtibial apices without spine. Tarsal claw appendiculate.

Distribution. Central and South America (Monrós 1952).

Remarks. Some species of *Chlamisus* (e.g., *Chlamisus achalay* Monrós, 1952 and *Chlamisus perforatus* Monrós, 1952) also have velvety spots on the elytra while others have a broad prosternal process. Monrós (1949) broadened his own definition of the genus to include species that lack velvety spots on the elytra, have a broad, parallel-sided prosternal process, and a globous, oval body shape with the pronotum dorsally smooth and continuous with rest of body. *Melittochlamys* can be separated from all other chlamisine genera by the nearly rectangular prosternal process; the process is more or less triangular in other chlamisines.

The genus consists of 13 species from the Neotropical Region. These include the first seven species Lacordaire (1848) listed in his division I under *Chlamisus* Rafinesque, one species described by Jacoby (1889), and four species described by Monrós (1948, 1949, 1951), most recently Bokermann (1964) described a species from Pará, Brazil.

Material examined.

Melittochlamys lamprosomoides (Lacordaire):

1) a. Santarem. Brazil. F. Knab/ b. collection F Knab/ c. *Chlamys lamprosomoides* Lac./ d. *Melittochlamys lamprosomoides* (Lac.) F. Monrós det. 1949.

Melittochlamys nicki Monrós:

1) a. [Brazil] Jabaquara, San Paolo-Capital, Dr. Nick 14.12.43/ b. Paratipo/ c. Dibujado/ d. F. Monrós Collection, 1959/ e. *Melittochlamys nicki* mihi F. Monrós det. 1949.

Melittochlamys specula (Klug):

1) a. Loreto Misiones, Rep. Argentina, Dr. A. Ogloblin/ b. Dibujado/ c. F. Monrós Collection, 1959/ d. *Melittochlamys specula* (Klug) F. Monrós det. 1948.

Neochlamisus Karren

(Figs. 1 J, K; 2 I, J; 3 I, J; 4 I, J; 5 I, J; 7 A, C)

Neochlamisus Karren, 1972: 932; Type species: *Neochlamisus velutinus* Karren, 1972, by original designation.

Diagnosis. Length 2.90-4.70 mm, width 2.10-3.68 mm. General body shape cylindrical. Body usually metallic in color. Frons in canthus of eye usually with yellow spots, or if without yellow spots, then elytron with two velvety spots. Frons glabrous. Pronotum and elytra glabrous. Antenna serrate beyond 3rd or 4th antennomeres, 2nd antennomere slightly widened, globose, 5th antennomere smaller than 6th. Pronotum medially elevated, with various bumps. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with well differentiated notch. Prosternum posteriorly narrow or explanate with lateral serration. Anterior margin of metasternum concave. Mesoscutellum short, transverse. Metascutellum exposed or concealed. Sutural serration of elytra usually incomplete (suture entire immediately beyond mesoscutellum, followed by well developed serration). Elytral tubercules well developed. Tibiae slightly curved, slightly flattened, with sharp dorsal edge. Fore- and midtibial apices with spine. Tarsal claw bifid or appendiculate. Male ejaculatory guide (part of internal sac of aedeagus) asymmetrical, with sheath. Apex of spermathecal duct globosely swollen, wider than rest of pump.

Distribution. North, Central, and South America (Karren 1972).

Remarks. *Neochlamisus* was proposed to include a few species, formerly placed in *Chlamisus* and *Diplacaspis,* based on their similarity in the male and female genitalia (Karren 1972). Degree of exposure of the metascutellum varies greatly, from broadly exposed to completely concealed by elytra. *Neochlamisus* can be separated from other

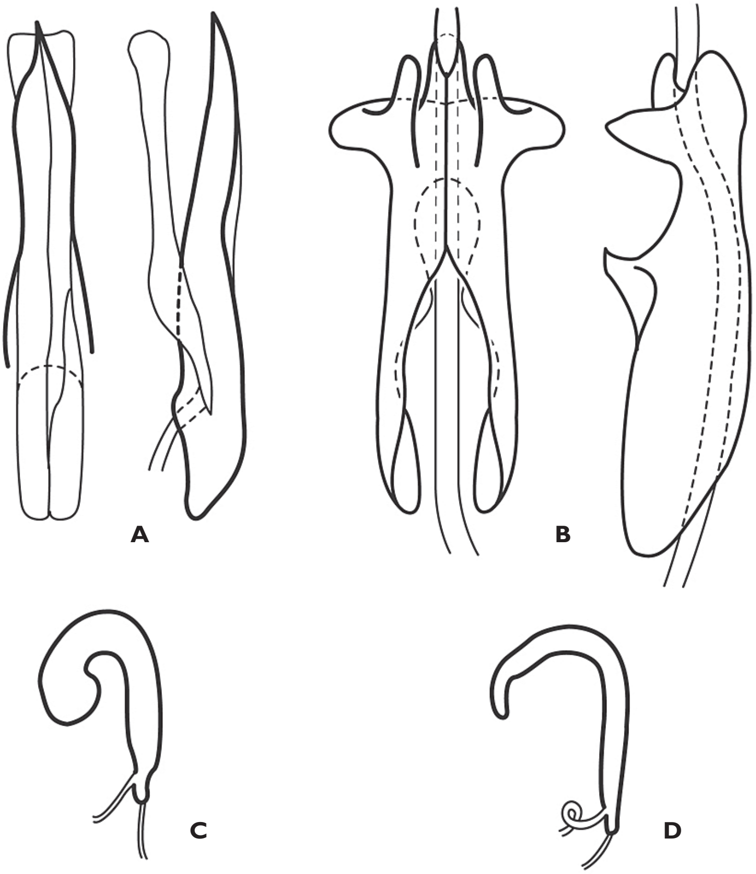

Figure 7. Genitalia of Chlamisini. **A**, Male ejaculatory guide of *Neochlamisus velutinus* Karren, dorsal and lateral views. **B**, Male ejaculatory guide of *Chlamisus maculipes* (Chevrolat), dorsal and lateral views. **C**, Spermatheca of *Neochlamisus velutinus.* **D**, Spermatheca of *Chlamisus maculipes.*

chlamisine genera by characters of the male genitalia. The male ejaculatory guide is asymmetrical, with a sheath. Among external characters, color of the frons in combination with the presence of velvety spots usually allows for recognition of *Neochlamisus* (frons on canthus of eye usually with yellow spots, or if without yellow spots, then elytron with two velvety spots).

Material examined.

Neochamisus cribripennis (LeConte):

1) a. [USA] Midvale N.J. A. Nicolay, 20.VIII.42/ b. Ernest Shoemaker Collection. 2) a. [Canada] Constance Bay, Ont., 22.V.42, W.J. Brown/ b. on Vaccinium/ c. *Neochamisus cribripennis* (LeConte) det. Karren 1968.

Neochlamisus insularis (Schaeffer):

1) a. [USA] Paradise Key, Fla. 25.II.19, EA Schwarz/ b. *Neochlamisus insularis* (Schaeffer) det. Karren.

Neochlamisus tuberculatus (Klug):

1) a. [USA] Capron Fla. 8.4/ b. ex coll. Knabe/ c. 409/ d. *Neochlamisus tuberculatus* (Klug) det Karren 1971.

Neochlamisus velutinus Karren:

1) a. [USA] 8 mi San Vicente, Ariz. (Pima) 3000' Aug.8.1954, F. G. Werner/ b. F. Monrós Collection, 1959/ c. Paratype *Neochlamisus velutinus* m. Jay B. Karren.

***Pseudochlamys* Lacordaire**

(Figs. 1 L; 2 K, L; 3 K, L; 4 K, L; 5 K)

Pseudochlamys Lacordaire, 1848:644; Type species: *Pseudochlamys megalostomoides* Lacordaire, 1848, by monotypy; Clavareau, 1913: 209 (catalog); Blackwelder, 1946: 647 (catalog); Monrós, 1952: 542 (summary of characters and distribution); Karren, 1972: 902 (overview of genus and description of new species); Seeno and Wilcox, 1982: 43 (catalog).

Diagnosis. Length 3.45-4.72 mm, width 2.18-3.22 mm. General body shape cylindrical. Body usually yellowish. Frons glabrous, canthus of eye as yellow as rest of frons. Pronotum and elytra glabrous. Head not completely retracted into prothorax; mandibles enlarged in males, normal in females (Figs. 4 K, L). Antenna serrate beyond 3rd antennomere, 2nd antennomere slightly widened, globose, 5th antennomere as large as 6th. Pronotum medially elevated, with small protuberances. Pronotal base opposite mesoscutellum (posterior pronotal lobe) with well differentiated notch. Prosternum strongly and abruptly constricted beyond anterior margin; prosternal process more than ¾ as long as prosternum. Anterior margin of metasternum concave. Mesoscutellum short, transverse. Metascutellum concealed by elytra. Sutural serration of elytra complete. Elytral tubercules poorly developed, their microsculpture not different from rest of body surface. Tibiae slightly curved, more or less cylindrical, with sharp dorsal edge and one more less developed ventral ridge. Fore- and midtibial apices without spine. Tarsal claw bifid or appendiculate.

Distribution. North, Central, and South America (Karren 1972).

Remarks. *Pseudochlamys* can be distinguished from other chlamisines by the following characters: head not completely retracted into prothorax; mandibles enlarged in males, normal in females; fore- and midtibial apices without spine; prosternum strongly and abruptly constricted beyond anterior margin; and prosternal process more than ¾ as long as prosternum.

Five species are included in this genus.

Material examined.

Pseudochlamys bellicosus Monrós:

1) a. Brazil, Bahia, G. Bondar/ b. 2 paratypos/ c. F. Monrós Collection, 1959/ d. *Pseudochlamys bellicosus mihi* F. Monrós det. 1952.

Pseudochlamys megalostomoides Lacordaire:

1) a. Brazil, Ceara, Ex. US.N.M./ b. F. Monrós Collection, 1959/ c. *Pseudochlamys megalostomoides* Lac. F. Monrós det. 1949. 2) a. Aguadulce, Panama, IX.1946/ b. N.L.H. Krauss/ c. *Pseudochlamys megalostomoides* Lacordaire Det. Karren, 1971.

Pseudochlamys seminigra (Jacoby):

1) a. Paraguay, Villarrica, Schade leg./ b. Dibujado/ c. F. Monrós Collection, 1959/ d. *Pseudochlamys seminigra* (Jac.) F. Monrós det. 1950.

Pseudochlamys semirufescens Karren:

1) a. USA, Ariz., Santa Catalina Mts. Pepper Sauce cn. 16.VIII.1924, E.P. Van Duzee/ b. F. Monrós Collection, 1959/ c. Paratype *Pseudochlamys semirufescens* 1971 ♀ Jay B. Karren.

Key to genera

1 Head with large laminar projection in occipital region. (Figs. 6 A, B, D) .... ***Kakita* Chamorro-Lacayo & Konstantinov, new name**

– Head without large laminar projection in occipital region **2**

2(1) Legs atypical; femora and tibiae flattened; tarsi reduced, retractile, able to fit into groove along apex of tibia (Fig. 3 B) ... ***Carcinobaena* Lacordaire, 1848**

– Legs normal and not as above (Fig. 3 E, H) **3**

3(1) Prosternum nearly rectangular, with posterior margin slightly narrower than anterior margin (Fig. 3 H). Pronotal and elytral tubercules reduced............. .... ***Melittochlamys* Monrós, 1948**

– Prosternum varying in shape, triangular, or angulate between mesocoxae, but never rectangular, with posterior margin much narrower than anterior margin (Figs. 3 A, I). Pronotal and elytral tubercules well developed **4**

4(3) Head with vertex longitudinally impressed. Tarsal claws simple. Body about 10 mm long and longer, bright metallic color. Pronotal and elytral tubercules pronounced .... ***Fulcidax* Voet, 1806**

– Head with vertex entire or convex. Tarsal claws usually appendiculate, if simple, see *Exema*. Body less than 10 mm long **5**

5(4) Prosternal process distally widened between midcoxae (Fig. 3 D). Metascutellum broadly exposed (Fig. 1 E) .... ***Diplacaspis* Jacobson, 1924**

– Sides of prosternal process convergent or serrate, if slightly widened between mesocoxae, then metascutellum not exposed (Fig. 1 A) **6**

6(5) Pronotum with 6 distinct, small, sharp, longitudinal carinae that converge medially near posterior margin (fan). Small size, elongate, uniform hue, generally black (Figs. 1 A, B) .... ***Aulacochlamys* Monrós, 1952**

– Pronotum with or without bumps, but never with 6 longitudinal carinae that converge medially near posterior margin.. **7**

7(6) Head not completely retracted into the prothorax; mandibles in males larger than in females (Fig. 4 K, L). Prosternum strongly and abruptly constricted beyond anterior margin; prosternal process more than ¾ as long as prosternum. (Figs. 3 K, L) .... ***Pseudochlamys* Lacordaire, 1848**

– Head completely retracted into prothorax; mandibles in males as large as in females (Fig. 4 A). Prosternum gradually constricted at about 2/3 of its length **8**

8(7) Metasternum anteriorly elongated into deltoid projection (Fig. 3 G). Antennae serrate beyond antennomere 5 .... ***Hymetes* Lacordaire, 1848**

– Metasternum anteriorly concave with two denticles on sides of concavity (Fig. 3 B). **9**

9(8) Body usually metallic in color. Frons on canthus of eye usually with yellow spots, or if without yellow spots, then elytron with two velvety spots. Male ejaculatory guide asymmetrical, with sheath (Fig. 7 A)................................ .... ***Neochlamisus* Karren, 1972**

– Body usually not metallic in color. Frons on canthus of eye usually without yellow spots (if face entirely or partly yellow, with yellow area extending onto canthus, elytra without velvety spots). Male ejaculatory guide symmetrical, without sheath (Fig. 7 B) **10**

10(9) Males without spines or spinulae on first ventrite. Fifth antennomere nearly as large as 6th. Sutural serration of elytra usually incomplete (suture entire immediately following mesoscutellum) (Fig. 1 D). Prosternum posteriorly pointed (narrowed), posteriorly much narrower than anterior margin.......... .... ***Chlamisus* Rafinesque, 1815**

– Males with spines or spinulae on first ventrite. Fifth antennomere much smaller than 6th. Sutural serration of elytra complete (Fig. 1 F). Pronotum without longitudinal carinae .... ***Exema* Lacordaire, 1848**

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The *Platycerus* (Coleoptera, Lucanidae) of California, with the recognition of *Platycerus cribripennis* Van Dyke as a valid species

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Abstract

The status of *Platycerus cribripennis* Van Dyke, generally treated as a synonym of *P. marginalis* Casey, has been unclear. Here we recognize and redescribe *P. cribripennis*, which is endemic to the coastal mountains of California, as a valid species due to its unique morphology. A key to the *Platycerus* of California is presented, and the distributions of the recognized species are discussed.

Keywords

Systematics, Lucanidae, Platycerini, *Platycerus cribripennis*

Introduction

The North American Platycerini (Coleoptera: Lucanidae: Lucaninae) consists of four species in the Holarctic genus *Platycerus* Geoffroy (Maes 1992; Smith 2003). Benesh's (1946) treatment of *Platycerus* is the most recent revision of the genus in North America, and of the genera *Platyceroides* Benesh and *Platyceropsis* Benesh of the tribe Platyceroidini (Paulsen and Hawks 2008).

Two species, *Platycerus marginalis* Casey and *Platycerus oregonensis* Westwood, have been reported from California (Benesh 1946; Evans and Hogue 2006). The recent rediscovery of an unusual *Platycerus* in California prompted a reassessment of the species reported from the state. We take this opportunity to provide additional distributional information for the *Platycerus* species known from California.

Prior to Benesh's revision of *Platycerus*, *P. marginalis* had been considered a western subspecies of the eastern and boreal *P. depressus* LeConte. Van Dyke (1928) described *P. depressus cribripennis* as an additional subspecies from three specimens from Monterey County, California. Van Dyke noted several differences, primarily in sculpturing, from other known forms of the species. He stated that its degree of difference nearly justified recognition as a separate species, but declined to take this action, citing variation exhibited by other lucanid species.

Benesh (1946) raised *P. marginalis* to specific status and synonymized Van Dyke's subspecies as an "apparent mutant", without seeing Van Dyke's type. Benesh suggested that this species "*merely represented a common occurrence in Lucanidae, whereby the males take on characteristics of females."* Subsequently, Benesh (1960) presented *P. cribripennis* as a valid species in his catalog without further discussion. However, later authors (*e.g.,* Maes 1992) have perpetuated the synonymy with *P. marginalis*, making the status of *P. cribripennis* unclear. Most recently, Smith (2003) listed *P. cribripennis* as a synonym of *P. marginalis.*

Collections as part of the second author's California Beetle Project produced a small series of *Platycerus* specimens from the mountains around Santa Barbara that correspond well with Van Dyke's description of *Platycerus depressus cribripennis*. We have since examined other specimens of this alleged 'mutant', and believe it constitutes a valid species. The differences noted by Van Dyke, particularly the densely punctate, subrugose elytra with discal striae obliterated, in addition to other characters described below, hold with little variation among the few known populations of this species. We see evidence neither for Benesh's view that these are aberrant *P. marginalis*, nor for his specific suggestion that males of *P. cribripennis* exhibit characteristics of females. In fact, males of *P. cribripennis* possess well-armed mandibles for the genus, with an additional exterior tooth present on each mandible near the base. Benesh examined supposed specimens of *P. cribripennis* from Yosemite and Oregon. Both localities lie outside the apparent distribution of *P. cribripennis,* indicating that the specimens examined by Benesh were not *P. cribripennis.*

Materials and methods

As part of the first author's revisionary studies of New World Lucanidae, specimens of *P. cribripennis* were examined from the following collections: California Academy of Sciences, San Francisco, CA (CASC); David C. Carlson Collection, Fair Oaks, CA (DCCC); Essig Museum of Entomology, Berkeley, CA (EMEC); Field Museum of Natural History, Chicago, IL (FMNH); Santa Barbara Natural History Museum, Santa Barbara, CA (SBMN).

Results and discussion

Key to the *Platycerus* species of California

1 Elytra entirely, irregularly punctate (discal rows of punctures indistinct), surface between punctures raised (Fig. 3)................. ***P. cribripennis* Van Dyke**

– Elytra serially punctate, discal rows of punctures distinct, surface between punctures not raised..**2**

2 Elytra generally with blue or green reflections, males with basal antennomere of club much shorter than distal antennomeres (Fig. 5) ....
....***P. oregonensis* Westwood**

– Elytra dark piceous in color without blue/green reflections, males with basal antennomere of club nearly as long as distal antennomeres (Fig. 4)..............
.... ***P. marginalis* Casey**

Redescription of *P. cribripennis* Van Dyke

***Platycerus cribripennis* Van Dyke, 1928: 107; New Status.**

Original combination: *Platycerus depressus cribripennis* Van Dyke, 1928: 107. Holotype male (CASC), labeled: a) "Tassajara. Cal. / Monterey Co. / V- 25 1920 / L. S. Slevin"; b) "on alder / log, chop'd / it up but / none in."; c) blue paper, "L.S. Slevin / Collection"; d) bordered white label with red highlighted "Holotype" at left margin and "[male symbol] / *Platycerus* / *depressus* / *cribripennis* / Van Dyke"; e) "California Academy / of Sciences / Type / No. "/ [handprinted] "2533"; f) "*Platycerus cribripennis* / Van Dyke, 1928 / det. MJ Paulsen 2008.

Description, male (n=7). **Length:** 12.7-14.7 mm. **Width at humerus:** 4.1-4.6 mm. **Color:** Black (Fig. 3). **Head:** Surface strongly alutaceous (microgranulate), irregularly punctate; puncture size variable from moderate to coarse; coarse punctures near eyes larger and more dense than in *P. oregonensis* or *P. marginalis*. Male majors with mandibles longer than head, upcurved, not evenly rounded externally; strong lateral tooth present on exterior near base; apex acute dorsally and ventrally blade-like with reduced dentition (multidentate in *P. marginalis*) and with dorsal subapical tooth small, obtuse. Male minors not seen. Antennal club with 4 tomentose antennomeres, basal antennomere of club (7th antennomere) nearly as long as antennomeres 8-10. Antennomere 6 also slightly produced internally. **Pronotum:** Surface strongly alutaceous, punctate; punctures irregularly spaced, moderate in size. **Elytra:** Surface alutaceous but more strongly shining than pronotum, densely punctate; punctures irregular (striae obscured, only sutural stria weakly evident); surface around punctures appearing raised, subrugose. **Male Genitalia:** (Fig. 2). Basal part of median lobe rounded, distal portion produced into two lobes. Male internal sac permanently partially everted, unsclerotized; flagellum present, sclerotized (not membranous).

Description, female (n=1). Length: 13.6 mm. **Width at humerus:** 4.8 mm. **Differs from male as follows: Head:** Surface with punctation dense, punctures larger. Mandibles shorter than head, not upcurved, lacking external tooth, instead tridentate with acute apex, dorsal, and ventral teeth. Antennal club with 4 antennomeres, basal antennomere glabrous and much shorter than remaining antennomeres. **Female Genitalia:** not examined.

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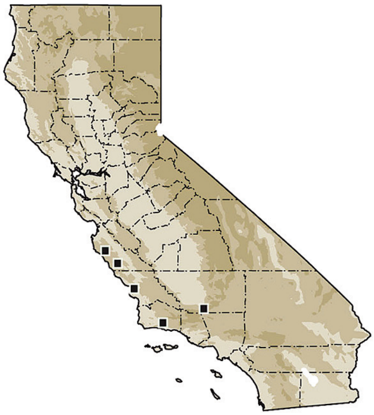

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Figure 1. Known distribution of *Platycerus cribripennis* in California.

Figure 2. Male genitalia of *P. cribripennis,* with sclerotized flagellum on the everted internal sac.

Figure 3. Dorsal habitus, *P. cribripennis* male.

Figure 4. Dorsal habitus, *P. marginalis* male.

Figure 5. Dorsal habitus, *P. oregonensis* male.

Diagnosis. This species is distinguished from other Nearctic *Platycerus* by the following combination of characters: The black coloration and strongly alutaceous and/or opaque dorsal surface is distinctive; the densely punctate elytra with obsolete discal striae and subrugose surface between punctures will immediately distinguish this species. The oblique, external tooth at the base of the male mandibles is unique among Nearctic *Platycerus*. Additionally, the male mandibles have a blade-like apex, whereas the apex is multidentate in *P. marginalis, P. depressus,* and *P. virescens* (Fabricius) and simply dentate in *P. oregonensis*. The antennal club of male *P. cribripennis* has the basal club antennomere not reduced and nearly as long as the three distal antennomeres; in males of *P. oregonensis* and *P. virescens* the basal club antennomere is reduced.

Distribution (Fig. 1). *Platycerus cribripennis* is known only from California's coastal mountains. Benesh's assertion that other specimens were present from Yosemite and Oregon is certainly an error based on his failure to examine Van Dyke's type.

Specimens examined (8). CALIFORNIA: KERN (1): Bear Trap Canyon, Tejon Ranch (DCCC). MONTEREY (3): Jolon (FMNH); Tassajara Road, 1 mi S of China Camp (CASC, EMEC). SAN LUIS OBISPO (1): Morro Bay (EMEC). SANTA BARBARA (3): Cold Spring Canyon, Los Padres National Forest (SBMN, California Beetle Project database numbers CBP0048052, CBP0049001, and CBP0049002).

Remarks. *Platycerus cribripennis* is one of the most infrequently collected species of stag beetles in North America, being known from only a few specimens from five localities. There may be a need to examine the species' geographically limited distribution in greater detail to ascertain whether or not it warrants conservation status. This is especially true where the known distribution intersects planned or on-going development.

Annotated checklist of the Platycerini of California

LUCANIDAE
Lucaninae
Platycerini

***Platycerus* Geoffroy, 1762: 62.** Holarctic.

***Platycerus cribripennis* Van Dyke, 1928: 107.**
Figs 1-3.
USA: CA: Kern, Monterey, San Luis Obispo, Santa Barbara.

***Platycerus marginalis* Casey, 1897: 639.**
Fig. 4.
USA: CA: Alpine, Amador, Butte, El Dorado, Glenn, Inyo, Lassen, Mariposa, Mono, Nevada, Placer, Plumas, Trinity, Tulare, Tuolumne, Shasta, Siskiyou. Also AZ, ID, NV, OR, UT, WA. Canada: BC.

Platycerus oregonensis **Westwood, 1844: 106.**
Fig. 5.
USA: CA: Alameda, Contra Costa, El Dorado, Humboldt, Kern, Marin, Mariposa, Mendocino, Monterey, Napa, Nevada, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sierra, Sonoma, Trinity, Tuolumne. Also OR; WA. Canada: BC.

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